



**PRESIDENCY
UNIVERSITY**

PROGRAMME REGULATIONS & CURRICULUM

2021-25

**PRESIDENCY SCHOOL OF
COMPUTER SCIENCE & ENGINEERING**
BACHELOR OF TECHNOLOGY (B.TECH.)
COMPUTER SCIENCE AND ENGINEERING



PRESIDENCY UNIVERSITY

Presidency University Act, 2013 of the Karnataka Act No. 41 of 2013 | Established under Section 2(f) of UGC Act, 1956

Approved by AICTE, New Delhi



PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

Program Regulations and Curriculum 2021-2025

BACHELOR OF TECHNOLOGY (B.Tech.) in COMPUTER SCIENCE AND ENGINEERING

**based on Choice Based Credit System (CBCS) and Outcome Based
Education (OBE)**

*(As amended up to the 24th Meeting of the Academic Council held on 3rd August 2024. This document
supersedes all previous guidelines)*

Regulations No: PU/AC-24.5/SOCSE04/CSE/2021-2025

AUGUST-2024

**Resolution No. 5 of the 24th Meeting of the Academic Council held on 3rd August 2024,
and ratified by the Board of Management in its 24th Meeting held on 5th August 2024.**

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PART A – PROGRAM REGULATIONS

1. Vision & Mission of the University and the School / Department

1.1 Vision of the University

To be a Value-driven Global University, excelling beyond peers and creating professionals of integrity and character, having concern and care for society.

1.2 Mission of the University

- Commit to be an innovative and inclusive institution by seeking excellence in teaching, research and knowledge-transfer.
- Pursue Research and Development and its dissemination to the community, at large.
- Create, sustain and apply learning in an interdisciplinary environment with consideration for ethical, ecological and economic aspects of nation building.
- Provide knowledge-based technological support and services to the industry in its growth and development.
- To impart globally-applicable skill-sets to students through flexible course offerings and support industry's requirement and inculcate a spirit of new-venture creation.

1.3 Vision of Presidency School of Computer Science and Engineering

To be a value based, practice-driven School of Computer Science and Engineering, committed to developing globally-competent Engineers, dedicated to developing cutting-edge technology to enhance the quality of life.

1.4 Mission of Presidency School of Computer Science and Engineering

- Cultivate a practice-driven environment with a contemporary Learning-pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the field of Core Engineering.
- Establish state-of-the-art facilities for effective Teaching and Learning-experiences.
- Promote Interdisciplinary Studies to nurture talent and impart relevant skill-sets for global impact.
- Instil Entrepreneurial and Leadership Skills to address Social, Environmental, and Community-needs.

2. Preamble to the Program Regulations and Curriculum

This is the subset of Academic Regulations and it is to be followed as a requirement for the award of B.Tech degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Social Project Based Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations of the University, the Academic Council hereby makes the following Regulations.

3. Short Title and Applicability

- a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2021-2025.
- b. These Regulations are subject to, and pursuant to the Academic Regulations.
- c. These Regulations shall be applicable to the ongoing Bachelor of Technology Degree Programs of the 2021-2025 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
- d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
- e. These Regulations shall come into force from the Academic Year 2024-2025.

4. Definitions

In these Regulations, unless the context otherwise requires:

- a. *“Academic Calendar” means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;*
- b. *“Academic Council” means the Academic Council of the University;*
- c. *“Academic Regulations” means the Academic Regulations, of the University;*
- d. *“Academic Term” means a Semester or Summer Term;*
- e. *“Act” means the Presidency University Act, 2013;*
- f. *“AICTE” means All India Council for Technical Education;*
- g. *“Basket” means a group of courses bundled together based on the nature/type of the course;*
- h. *“BOE” means the Board of Examinations of the University;*
- i. *“BOG” means the Board of Governors of the University;*

- j. *“BOM” means the Board of Management of the University;*
- k. *“BOS” means the Board of Studies of a particular Department/Program of Study of the University;*
- l. *“CGPA” means Cumulative Grade Point Average as defined in the Academic Regulations;*
- m. *“Clause” means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;*
- n. *“COE” means the Controller of Examinations of the University;*
- o. *“Course In Charge” means the teacher/faculty member responsible for developing and organising the delivery of the Course;*
- p. *“Course Instructor” means the teacher/faculty member responsible for teaching and evaluation of a Course;*
- q. *“Course” means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;*
- r. *“Curriculum Structure” means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.*
- s. *“DAC” means the Departmental Academic Committee of a concerned Department/Program of Study of the University;*
- t. *“Dean” means the Dean / Director of the concerned School;*
- u. *“Degree Program” includes all Degree Programs;*
- v. *“Department” means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;*
- w. *“Discipline” means specialization or branch of B.Tech. Degree Program;*
- x. *“HOD” means the Head of the concerned Department;*
- y. *“L-T-P-C” means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;*
- z. *“MOOC” means Massive Open Online Courses;*
- aa. *“MOU” means the Memorandum of Understanding;*
- bb. *“NPTEL” means National Program on Technology Enhanced Learning;*

- cc. *“Parent Department” means the department that offers the Degree Program that a student undergoes;*
- dd. *“Program Head” means the administrative head of a particular Degree Program/s;*
- ee. *“Program Regulations” means the Bachelor of Technology Degree Program Regulations and Curriculum, 2024-2028;*
- ff. *“Program” means the Bachelor of Technology (B.Tech.) Degree Program;*
- gg. *“PSCS” means the Presidency School of Computer Science;*
- hh. *“Registrar” means the Registrar of the University;*
- ii. *“School” means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;*
- jj. *“Section” means the duly numbered Section, with Clauses included in that Section, of these Regulations;*
- kk. *“SGPA” means the Semester Grade Point Average as defined in the Academic Regulations, 2021;*
- ll. *“Statutes” means the Statutes of Presidency University;*
- mm. *“Sub-Clause” means the duly numbered Sub-Clause of these Program Regulations;*
- nn. *“Summer Term” means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;*
- oo. *“SWAYAM” means Study Webs of Active Learning for Young Aspiring Minds.*
- pp. *“UGC” means University Grant Commission;*
- qq. *“University” means Presidency University, Bengaluru; and*
- rr. *“Vice Chancellor” means the Vice Chancellor of the University.*

5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2021-2025 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2021-2025 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as B.Tech. Computer Science and Engineering;
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as B.Tech. Computer Science and Technology (Big Data);

3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as B.Tech. Computer Science and Engineering (Block Chain);
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as B.Tech. Computer Science and Technology (Dev Ops);
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as B.Tech. Computer Science and Engineering (Cyber Security);
6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as B.Tech. Computer Science and Engineering (Internet of Things);
7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as B.Tech. Computer Science and Engineering (Data Science);
8. Bachelor of Technology in Computer Science and Technology (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Science and Technology (Artificial Intelligence and Machine Learning);
9. Bachelor of Technology in Information Science and Technology, abbreviated as B.Tech. Information Science and Technology;
10. Bachelor of Technology in Computer Science and Information Technology, abbreviated as B.Tech. Computer Science and Information Technology;
11. Bachelor of Technology in Computer Science and Engineering (Networks), abbreviated as B.Tech. Computer Science and Engineering (Networks);
12. Bachelor of Technology in Computer Engineering (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Engineering (Artificial Intelligence and Machine Learning);
13. Bachelor of Technology in Information Science and Engineering (Artificial Intelligence and Robotics), abbreviated as B.Tech. Information Science and Engineering (Artificial Intelligence and Robotics); and
14. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning);

5.1 These Program Regulations shall be applicable to other similar programs, which may be introduced in future.

5.2 These Regulations may evolve and get amended or modified or changed through appropriate approvals from the Academic Council, from time to time, and shall be binding on all concerned.

5.3 The effect of periodic amendments or changes in the Program Regulations, on the students admitted in earlier years, shall be dealt with appropriately and carefully, so as to ensure that those students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised Program Regulations, without any undue favour or considerations

6. Minimum and Maximum Duration

- 6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.
- 6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.
- 6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause **Error! Reference source not found.** of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.
- 6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.
- 6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.**Error! Reference source not found.** of Academic Regulations) in the prescribed maximum duration (Sub-Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

After four years of successful completion of the program, the graduates shall be able to :

PEO 01: Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values

PEO 02: Become a Teaching and Research Professional in the area of Computer science and engineering through lifelong learning.

PEO 03: Emerge as a Consultancy team member in the Computer Science and Engineering Industry.

PEO 04: Evolve as an entrepreneur in the computer science and other related areas of specialization.

8 Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

8.1 Programme Outcomes (PO)

On successful completion of the Program, the students shall be able to:

- PO1. Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2. Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6. The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9. Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to

comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

8.2 Program Specific Outcomes (PSOs):

On successful completion of the Program, the students shall be able to:

PSO 01: [Problem Analysis]: Identify, formulate, research literature, and analyse complex engineering problems related to Software Engineering principles and practices, Programming and Computing technologies reaching substantiated conclusions using first principle

PSO 02: [Design/development of Solutions]: Design solutions for complex engineering problems related to Software Engineering principles and practices, Programming and Computing technologies and design system components or processes that meet the specified needs

PSO 03: [Modern Tool usage] : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities related to Software Engineering principles and practices, Programming

9 Admission Criteria (as per the concerned Statutory Body)

The University admissions shall be open to all persons irrespective of caste, class, creed, gender or nation. All admissions shall be made on the basis of merit in the qualifying examinations; provided that forty percent of the admissions in all Programs of the University shall be reserved for the students of Karnataka State and admissions shall be made through a Common Entrance Examination conducted by the State Government or its agency and seats shall be allotted as per the merit and reservation policy of the State Government from time to time. The admission criteria to the B.Tech. Program is listed in the following Sub-Clauses:

- 9.1 An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from

Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.

- 9.2 Provided further, the applicant must have taken Physics and Mathematics as compulsory subjects in the Pre-University / Higher Secondary / (10+2) / (11+1) examination, along with either Chemistry / Biology / Electronics / Computer Science / Biotechnology subject, and, the applicant must have obtained a minimum of 45% of the total marks (40% in case of candidates belonging to the Reserved Category as classified by the Government of Karnataka) in these subjects taken together.
- 9.3 The applicant must have appeared for Joint Entrance Examinations (JEE) Main / JEE (Advanced) / Karnataka CET / COMED-K, or any other State-level Engineering Entrance Examinations.
- 9.4 Reservation for the SC / ST and other backward classes shall be made in accordance with the directives issued by the Government of Karnataka from time to time.
- 9.5 Admissions are offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission, issued from time to time, by the Government of India.
- 9.6 Candidates must fulfil the medical standards required for admission as prescribed by the University.
- 9.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation and any other falsification, the Registrar shall report the matter to the Board of Management (BOM), recommending revoking the admission of the candidate.
- 9.8 The decision of the BOM regarding the admissions is final and binding.

10 Lateral Entry / Transfer Students requirements

10.1 Lateral Entry

The University admits students directly to the second year (3rd Semester) of the B.Tech. Degree program as per the provisions and/or regulations of the Government of Karnataka pertaining to the “Lateral Entry” scheme announced by the Government from time to time. Further, the general conditions and rules governing the provision of Lateral Entry to the B.Tech. Program of the University are listed in the following Sub-Clauses:

- 10.1.1 Admission to 2nd year (3rd Semester) of the B.Tech. Degree program shall be open to the candidates who are holders of a 3-year Diploma in Engineering (or equivalent qualification as recognized by the University), who have secured not less than forty-five percentage (45%) marks in the final year examination (5th and

6th Semesters of the Diploma Program) in the appropriate branch of Engineering. Provided that, in case of SC / ST and OBC candidates from Karnataka the minimum marks for eligibility shall be forty percent (40%).

- 10.1.2 Provided further that, candidates seeking Lateral Entry may be required to complete specified bridge Courses as prescribed by the Presidency University. Such bridge Courses, if any, shall not be included in the CGPA computations.
- 10.1.3 All the existing Regulations and Policies of the University shall be binding on all the students admitted to the Program through the provision of Lateral Entry.
- 10.1.4 The Course requirements prescribed for the 1st Year of the B.Tech. Program shall be waived for the student(s) admitted through Lateral Entry and the duration of the B.Tech. Program for such students is three (03) years, commencing from the 3rd Semester (commencement of the 2nd Year) of the B.Tech. Program and culminating with the 8th Semester (end of the 4th Year) of the B.Tech. Program.
- 10.1.5 Provided that, if a Lateral Entry student misses any mandatory program specific courses that are typically offered in the 1st year (1st or 2nd semesters), then those courses must be cleared by the students as soon as possible, preferably during the Summer Term.
- 10.1.6 The existing Program Regulations of the concerned Program to which the student is admitted through the provision of Lateral Entry shall be binding on the student with effect from the 3rd Semester of the Program. i.e., the Program Structure and Curriculum from the 3rd to 8th Semesters of the Program concerned shall be binding on the student admitted through Lateral Entry. Further, any revisions / amendments made to the Program Regulations thereafter, shall be binding on all the students of the concerned Program.
- 10.1.7 All the Courses (and the corresponding number of Credits) prescribed for the 1st Year of the concerned B.Tech. Program shall be waived for the student(s) admitted to the concerned B.Tech Program through Lateral Entry. Further, the *Minimum Credit Requirements* for the award of the B.Tech. Degree in the

concerned Program shall be prescribed / calculated as follows:

The *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree prescribed by the concerned Bachelor of Technology Degree Program Regulations and Curriculum, 2021-2025, minus the number of Credits prescribed / accepted by the Equivalence Committee for the 1st Year (1st and 2nd Semesters) of the B.Tech. Program.

For instance, if the *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree as prescribed by the Regulations for B.Tech. (Computer Science and Engineering) is “N” Credits, and, if the total credits prescribed in the 1st Year (total credits of the 1st and 2nd Semesters) of the Program concerned is “M” Credits, then the *Minimum Credit Requirements* for the award of the B.Tech. in Computer Science and Engineering for a student who joins the Program through the provision of the Lateral Entry, shall be “N – M” Credits.

- 10.1.8 Further, no other waiver except the Courses prescribed for the 1st year of the B.Tech. Program of the University shall be permissible for students joining the B.Tech. Program through the provision of Lateral Entry.

10.2 Transfer of student(s) from another recognized University to the 2nd year (3rd Semester) of the B.Tech. Program of the Presidency University

A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the B.Tech/BS/ Four-Year Degree Program from another recognized University, may be permitted to transfer to the 2nd Year (3rd Semester) of the B.Tech. Program of the Presidency University as per the rules and guidelines prescribed in the following Sub-Clauses:

- 10.2.1 The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3.
- 10.2.2 The student shall submit the Application for Transfer along with a non-refundable Application Fee (as prescribed by the University from time to time) to the Presidency University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) B.Tech. Program commencing on August 1 on the year concerned.

- 10.2.3** The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.
- 10.2.4** The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the B.Tech, Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.
- 10.2.5** The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

11 Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Tech. Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the B.Tech. Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

- 11.1** Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the B.Tech. Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester, shall be eligible for consideration for a change of Branch.
- 11.2** Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the B.Tech. Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.
- 11.3** The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the B.Tech. Program, the Fee Policy pertaining to that Branch of the B.Tech. Program, and, all other rules

pertaining to the changed Branch existing at the time.

11.4 Change of Branch once made shall be final and binding on the student. No student shall be permitted, under any circumstances, to refuse the change of Branch offered.

11.5 The eligible student may be allowed a change in Branch, strictly in order of *inter se* merit, subject to the conditions given below:

11.5.1 The actual number of students in the 3rd Semester in any particular Branch to which the transfer is to be made, should not exceed the intake fixed by the University for the concerned Branch;

11.5.2 The actual number of students in any Branch from which transfer is being sought does not fall below 75% of the total intake fixed by the University for the concerned Branch.

The process of change of Branch shall be completed within the first five days of Registration for the 3rd Semester of the B.Tech. Program.

12 Specific Regulations regarding Assessment and Evaluation (including the Assessment Details of NTCC Courses, Weightages of Continuous Assessment and End Term Examination for various Course Categories)

12.1 The academic performance evaluation of a student in a Course shall be according to the University Letter Grading System based on the class performance distribution in the Course.

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 8.8

of Academic regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

12.3 Format of the End-Term examination shall be specified in the Course Plan.

12.4 Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:

- Non-Teaching Credit Courses (NTCC)
- Courses with a class strength less than 30

Absolute grading method may be adopted, where necessary with prior approval of concerned DAC.

Grading shall be done at the end of the Academic Term by considering the aggregate performance of the student in all components of Assessments prescribed for the Course. Letter Grades (refer Clause 8.10 of Academic regulations) shall be awarded to a student based on her/his overall performance relative to the class performance distribution in the concerned Course. These Letter Grades not only indicate a qualitative assessment of the student's performance but also carry a quantitative (numeric) equivalent called the Grade Point.

12.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage											
S. No	Credit Structure [L-T-P-C]	Percent age/ Marks	CA		Mid-Term		End-term		Project	Total	Exam Conducted by
			Theory	Practical	Theory	Practical	Theory	Practical			
1	3-0-0-3	Percent age	25%	-	25%	-	50%	-	-	100%	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	
2	2-0-2-3	Percent age	12.50%	12.50%	12.50%	12.50%	25%	25%	-	100%	Mid-Term & End Term by CoE * Except for full stack courses
		Marks	25	25	25	25	50	50	-	200	
3	1-0-4-3	Percent age	-	25%	10%	40%	5%	20%	-	100%	Mid-Term & End Term by School
		Marks	-	25	10	40	5	20	-	100	
4	2-0-4-4	Percent age	12.50%	12.50%	10%	15%	20%	30%	-	100%	*Mid-Term & End Term by CoE
		Marks	25	25	20	30	40	60	-	200	
5	0-0-4-2	Percent age	-	50%	-	-	-	-	50%	100%	Project evaluated by IC at School level
		Marks	-	50	-	-	-	-	50	100	
6	0-0-2-1	Percent age	-	100%	-	-	-	-	-	100%	Only CA at School Level
		Marks	-	100	-	-	-	-	-	100	
7	3-0-2-4	Percent age	12.50%	12.50%	15%	10%	30%	20%	-	100%	Mid-Term & End Term by CoE
		Marks	25	25	30	20	60	40	-	200	
8	2-0-0-2	Percentage	25%	-	25%	-	50%	-	-	100%	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	

*CSE3150-Front End Full stack development

CSE3151-Java Full Stack Development

CSE3152-.Net Full Stack development

The exact weightages of Evaluation Components shall be clearly specified in the concerned PRC and respective Course Plan.

Normally, for Practice/Skill based Courses, without a defined credit structure (L–T–P) [NTCC], but with assigned Credits (as defined in Clause 5.2 of the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of evaluation/assessment, shall be as decided and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

12.6 Minimum Performance Criteria:

12.6.1 Theory only Course and Lab/Practice Embedded Theory Course

A student shall satisfy the following minimum performance criteria to be eligible to earn the credits towards the concerned Course:

- a. A student must obtain a minimum of 30% of the total marks/weightage assigned to the End Term Examinations in the concerned Course.
- b. The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of the components of Continuous Assessments, Mid Term Examinations and End Term Examinations in the concerned Course.

12.6.2 Lab/Practice only Course and Project Based Courses

The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of all assessment components in the concerned Course.

- 12.6.3** A student who fails to meet the minimum performance criteria listed above in a Course shall be declared as “Fail” and given “F” Grade in the concerned Course. For theory Courses, the student shall have to re-appear in the “Make-Up Examinations” as scheduled by the University in any subsequent semester, or, re-appear in the End Term Examinations of the same Course when it is scheduled at the end of the following Semester or Summer Term, if offered. The marks obtained in the Continuous Assessments (other than the End Term Examination) shall be carried forward and be included in computing the final grade, if the student secures the minimum requirements (as per sub-clauses 8.9.1 and 8.9.2 of Academic Regulations) in the “Make-

Up Examinations” of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

13 Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc. – Note: These are covered in Academic Regulations

The University allows students to acquire credits from other Indian or foreign institutions and/or Massive Open Online Course (MOOC) platforms, subject to prior approval. These credits may be transferred and counted toward fulfilling the minimum credit requirements for the award of a degree. The process of transfer of credits is governed by the following rules and guidelines:

- 13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer (Refer ANNEXURE B of Academic Regulations) and approved by the Dean - Academics.
- 13.2 Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.
- 13.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:
 - 13.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 13.3 (as per Academic regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective

Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

- 13.3.2** SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 13.3 (as per Academic Regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.
- 13.3.3** Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.
- 13.3.4** Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.
- 13.3.5** A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.
- 13.3.6** SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.
- 13.3.7** A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.
- 13.3.8** The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic regulations.

Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses		
Sl. No.	Course Duration	Credit Equivalence
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

13.3.9 The maximum permissible number of credits that a student may request for credit transfer from MOOCs shall not exceed 20% of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree.

13.3.10 The University shall not reimburse any fees/expense; a student may incur for the SWAYAM/NPTEL/other approved MOOCs.

13.4 The maximum number of credits that can be transferred by a student shall be limited to forty percent (40%) of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree. However, the grades obtained in the Courses transferred from other Institutions/MOOCs, as mentioned in this Section (13.0), shall not be included in the calculation of the CGPA.

PART B: PROGRAM STRUCTURE

14. Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The B.Tech. (Computer Science and Engineering) Program Structure (2021-2025) totalling 160 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. (Computer Science and Engineering) 2021-2025: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets		
Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	18
2	Basic Science Courses (BSC)	14
3	Engineering Science Courses (ESC)	15
4	Professional Core Courses (PCC)	61
5	Professional Elective Courses (PEC)	30
6	Open Elective Courses (OEC)	9
7	Project Work (PRW)	13
8	Mandatory Courses (MAC)	0
	Total Credits	160 (Minimum)

In the entire Program, the practical and skill based course component contribute to an extent of approximately 64% out of the total credits of 160 for B.Tech. (Computer Science and Engineering) program of four years' duration.

15. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 160 credits is required for the award of a B.Tech. degree.

16. Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies,

- 16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University.
- 16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:
 - a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;

- b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause 19.2.1 of Academic Regulations;
- c. No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and
- d. No disciplinary action is pending against her/him.

PART- C : CURRICULUM STRUCTURE

17. Curriculum Structure – Basket Wise Course List (not Semester Wise)

List of Courses Tabled – aligned to the Program Structure

(Course Code, Course Name, Credit Structure (LTPC), Contact Hours, Course Basket, Type of Skills etc., as applicable).

Table 3.1 : List of Humanities and Social Sciences including Management Courses (HSMC)					
S.No	Course Name	L	T	P	C
1	Foundation of English/ Technical English	1	0	2	2
2	Technical English/ Advanced English	1	0	2	2

3	Management-I (People Management)	3	0	3	3
4	PPS (Soft Skills)	0	0	2	1
5	Kali Kannada / Thili Kannada	1	0	0	1
6	PPS (Soft Skills for Engineers)	0	0	2	1
7	(PPS) Introduction to Aptitude	0	0	2	1
8	Reasoning and Employment Skills	0	0	2	1
9	Being Corporate Ready	0	0	2	1
10	Management-II	3	0	0	3
11	Aptitude for Employment	0	0	2	1
11	Preparedness for Interview	0	0	2	1
Total No. of Credits					18

Table 3.2 : List of Basic Science Courses (BSC)					
S.No	Course Name	L	T	P	C
1	Calculus and Linear Algebra	3	0	2	4
2	Applied Statistics	1	0	2	2
3	Optoelectronics and Device Physics	2	0	2	3
4	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3
5	Numerical Methods for Engineers	1	0	2	2
Total No. of Credits					14

Table 3.3 : List of Engineering Science Courses (ESC)					
S.No	Course Name	L	T	P	C
1	Elements of Electronics Engineering	3	0	2	4
2	Problem Solving using JAVA	2	0	2	3
3	Innovative Projects - Arduino using Embedded 'C'	0	0	4	2
4	Data Structures and Algorithms	3	0	2	4
5	Innovative Projects Raspberry Pi Using Python	0	0	4	2
Total No. of Credits					15

Table 3.4 : List of Professional Core Courses (PCC)					
S. No	Course Name	L	T	P	C
1	Discrete Mathematical Structures	3	0	0	3
2	Web Technology	2	0	2	3
3	Digital Design	2	0	2	3
4	Software Engineering	3	0	0	3
5	Advanced Java Programming	1	0	4	3
6	Data Base Management System	2	0	2	3
7	Design and Analysis of Algorithms	3	0	0	3
8	Fundamentals of Data Analytics	3	0	0	3

9	Computer Organization and Architecture	3	0	0	3
10	Operating Systems	3	0	0	3
11	Data Communication and Computer Networks	3	0	0	3
12	Computer Graphics	3	0	0	3
13	Artificial Intelligence and Machine Learning	2	0	2	3
14	Mobile Application Development	1	0	4	3
15	Cryptography and Network Security	3	0	0	3
16	Theory of Computation	3	0	0	3
17	Object Oriented Analysis and Design	3	0	0	3
18	Cloud Computing	3	0	0	3
19	Compiler Design	2	0	2	3
20	Data Analysis and Visualization	2	0	4	4
Total No. of Credits					61

Table 3.5: List of course in Project Work basket (PRW)					
S.No	Course Name	L	T	P	C
1	Capstone Project	0	0	0	4
2	Internship	0	0	0	8
Total No. of Credits					12

18. Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip B.Tech. graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations). The same shall be prescribed in the Course Handout.

18.1 Internship

A student may undergo an Internship for a period of 10-12 weeks in an industry / company or academic / research institution during the 8th Semester, subject to the following conditions:

18.1.1 The Internship shall be in conducted in accordance with the Internship Policy prescribed by the University from time to time.

18.1.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Internship to a student;

18.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 18.1.2 above.

18.1.4 A student may opt for Internship in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Internship confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.1.5 A student selected for an Internship in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

18.2 Capstone Project

A student may undergo a Capstone Project for a period of 6-8 weeks in the 7th Semester as applicable, subject to the following conditions:

18.2.1 The Capstone Project shall be in conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.

18.2.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other

qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Capstone Project to a student;

- 18.2.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 18.2.2 above.
- 18.2.4 A student may opt for Capstone Project in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Internship Policy of the University.
- 18.2.5 student selected for a Capstone Project in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Capstone Project Policy of the University.

18.3 Research Project / Dissertation

A student may opt to do a Research Project / Dissertation for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Capstone Project, subject to the following conditions:

- 18.3.1 The Research Project / Dissertation shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.3.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

19. List of Elective Courses under various Specialisations / Stream Basket

Table 3.6: Professional Electives Courses/Specialization Tracks
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Track -1 Artificial Intelligence and Machine Learning Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE3005	Applied Artificial Intelligence	3	0	0	3	S		CSE3001	
2	CSE3016	Neural Networks and Fuzzy Logic	3	0	0	3	S/ EM		MAT1002	
3	CSE3087	Applied Machine Learning	2	0	2	3	S		CSE3001	
4	CSE3009	Optimization Techniques for Machine Learning	3	0	0	3	S/EM		CSE3087	
5	CSE3010	Deep Learning Techniques	3	0	0	3	S		CSE3087	
6	CSE3011	Reinforcement Learning	2	0	2	3	S		CSE3008	
7	CSE3014	Fundamentals of Natural Language Processing	3	0	0	3	S		CSE3001	
8	CSE3015	Advanced Natural Language Processing	2	0	2	3	S/ EM		CSE3014	
9	CSE3017	Autonomous Navigation and Vehicles	3	0	0	3	S/ EM		MAT1002	
10	CSE3018	Digital Health and Imaging	3	0	0	3	S/ EM		CSE3008	
11	CSE3019	Stochastic Decision Making	3	0	0	3	S/ EM		MAT1003	
12	CSE3088	Business Intelligence and Analytics	3	0	0	3	S/ EM		CSE3008	
13	CSE3103	Cognitive Science & Analytics	3	0	0	3	S/ EM		CSE3008	
14	CSE3108	Expert Systems	3	0	0	3	S/ EM		CSE3008	
15	CSE3348	Generative AI	2	0	2	3	S/EM		CSE3008	
Track -2 Big Data Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE2021	Data Mining	3	0	0	3	S/ EM	-	MAT1001	-

2	CSE2022	Domain Specific Predictive Analytics	3	0	0	3	S/EM	-	CSE2027	-
3	CSE2023	Data Warehousing and its Applications	3	0	0	3	S/EM	-	MAT1001	-
4	CSE2024	No SQL Databases	2	0	2	3	S	-	CSE2074	-
5	CSE3002	Big Data Technologies	2	0	2	3	S	-	CSE2074	
6	CSE3030	Mining Massive Datasets	2	0	2	3	S/EM	-	CSE2027	-
7	CSE3031	Web Intelligence and Analytics.	2	0	2	3	S	-	CSE2027	-
8	CSE3032	Streaming Data Analytics	2	0	2	3	S	-	CSE2027	-
9	CSE3033	Information Visualization	2	0	2	3	S/EM	-	CSE2027	-
10	CSE3034	Big Data Security and Privacy.	3	0	0	3	S	-	CSE3002	-
Track -3 Block Chain Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE3021	Blockchain for Public Sector	3	0	0	3	S/EM	-	CSE2020	-
2	CSE3022	Crypto Currency Technology	3	0	0	3	S/EM		CSE2019	-
3	CSE3024	Emerging Areas in Blockchain	3	0	0	3	S/EM	-	CSE2020	-
4	CSE3025	Industry Use Cases using Blockchain	3	0	0	3	S/EM	-	CSE2020	-
5	CSE2019	Foundations of Blockchain Technology	3	0	0	3	S	-		
6	CSE2020	Blockchain Technology And Applications	3	0	0	3	S	-		
7	CSE3020	Smart Contract and Solidity	2	0	2	3	S	-	CSE2019	
8	CSE3023	Distributed Ledger Technology	2	0	2	3	S		CSE 2019	
9	CSE3028	Blockchain Security and Performance	2	0	2	3	S		CSE2019	

Track -4 Cyber Security Basket											
Sl.No	Course Code	Course Name	L	T	P	C	S/EM				
1	CSE2037	Cyber Forensics	2	0	2	3	S			MAT1001	
2	CSE2038	Privacy and Security in Online Social Media	3	0	0	3	S/EM			CSE1001	
3	CSE2039	Ethical Hacking	2	0	2	3	S			CSE1001	
4	CSE2040	Cyber Threats for IoT and Cloud	3	0	0	3	S				
5	CSE3145	Intrusion Detection and Prevention System	3	0	0	3	S	-		CSE2037	
6	CSE3094	Cyber Security	3	0	0	3	S/EM			CSE3078	
7	CSE3096	Cyber Digital Twin	3	0	0	3	S/EM			CSE2013	
8	CSE3097	Web Security	2	0	2	3	S	-		CSE2011	
9	CSE3098	Vulnerability Assessment and Penetration Testing	3	0	0	3	S/EM			CSE3078	
10	CSE3099	Digital and Mobile Forensics	2	0	2	3	S/EM	-		CSE2011	
11	CSE3100	Security Assessment and Testing	2	0	2	3	S/EM	-		CSE2011	
12	CSE3101	Digital Watermarking and Steganography	3	0	0	3	S/EM	-		CSE3078	
13	CSE3102	Malware Analysis	3	0	0	3	S/EM	-		CSE3078	
Track – 5 Data Science Basket											
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite		
1	CSE2025	Business Continuity and Risk Analysis	3	0	0	3	S/EM	-		CSE2027	-
2	CSE2026	Data Handling and Visualization	2	0	2	3	S/EM	-		CSE2027	
3	CSE2028	Statistical Foundations of Data Science	2	0	2	3	S/EM			MAT1003	

4	CSE2029	Web Data Analytics	2	0	2	3	S/EM		CSE2027	-
5	CSE3035	R programming for Data Science	1	0	4	3	S		CSE2027	-
6	CSE3036	Predictive Analytics	2	0	2	3	S	-	CSE2026	
7	CSE3037	Optimization for Data Science	2	0	2	3	S		CSE2027	
8	CSE3038	Applied Data Science	2	0	2	3	S		CSE2027	
9	CSE3039	Social Media Analytics	2	0	2	3	S		CSE3036	-
10	CSE3136	E-Business and Marketing Analytics	3	0	0	3	S/EM		CSE2025	
11	CSE3137	Text Mining and Analytics	3	0	0	3	S/EM	-	CSE3001	
Track -6 DevOps Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE3040	Agile Structures and Frameworks	3	0	0	3	S	-		-
2	CSE3042	Applied DevOps	2	0	2	3	S/EM	-	CSE2014	-
3	CSE3043	Automated Test Management	2	0	2	3	S	-	CSE2014	-
4	CSE3044	Build and Release Management	3	0	0	3	S/EM	-	CSE2014	-
5	CSE3045	Development Automation	2	0	2	3	S	-	CSE2014	-
6	CSE3046	DevOps Tools Internals	2	0	2	3	S	-		-
7	CSE3050	Software Project Management	3	0	0	3	S/EM	-	CSE2014	-
8	CSE3051	System Monitoring	3	0	0	3	S/EM	-	CSE3120	-
9	CSE3052	System Provisioning and Configuration Management	3	0	0	3	S	-	CSE2014	-
Track -7 IoT Basket										

Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE2032	Introduction to Fog Computing	3	0	0	3	S	-	CSE2011	
2	CSE3053	Big Data Analytics for IoT	1	0	4	3	S	-	CSE3002	
3	CSE3055	Wireless Communication in IoT	3	0	0	3	S	-	CSE2011	
4	CSE3063	Privacy and Security in IoT	3	0	0	3	S		CSE3078	
5	CSE3066	Mobile Application for IoT	3	0	0	3	S		CSE2011	
6	ECE3075	IoT: Architecture and Protocols	3	0	0	3	S / EM			
7	ECE3076	IoT Platforms and Application Development	2	0	2	3	S / EM			
8	ECE3086	Industrial Internet of Things (IIoT)	3	0	0	3	S / EM	-		
9	ECE3088	Internet of Medical Things (IoMT)	3	0	0	3	S / EM	-		
Track -8 General Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE2033	Go Programming	3	0	0	3	S/ EM	-	CSE1002	-
2	CSE2066	Computer Graphics	3	0	0	3	S	-		-
3	CSE3146	Advanced Java Programming	1	0	4	3	S	-	CSE1001	-
4	CSE2036	Programming in C++	1	0	4	3	S/ EM	-	CSE1001	-
5	CSE3068	Advanced Database Management Systems	2	0	2	3	S/ EM	-	CSE2074	-
6	CSE3069	Introduction to Bioinformatics	3	0	0	3	S/ EM	-		-
7	CSE3070	Advanced Computer Networks	3	0	0	3	S/ EM		CSE2011	-
8	CSE3071	Computer Vision	2	0	2	3	S/ EM	-	MAT 1003	-

9	CSE3072	Wireless Sensor Networks	3	0	0	3	S/ EM		CSE 2011	
10	CSE3073	Game Design and Development	3	0	0	3	S/ EM	-		-
11	CSE3074	Microprocessors and Microcontrollers	3	0	0	3	S/ EM			
12	CSE3075	Mobile Application Development	1	0	4	3	S	-	CSE1001	-
13	CSE3077	Compiler Design	2	0	2	3	S	-		-
14	CSE3079	Parallel Computing	3	0	0	3	S/ EM	-	CSE2009	-
15	CSE3080	Quantum Computing	3	0	0	3	S/ EM	-	MAT1002	-
16	CSE3081	Digital Image Processing	2	0	2	3	S/ EM		MAT1002	-
17	CSE3082	Object Oriented Analysis and Design	3	0	0	3	S	-	CSE1001	
18	CSE3083	Advanced Computer Architecture	3	0	0	3	S/ EM	-	CSE2009	-
19	CSE3084	Software Quality Assurance	2	0	2	3	S/ EM	-	CSE2014	-
20	CSE3085	Real Time Operating System	3	0	0	3	S/ EM	-	CSE2010	-
21	CSE3086	Information Theory and Coding	3	0	0	3	S/ EM		MAT1002	-
22	CSE3089	Software Architecture	3	0	0	3	S/ EM	-	CSE2009	
23	CSE3090	5G Networking	3	0	0	3	S/ EM		CSE2011	-
24	CSE3091	Programming in C# and .NET	1	0	4	3	S/ EM	-	CSE1001	
25	CSE2052	Distributed Systems	3	0	0	3	S/ EM	-	CSE2010,	-
Track-9 Cloud Computing Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE2034	Edge Computing	3	0	0	3	S/EM	-	CSE2011	

2	CSE3095	Cloud Security	3	0	0	3	S/EM	-	CSE2013	
3	CSE3054	Data Center Design	3	0	0	3	S/EM	-	CSE2013	
4	CSE3127	Cloud Application Development	3	0	0	3	S/EM		CSE2013	
5	CSE3129	Middleware Technologies	3	0	0	3	S/EM	-	CSE2011	
Track 10 - Information Science & Engineering Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE3126	E-Commerce	3	0	0	3	S/EM	-	CSE2007	
Track -11 Information Science & Technology Basket										
Sl.No	Course Code	Course Name	L	T	P	C	S/EM		Prerequisite	
1	CSE2054	Storage Area Networks	3	0	0	3	S	-	CSE2011	
2	CSE2055	Information System Audit	3	0	0	3	S	-	CSE2011	
3	CSE2056	Web 2.0	2	0	2	3	S/EM	-	CSE2007	
4	CSE2057	Cloud Computing and Virtualization	3	0	0	3	S/EM	-	CSE2011	
5	CSE2058	Firewall and Internet Security	2	0	2	3	S		CSE2011	
6	CSE2059	Mobile Networking	2	0	2	3	S	-	CSE2011	
7	CSE2060	Information Security and Management	3	0	0	3	S/EM		CSE2011	
8	CSE3128	Human Computer Interaction	3	0	0	3	S/EM	-	CSE2007	
9	CSE3143	Infrastructure Management	3	0	0	3	S/EM		CSE2011	
10	CSE3132	Network Management Systems	3	0	0	3	S	-	CSE2011	

20. List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters.

Table 3.7 : Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 9											
Sl. No.	Course Code	Course Name	L	T	P	C	Type of Skill/ Focus	Course Caters to	Prerequisites/ Corequisites	Antir equisites	Future Courses that need this as a Prerequisite
Chemistry Basket											
1	CHE1003	Fundamentals of Sensors	3	0	0	3	S	ES	-	-	-
2	CHE1004	Smart materials for IOT	3	0	0	3	S	ES	-	-	-
3	CHE1005	Computational Chemistry	2	0	0	2	S	ES	-	-	-
4	CHE1006	Introduction to Nano technology	3	0	0	3	S	ES	-	-	-
5	CHE1007	Biodegradable electronics	2	0	0	2	S	ES	-	-	-
6	CHE1008	Energy and Sustainability	2	0	0	2	S	ES	-	-	-
7	CHE1009	3D printing with Polymers	2	0	0	2	S	ES	-	-	-
8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES	-	-	-
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES	-	-	-
10	CHE1012	Introduction to Composite materials	2	0	0	2	S	ES	-	-	-
11	CHE1013	Chemistry for Engineers	3	0	0	3	S	ES	-	-	-
12	CHE1014	Surface and Coatings technology	3	0	0	3	S	ES	-	-	-
13	CHE1015	Waste to Fuels	2	0	0	2	S	ES	-	-	-
14	CHE1016	Forensic Science	3	0	0	3	S	ES	-	-	-
Civil Engineering Basket											
1	CIV1001	Disaster mitigation and management	3	0	0	3	S	-	-	-	-
2	CIV1002	Environment Science and Disaster Management	3	0	0	3	FC	-	-	-	-
3	CIV2001	Sustainability Concepts in Engineering	3	0	0	3	S	-	-	-	-
4	CIV2002	Occupational Health and Safety	3	0	0	3	S	-	-	-	-
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	-	-	-	-
6	CIV2004	Integrated Project Management	3	0	0	3	EN	-	-	-	-
7	CIV2005	Environmental Impact Assessment	3	0	0	3	EN	-	-	-	-
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	-	-	-	-
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	-	-	-	-
10	CIV2045	Environmental Meteorology	3	0	0	3	S	-	-	-	-
11	CIV3046	Project Problem Based Learning	3	0	0	3	S	-	-	-	-
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	-	-	-	-
Commerce Basket											
1	COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS	-	-	-
2	COM2002	Finance for Non Finance	2	0	0	2	S	-	-	-	-
3	COM2003	Contemporary Management	2	0	0	2	F	-	-	-	-

4	COM2004	Introduction to Banking	2	0	0	2	F	-	-	-	-
5	COM2005	Introduction to Insurance	2	0	0	2	F	-	-	-	-
6	COM2006	Fundamentals of Management	2	0	0	2	F	-	-	-	-
7	COM2007	Basics of Accounting	3	0	0	3	F	-	-	-	-
Computer Science Basket											
1	CSE2002	Programming in Java	2	0	2	3	S/EM	-	-	-	-
2	CSE2003	Social Network Analytics	3	0	0	3	S	GS	-	-	-
3	CSE2004	Python Application Programming	2	0	2	3	S/ EM	-	-	-	-
4	CSE2005	Web design fundamentals	2	0	2	3	S/ EM/EN	-	-	-	-
5	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	0	3	S/ EM/EN	-	-	-	-
6	CSE3112	Privacy And Security In Online Social Media	3	0	0	3	S/ EM/EN	-	-	-	-
7	CSE3113	Computational Complexity	3	0	0	3	S/ EM/EN	-	-	-	-
8	CSE3114	Deep Learning for Computer Vision	3	0	0	3	S/ EM/EN	-	-	-	-
9	CSE3115	Learning Analytics Tools	3	0	0	3	S/ EM/EN	-	-	-	-
Design Basket											
1	DES1001	Sketching and Painting	0	0	2	1	S	-	-	-	-
2	DES1002	Innovation and Creativity	2	0	0	2	F	-	-	-	-
3	DES1121	Introduction to UX design	1	0	2	2	S	-	-	-	-
4	DES1122	Introduction to Jewellery Making	1	0	2	2	S	-	-	-	-
5	DES1124	Spatial Stories	1	0	2	2	S	-	-	-	-
6	DES1125	Polymer Clay	1	0	2	2	S	-	-	-	-
7	DES2001	Design Thinking	3	0	0	3	S	-	-	-	-
8	DES1003	Servicability of Fashion Products	1	0	2	2	F	ES	-	-	-
9	DES1004	Choices in Virtual Fashion	1	0	2	2	F	ES, GS, HP	-	-	-
10	DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2	F	ES, GS, HP	-	-	-
11	DES1006	Colour in Everyday Life	1	0	2	2	F	ES	-	-	-
12	DES2080	Art of Design Language	3	0	0	3	S	-	-	-	-
13	DES2081	Brand Building in Design	3	0	0	3	S	-	-	-	-
14	DES2085	Web Design Techniques	3	0	0	3	S	-	-	-	-
15	DES2089	3D Modeling for Professionals	1	0	4	3	S	-	-	-	-
16	DES2090	Creative Thinking for Professionals	3	0	0	3	S	-	-	-	-
17	DES2091	Idea Formulation	3	0	0	3	S	-	-	-	-
Electrical and Electronics Basket											
1	EEE1002	IoT based Smart Building Technology	3	0	0	3	S	-	-	-	-
2	EEE1003	Basic Circuit Analysis	3	0	0	3	S	-	-	-	-
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3	S	-	-	-	-
4	EEE1005	Electric Vehicles & Battery Technology	3	0	0	3	S	-	-	-	-
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	S	-	-	-	-
Electronics and Communication Basket											
1	ECE1003	Fundamentals of Electronics	3	0	0	3	F	-	-	-	-
2	ECE1004	Microprocessor based systems	3	0	0	3	F	-	-	-	-
3	ECE3089	Artificial Neural Networks	3	0	0	3	S	-	-	-	-
4	ECE3097	Smart Electronics in Agriculture	3	0	0	3	F/EM	-	-	-	-
5	ECE3098	Environment Monitoring Systems	3	0	0	3	F/EM	-	-	-	-
6	ECE3102	Consumer Electronics	3	0	0	3	F/EM	-	-	-	-

7	ECE3103	Product Design of Electronic Equipment	3	0	0	3	S/F/ EM / EN	-	-	-	-
8	ECE3106	Introduction to Data Analytics	3	0	0	3	F/EM	-	-	-	-
9	ECE3107	Machine Vision for Robotics	3	0	0	3	F/EM	-	-	-	-
English Basket											
1	ENG1008	Indian Literature	2	0	0	2	-	GS/ HP	-	-	-
2	ENG1009	Reading Advertisement	3	0	0	3	S	-	-	-	-
3	ENG1010	Verbal Aptitude for Placement	2	0	2	3	S	-	-	-	-
4	ENG1011	English for Career Development	3	0	0	3	S	-	-	-	-
5	ENG1012	Gender and Society in India	2	0	0	2	-	GS/ HP	-	-	-
6	ENG1013	Indian English Drama	3	0	0	3	-	-	-	-	-
7	ENG1014	Logic and Art of Negotiation	2	0	2	3	-	-	-	-	-
8	ENG1015	Professional Communication Skills for Engineers	1	0	0	1	-	-	-	-	-
DSA Basket											
1	DSA2001	Spirituality for Health	2	0	0	2	F	HP	-	-	-
2	DSA2002	Yoga for Health	2	0	0	2	S	HP	-	-	-
3	DSA2003	Stress Management and Well Being	2	0	0	2	F	-	-	-	-
Kannada Basket											
1	KAN1001	Kali Kannada	1	0	0	1	S	-	-	-	-
2	KAN1003	Kannada Kaipidi	3	0	0	3	S	-	-	-	-
3	KAN2001	Thili Kannada	1	0	0	1	S	-	-	-	-
4	KAN2003	Pradharshana Kale	1	0	2	2	S	-	-	-	-
5	KAN2004	Sahithya Vimarshe	2	0	0	2	S	-	-	-	-
6	KAN2005	Anuvadha Kala Sahithya	3	0	0	3	S	-	-	-	-
7	KAN2006	Vichara Manthana	3	0	0	3	S	-	-	-	-
8	KAN2007	Katha Sahithya Sampada	3	0	0	3	S	-	-	-	-
9	KAN2008	Ranga Pradarshana Kala	3	0	0	3	S	-	-	-	-
Foreign Language Basket											
1	FRL1004	Introduction of French Language	2	0	0	2	S	S	-	-	-
2	FRL1005	Fundamentals of French	2	0	0	2	S	S	-	-	-
3	FRL1009	Mandarin Chinese for Beginners	3	0	0	3	S	S	-	-	-
Law Basket											
1	LAW1001	Introduction to Sociology	2	0	0	0	2	F	HP	-	-
2	LAW2001	Indian Heritage and Culture	2	0	0	0	2	F	HP/GS	-	-
3	LAW2002	Introduction to Law of Succession	2	0	0	0	2	F	HP/GS	-	-
4	LAW2003	Introduction to Company Law	2	0	0	0	2	F	HP	-	-
5	LAW2004	Introduction to Contracts	2	0	0	2	F	HP	-	-	-
6	LAW2005	Introduction to Copy Rights Law	2	0	0	2	F	HP	-	-	-
7	LAW2006	Introduction to Criminal Law	2	0	0	2	F	HP	-	-	-
8	LAW2007	Introduction to Insurance Law	2	0	0	2	F	HP	-	-	-
9	LAW2008	Introduction to Labour Law	2	0	0	2	F	HP	-	-	-
10	LAW2009	Introduction to Law of Marriages	2	0	0	2	F	HP/GS	-	-	-
11	LAW2010	Introduction to Patent Law	2	0	0	2	F	HP	-	-	-
12	LAW2011	Introduction to Personal Income Tax	2	0	0	2	F	HP	-	-	-
13	LAW2012	Introduction to Real Estate Law	2	0	0	2	F	HP	-	-	-
14	LAW2013	Introduction to Trademark Law	2	0	0	2	F	HP	-	-	-
15	LAW2014	Introduction to Competition Law	3	0	0	3	F	HP	-	-	-
16	LAW2015	Cyber Law	3	0	0	3	F	HP	-	-	-
17	LAW2016	Law on Sexual Harrassment	2	0	0	2	F	HP/GS	-	-	-
18	LAW2017	Media Laws and Ethics	2	0	0	2	F	HP/GS	-	-	-
Mathematics Basket											
1	MAT2008	Mathematical Reasoning	3	0	0	3	S	-	-	-	-
2	MAT2014	Advanced Business Mathematics	3	0	0	3	S	-	-	-	-

3	MAT2041	Functions of Complex Variables	3	0	0	3	S	-	-	-	-
4	MAT2042	Probability and Random Processes	3	0	0	3	S	-	-	-	-
5	MAT2043	Elements of Number Theory	3	0	0	3	S	-	-	-	-
6	MAT2044	Mathematical Modelling and Applications	3	0	0	3	S	-	-	-	-
Mechanical Basket (not to be offered for Mechanical Department students)											
1	MEC1001	Fundamentals of Automobile Engineering	3	0	0	3	F	-	-	-	-
2	MEC1002	Introduction to Matlab and Simulink	3	0	0	3	S/EM	-	-	-	-
3	MEC1003	Engineering Drawing	1	0	4	3	S	-	-	-	-
4	MEC2001	Renewable Energy Systems	3	0	0	3	F	ES	-	-	-
5	MEC2002	Operations Research & Management	3	0	0	3	F	-	-	-	-
6	MEC2003	Supply Chain Management	3	0	0	3	S/ EM/ EN	-	-	-	-
7	MEC2004	Six Sigma for Professionals	3	0	0	3	S/EM	-	-	MEC 2008	-
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3	F	-	-	-	-
9	MEC2006	Safety Engineering	3	0	0	3	S/EM	ES	-	-	-
10	MEC2007	Additive Manufacturing	3	0	0	3	F/EM	-	-	-	-
11	MEC3069	Engineering Optimisation	3	0	0	3	S/EM	-	-	-	-
12	MEC3070	Electronics Waste Management	3	0	0	3	F/S	ES	-	-	-
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	S/EM	ES	-	-	-
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	S/EM	-	-	-	-
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3	S/EM	-	-	-	-
16	MEC3201	Industry 4.0	3	0	0	3	S/EM	-	-	-	-
Petroleum Basket											
1	PET1011	Energy Industry Dynamics	3	0	0	3	FC	ES	-	NIL	-
2	PET1012	Energy Sustainability Practices	3	0	0	3	FC	ES	-	NIL	-
Physics Basket											
1	PHY1003	Mechanics and Physics of Materials	3	0	0	3	FC / SD				
2	PHY1004	Astronomy	3	0	0	3	FC				
3	PHY1005	Game Physics	2	0	2	3	FC / SD				
4	PHY1006	Statistical Mechanics	2	0	0	2	FC				
5	PHY1007	Physics of Nanomaterials	3	0	0	3	FC				
6	PHY1008	Adventures in nanoworld	2	0	0	2	FC				
7	PHY2001	Medical Physics	2	0	0	2	FC	ES			
8	PHY2002	Sensor Physics	1	0	2	2	FC / SD				
9	PHY2003	Computational Physics	1	0	2	2	FC				
10	PHY2004	Laser Physics	3	0	0	3	FC	ES			
11	PHY2005	Science and Technology of Energy	3	0	0	3	FC	ES			
12	PHY2009	Essentials of Physics	2	0	0	2	FC				
Management Basket- I											
1	MGT2007	Digital Entrepreneurship	3	0	0	3	S/EM/EN	-	-	-	-
2	MGT2015	Engineering Economics	3	0	0	3	S	-	-	-	-
3	MGT2023	People Management	3	0	0	3	S/EM/EN	HP	-	-	-
Management Basket- II											
1	MGT1001	Introduction to Psychology	3	0	0	3	F	HP	-	-	-
2	MGT1002	Business Intelligence	3	0	0	3	EN	-	-	-	-
3	MGT1003	NGO Management	3	0	0	3	S	-	-	-	-
4	MGT1004	Essentials of Leadership	3	0	0	3	EM/ EN	GS/ HP	-	-	-
5	MGT1005	Cross Cultural Communication	3	0	0	3	S/EM/EN	HP	-	-	-

6	MGT2001	Business Analytics	3	0	0	3	S/ EM/EN	-	-	-	-
7	MGT2002	Organizational Behaviour	3	0	0	3	F	HP	-	-	-
8	MGT2003	Competitive Intelligence	3	0	0	3	S	-	-	-	-
9	MGT2004	Development of Enterprises	3	0	0	3	S/EM/E N	-	-	-	-
10	MGT2005	Economics and Cost Estimation	3	0	0	3	S/EM	-	-	-	-
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3	S	-	-	-	-
12	MGT2008	Econometrics for Managers	3	0	0	3	S	-	-	-	-
13	MGT2009	Management Consulting	3	0	0	3	S/EM/E N	-	-	-	-
14	MGT2010	Managing People and Performance	3	0	0	3	S/EM/E N	HP/GS	-	-	-
15	MGT2011	Personal Finance	3	0	0	3	F	-	-	-	-
16	MGT2012	E Business for Management	3	0	0	3	S/EM	-	-	-	-
17	MGT2013	Project Management	3	0	0	3	EN / EM	GS/HP/E S	-	-	-
18	MGT2014	Project Finance	3	0	0	3	EN / EM	HP	-	-	-
19	MGT2016	Business of Entertainment	3	0	0	3	EM/ EN	-	-	-	-
20	MGT2017	Principles of Management	3	0	0	3	S/EM/ EN	-	-	-	-
21	MGT2018	Professional and Business Ethics	3	0	0	3	S/EM/ EN	HP	-	-	-
22	MGT2019	Sales Techniques	3	0	0	3	S/EM/ EN	HP	-	-	-
23	MGT2020	Marketing for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
24	MGT2021	Finance for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
25	MGT2022	Customer Relationship Management	3	0	0	3	S/EM/ EN	HP	-	-	-
Media Studies Basket											
1	BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2	EM	HP	-	-	-
2	BAJ3051	Digital Photography	2	0	2	3	EM	HP	-	-	-
3	BAJ3055	Introduction to News Anchoring and News Management	0	0	2	1	EM	-	-	-	-

21. List of MOOC (NPTEL) Courses

21.1 NPTEL - Discipline Elective Courses for B. Tech. (Computer Science Engineering)

Sl. No.	Course ID	Course Name	Duration
1	noc25-cs22	Deep Learning for Natural Language Processing	12 Weeks
2	noc25-cs49	Machine Learning for Engineering and Science Applications	12 Weeks
3	noc25-cs06	Algorithms in Computational Biology and Sequence Analysis	12 Weeks
4	noc25-cs45	Introduction to Large Language Models (LLMs)	12 Weeks

5	noc25-cs61	Quantum Algorithms and Cryptography	12 Weeks
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21.2 NPTEL - Open Elective Courses for B. Tech. (Computer Science and Engineering)

Sl. No.	Course ID	Course Name	Duration
1	BBA2022	Supply Chain digitization	12 Weeks
2	BBA2021	E Business	12 Weeks
3	BBB2016	Business Analytics for Management Decisions	12 Weeks
4	BBB2015	Artificial Intelligence for Investments	12 Weeks

Sl. No	Course Code	Course Name	Total Credits	L-T-P-C
1	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	3-0-0-3
2	CSE3112	Privacy And Security In Online Social Media	3	3-0-0-3
3	CSE3113	Computational Complexity	3	3-0-0-3
4	CSE3114	Deep Learning for Computer Vision	3	3-0-0-3
5	CSE3115	Learning Analytics Tools	3	3-0-0-3
6	CSE502	Technical Skills in JAVA	3	0-0-6-3
7	CSE503	Technical Skills in Python	3	0-0-6-3
8	CSE504	Comprehensive Technical Skills	5	0-0-10-5
9	CSE505	The Joy Of Computing Using Python	3	3-0-0-3
10	CSE3119	Coding Skills in Python	3	3-0-0-3
11	CSE3121	Parallel Computer Architecture	3	3-0-0-3
12	CSE3124	Games and Information	3	3-0-0-3
13	CSE3140	Introduction To Industry 4.0 And Industrial Internet Of Things	3	3-0-0-3
14	CSE3142	Affective Computing	3	3-0-0-3
15	CSE3112	Privacy and Security in Online Social Media	3	3-0-0-3
16	CSE3196	Foundations of Cyber Physical Systems	3	3-0-0-3
17	CSE3197	Getting Started with Competitive Programming	3	3-0-0-3
18	CSE3198	GPU Architectures And Programming	3	3-0-0-3
19	CSE3199	Artificial Intelligence: Knowledge Representation And Reasoning	3	3-0-0-3
20	CSE3200	Programming in Modern C++	3	3-0-0-3
21	CSE3201	Circuit Complexity Theory	3	3-0-0-3
22	CSE3202	Basics of Computational Complexity	3	3-0-0-3
23	CSE3212	Introduction to Computer and Network Performance Analysis Using Queuing	1	1-0-0-1
24	CSE3213	C Programming And Assembly Language	1	1-0-0-1
25	CSE3214	Python For Data Science	1	1-0-0-1
26	CSE3215	Software Conceptual Design	1	1-0-0-1
27	CSE3117	Industrial Digital Transformation	3	3-0-0-3
28	CSE3118	Blockchain for Decision Makers	3	3-0-0-3
29	CSE3349	Technology for Lawyers	3	3-0-0-3
30	CSEXXXX	Deep Learning for Natural Language Processing	3	3-0-0-3
31	CSEXXXX	Machine Learning for Engineering and science applications	3	3-0-0-3
32	CSEXXXX	Algorithms in Computational Biology and Sequence Analysis	3	3-0-0-3
33	CSEXXXX	Introduction to Large Language Models (LLMs)	3	3-0-0-3
34	CSEXXXX	Quantum Algorithms and Cryptography	3	3-0-0-3

22. Recommended Semester Wise Course Structure / Flow including the Programme / Discipline Elective Paths / Options

SEMESTER-1									
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					CONTACT HOURS	BASKET
			L	T	P	C			
1.	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	BSC	
2.	CSE1001	Problem Solving using Java	2	0	2	3	4	ESC	

3.	PHY1002	OptoElectronics and Device Physics	2	0	2	3	4	BSC
4.	CSE1002	Innovation Project - Arduino using Embedded C	0	0	4	2	4	ESC
5.	ENG1001/ ENG1002	Foundation of English/ Technical English	1	0	2	2	3	HSMC
6.	PPS1001	Introduction to soft skills	0	0	2	1	2	HSMC
7.	XXXXXXX	Open Elective-I	3	0	0	3	3	OEC
8.	KAN1001/ KAN2001	Kali Kannada / Thili Kannada	1	0	0	1	1	HSMC
		TOTAL	12	0	14	19	26	-

SEMESTER II								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1.	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	3	BSC
2.	MAT1003	Applied Statistics	1	0	2	2	3	BSC
3.	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	ESC
4.	CSE2001	Data Structures and Algorithms	2	0	2	4	4	ESC
5.	ENG1002/ ENG2001	Technical English/ Advanced English	1	0	2	2	3	HSMC
6.	CSE2074/ CSE2018	Data Base Management Systems/ Theory of Computation	3	0	0	3	3	PCC
7.	PPS1002	Soft Skills for Engineers	0	0	2	1	2	PCC
8.	CSE2014	Software Engineering	3	0	0	3	3	PCC
9.	CHE1001	Environmental Studies	2	0	0	0	2	BSC
10.	XXXXXXX	Open Elective-II	3	0	0	3	3	OEC
11.	CSE1002	Innovative Projects – Raspberry PI using Python	0	0	4	2	4	ESC
		TOTAL				27	35	

SEMESTER III								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1.	PPS2001	Reasoning and Employment Skills	0	0	2	1	2	BSC
2.	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	BSC
3.	CSE2066	Computer Graphics	3	0	0	3	3	ESC
4.	ECE2007	Digital Design	2	0	2	3	4	ESC
5.	CSE2074/ CSE2018	Data Base Management System/ Theory of Computation	3	0	0	3	3	HSMC
6.	CSE2067	Web Technologies	2	0	2	3	4	PCC
7.	CSE2027	Fundamentals of Data Analytics	3	0	0	3	3	PCC
		TOTAL				19	22	

Semester 4								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	BSC
2	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	PCC
3	CSE3146	Advanced Java Programming	1	0	4	3	5	PCC
4	CSE2009	Computer Organization and Architecture	3	0	0	3	3	PCC

5	CSE2010	Operating Systems	3	0	0	3	3	PCC
6	CSE2011	Data Communication and Computer Networks	3	0	0	3	3	PCC
7	CSEXXXX	Discipline Elective – I	3	0	0	3	3	PEC
8	PPS2002	Being Corporate Ready	0		2	1	2	HSMC
9	CSEXXXX	Discipline Elective – II	3	0	0	3	3	PEC
		TOTAL				24	28	

Semester 5								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1	PPS4002	Introduction to Aptitude	0	0	2	1	2	HSMC
2	CSE3001	Artificial Intelligence and Machine Learning	2	0	2	3	4	PCC
3	CSE3075	Mobile Application and Development	1	0	4	3	5	PCC
4	CSE3078	Cryptography and Network Security	3	0	0	3	3	PCC
5	CSE3082	Object Oriented Analysis and Design	3	0	0	3	3	PCC
6	CSEXXXX	Discipline Elective – III	3	0	0	3	3	PEC
7	CSEXXXX	Discipline Elective – IV	3	0	0	3	3	PEC
8	CSEXXXX	Discipline Elective – V	2	0	2	3	4	PEC
9	XXXXXXXX	Open Elective III from Management basket	3	0	0	3	3	HSMC
		TOTAL				25	30	

Semester 6								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1	PPS4005	Aptitude for employment	0	0	2	1	2	HSMC
2	CSE2013	Cloud Computing	3	0	0	3	3	PCC
3	CSE3077	Compiler Design	2	0	2	3	4	PCC
4	CSE2015	Data Analysis and Visualization	2	0	4	4	6	PCC
5	CSEXXXX	Discipline Elective – VI	3	0	0	3	3	PEC
6	CSEXXXX	Discipline Elective - VII	3	0	0	3	3	PEC
7	CSEXXXX	Discipline Elective – VIII	3	0	0	3	3	PEC
8	XXXXXXXX	Open Elective- IV	3	0	0	3	3	OEC
9	PIP1001	Apprenticeship	0		0	0	0	MC
		TOTAL				23	27	

Semester 7									
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					CONTACT HOURS	BASKET
			L	T	P	C			
1	PIP2001	Capstone Project	-	0	-	4	0	PRW	
2	PPS3018	Preparedness for Interview	0	0	2	1	2	PEC	
3	CSEXXXX	Discipline Elective - IX	3	0	0	3	3	PEC	
4	CSEXXXX	Discipline Elective – X	3	0	0	3	3	PEC	

5	XXXXXXX	Open Elective (Management Basket) – V	3	0	0	3	3	OE
6	XXXXXXX	Open Elective-VI**	0	0	2	1		HSMC
		TOTAL				14	11	

Open Elective-VI**

Students who have not earned the 15 credits of Open Elective until 7th semester are eligible towards the registration and completion of the Open Elective VI course under NPTEL MOOC Swayam.

Semester 8								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1	PIP4004	Internship	-	-	-	9	0	PRW
		TOTAL				9		

COURSE CATALOGUES:

Course Code: MAT1001	Course Title: Calculus and Linear Algebra		L-T-P- C	2	1	2	4
	Type of Course: School Core Lab Integrated						
Version No.	3.0						
Course Pre-requisites	Basic Concepts of Limits, Differentiation, Integration						
Anti-requisites	NIL						
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software.						
Course Objective	The objective of the course is <u>Skill Development</u> of student by using <u>Problem Solving Techniques</u> .						
Course Out Comes	On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations. 5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems.						
Course Content:							
Module 1	Linear Algebra						10 Classes
Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) $AX = O$ and $AX = B$ using rank method. Linear Algebra: Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.							
Module 2	Partial Derivatives						10 CLASSES

Review: Differential calculus with single variable.

Partial Derivatives:

Homogeneous functions and Euler's theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

Engineering Applications of partial derivatives.

Module 3	Advanced Integral calculus			12 Classes
<p>Review: Integral calculus for single integrals.</p> <p>Advanced Integral calculus: Beta and Gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates. Engineering applications of partial derivatives.</p>				
Module 4	Ordinary Differential Equations	Assignment	Programming	13 Classes
<p>Review: First order and first-degree Ordinary Differential Equations, Method of separation of variables, Homogeneous and Non- Homogeneous Equations reducible to Homogeneous form.</p> <p>Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non- Exact Differential Equations, Higher order Differential Equation with constant coefficients and with right hand side of the form e^{ax}, $\sin ax$, $\cos ax$, $e^{ax}f(x)$, $x^n f(x)$ etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, D-operators and Inverse D- operators, Method of Variation of Parameters. Engineering applications of differential equations.</p>				
<p>List of Laboratory Tasks:</p> <p>Introductory Task: Introduction to usage of the software and simple programming tasks. [3 Sessions]</p>				

<p>Experiment N0 1: Solution of Simple differentiation with single variable and use of chain Rule.</p> <p>Experiment No. 2: Solution based on application of Tailors' Series using software</p> <p>Experiment No. 3: Application of Maxima and Minima condition using software.</p> <p>Experiment No. 4 Computation of different functions for a specific problem</p> <p>Experiment No. 5 Computation of Area under a curve.</p> <p>Experiment No. 6 Solution of a set of simultaneous equations in matrix method</p> <p>Experiment No. 7 Computation of Eigen Values and Eigen Vectors.</p> <p>Experiment No. 8 Solution of Partial Differential equation</p> <p>Experiment No. 9 solution using Cauchy Equation and Lagrange's Equation</p>
<p>Targeted Application & Tools that can be used:</p> <p>The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design.</p> <p>Tools Used: MatLab, Zylink.</p>
<p>Assignment:</p> <ol style="list-style-type: none"> 1. List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using MATLAB. 2. Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.
<p>Text Book</p> <ol style="list-style-type: none"> 1. Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011 2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.
<p>References:</p> <ol style="list-style-type: none"> 1. Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013. 2. Walter Ledermann, Multiple integrals, Springer, 1st edition 3. Lay, Linear Algebra and its applications, 3rd Ed., 2002, Pearson Education India. 4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc. 10th Edition 5. MatLab usage manual <p>E-resources/ Web links:</p> <ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/109104124 2. https://nptel.ac.in/courses/111106051 3. https://nptel.ac.in/courses/111102137

4. <https://www.cuemath.com/learn/mathematics/algebra-vs-calculus/>
5. <https://stanford.edu/~shervine/teaching/cs-229/refresher-algebra-calculus>
6. <https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/linear-algebra/>
7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
8. <https://www.scu.edu.au/study-at-scu/units/math1005/2022/>

Topics relevant to the development of Foundation Skills: All solution methods

Topics relevant to development of Employability skills: Use of Matlab software.

Course Code: MAT1003	Course Title: Applied Statistics Type of Course: School Core	L T P C	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of “Applied Statistics” and attain <u>Skill Development</u> Through <u>Problem Solving</u> techniques.					
Expected Outcome:	At the end of this course, students will be in a position to 1. apply the techniques of descriptive statistics effectively 2. interpret the ideas of probability and conditional probability 3. demonstrate the knowledge of probability distributions 4. Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.					
Module 1	Descriptive Statistics	Assignment	Coding needed	10 classes		
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson’s Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression .						

Module 2	Probability			6 classes
Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples				
Module 3	Random Variables and Probability Distributions		Coding needed	14 classes
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, Negative Binominal (Self Study) , Poisson, Normal and Exponential distributions				
Module 4	Sampling Theory		Coding needed	15 classes
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and Difference of Means (Self Study) , Small Sample Tests: Student's t-Test for Single Mean and Difference of Means , F-Test, Chi-Square Test.				
<p>Targeted Application & Tools that can be used:</p> <p>The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems.</p> <p>Tools used: R Software / MS-Excel</p>				
<p>Text Book</p> <ol style="list-style-type: none"> 1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016. 				
<p>References</p> <ol style="list-style-type: none"> 1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018. 2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020. 3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019. 				

4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.
5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.
6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.

Topics relevant to SKILL DEVELOPMENT: The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions for **Skill Development through Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: ENG1002	Course Title: Technical English Type of Course: 1] School Core 2] Laboratory integrated	L-T-P-C	1-0-2-2
Version No.	1.0 V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING and PARTICIPATIVE LEARNING TECHNIQUES .		
Course Outcomes	On successful completion of the course, the students shall be able to: <ol style="list-style-type: none"> 1. Develop proficiency in using technical vocabulary and terminology. 2. Apply language skills for better speaking skills in technical fields. 3. Write technical descriptions 4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles. 		

Course Content:				
Module 1	Fundamentals of Technical Communication	Worksheets & Quiz	Vocabulary building	9 Classes
Introduction to Technical English Differences between Technical English and General English Technical Writing Basics Technical Vocabulary				
Module 2	Technical Presentation	Presentations	Speaking Skills	12 Classes
Introduction Planning the Presentation Creating the Presentation Giving the Presentation				
Module 3	Technical Description	Assignment	Group Presentation	12 Classes
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	Technical Writing	Assignment	Writing Skills	12 Classes
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively Technical Report Writing				

Types of technical reports (Lab reports, research reports, etc.)
Components of technical reports
Writing an abstract and executive summary
Structure and content organization
Transcoding: diagrams, charts and images
List of Laboratory Tasks: <ol style="list-style-type: none"> Module-1 <ul style="list-style-type: none"> Level 1: Worksheets Level 2: Worksheets Module 2 <ul style="list-style-type: none"> Level 1: Preparing Presentation Level 2: Giving Presentation (Individual) Module-3 <ul style="list-style-type: none"> Level 1: Product Description & User Manual Level 2: Process Description & Transcoding Module 4 <ul style="list-style-type: none"> Level 1: Email Writing Level 2: Report Writing
Targeted Applications & Tools that can be used: <ol style="list-style-type: none"> Flipgrid Quizzes Youtube Videos Podcast
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course <ol style="list-style-type: none"> Bring out the essence of technical communication with reference to the conventions of technical communication, with examples Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.
The following individual, as well as group Assignments, will be given to the students. <ol style="list-style-type: none"> Presentation Describing a product/process Individual Reports
Text Books <ol style="list-style-type: none"> Kumar, Sanjay; Pushpalatha. <i>English Language and Communication Skills for Engineers</i>. Oxford University Press. 2018. Brieger, Nick and Alison Paul. <i>Technical English Vocabulary and Grammar</i>. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf
Reference Book: <ol style="list-style-type: none"> Chauhan, Gajendra Singh, and Kashmiramka, Smita, <i>Technical Communication</i>. Cengage Publication. 2018. Sunder Jain. <i>Technical Report Writing</i>. Centrum Press, 2013.

<p>3. John Bowden. “Writing a Report: How to Prepare, Write & Present Really Effective Reports?”. 9th Edition 2011</p> <p>Comfort, Jeremy et. al. 1984. <i>Business Reports in English</i>. Cambridge University Press.</p> <p>4. Sharma, R.C. and K. Mohan. 2011. <i>Business Correspondence and Report Writing</i>, Fourth Edition. Tata McGraw Hill.</p>
<p>Web Resources:</p> <p>1: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.</p> <p>2: https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdc8f4a5%40redis&bdata=JnNpdGU9ZW9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih</p> <p>3: Last, Suzan, et. al. <i>Technical Writing Essentials</i>. University of Victoria, British Columbia, 2019 (E-Book)</p> <p>4 Wambui, Tabita Wangare, et al. <i>Communication Skills- Volume 1</i>, LAP LAMBERT, USA, 2012 (E-Book)</p>
<p>Topics Relevant to the Development of Employability Skills: Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.</p>

Course Code: PPS 1001	Course Title: Introduction to Soft Skills Type of Course: Practical Only Course	L- P- C	0	2	1
Version No.	1.0				
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.				
Anti-requisites	NIL				
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.				

Course Objective	The objective of the course is to familiarize the learners with the concepts of “Soft Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.		
Course Out Comes	On successful completion of this course the students shall be able to: CO1: Recognize significance of soft skills CO2: Illustrate effective communication while introducing oneself and others CO3: List techniques of forming healthy habits CO4: Apply SMART technique to achieve goals and increase productivity		
Course Content:			
Module 1	INTRODUCTION TO SOFT SKILLS	Classroom activity	06 Hours
Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality			
Module 2	EFFECTIVE COMMUNICATION	Individual Assessment	10 Hours
Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email- writing, Resume Building- Digital, Video, Traditional.			
Module 3	HABIT FORMATION	Worksheets & Assignment	6 Hours
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right			
Module 4	Goal setting & Time Management	Goal sheet	8 Hours
A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity			
Targeted Application & Tools that can be used: LMS			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
1) Individual Assessment			

2) LMS MCQ

The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: KAN1001	Course Title: Kali Kannada Type of Course: School Core	L- T-P- C	1	0	0	1
Version No.						
Course Pre-requisites	Mother tongue with thorough knowledge					
Anti-requisites	–					
Course Description	This course aims to help the non Kannada speaking students to converse in Kannada for their day- to –day life activities. It supports to develop strong cognitive skills, use of local language, helps to mingle with the local society,. At the end of the course, the students will have better skills, to the students of Engineering for a better communication. Furthermore, this course is offered to all the students, irrespective of their domain.					
OBJECTIVE OF THE COURSE	The objective of the course is SKILL DEVELOPMENT of students by using PARTICIPATIVE LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Identify Alphabets and few words with phonetic sound ; understand and express Kannada language for social interaction and basic reading capacity 2] Recognize different basic Kannada vocabulary to know about others perspectives. 3] Use simple kannada in the different contexts 4] Respect the Regional Language and Culture.					
Course Content:	The course contents in the form of different modules each module having similar topics in order in which we have given such type of the topics are arranged from given topics 1 Credit course must have 4 modules, 2 Credit course must have 5 modules					

Module 1	Alphabet – VarNamale,	Assignment	Pronunciation Listening	No. of Hours 3
<p>*Alphabet –varNamale, *Vowels-Short vowels,Long vowels, Pronunciation of vowels, writing vowels *Consonants,(vyanjanagalu)-classified consonants, unclassified consonants, pronunciation of consonants, Unseparated (alpa praana), Aspirated (mahaapraana), Nasals(anunaasika) *Origin of sound</p>				
Module 2	Parts of Speech	Pronunciation Practice	Vocabulary Practice to remember the words, Translation and transliteration	No. of Hours 4
<p>Parts of Speech 1. Nouns 2. Pronoun 3. Adjective 4. Verbs 5. Adverbs 6. Prepositions 7. Conjunctions 8. Interjections</p>				
Module 3	TENSE & GENDER	Assignment	Speaking Listening Practice conversation	No. of Hours 4
<p>* Tense - Types and Examples * Gender – Types and Examples * Simple Sentences using Tense and Gender</p>				
Module 4	SAMBHASHANE (CONVERSATION)	Assignment	Speaking Listening Practice conversation	No. of Hours 4
<p>* Conversation (sambhaashane) Interrogative words and Interrogative sentences Introducing each other Conversation on Enquiring about room Conversation on Enquiring about friends family Conversation between doctor and patient Conversation in vegetable market List of simple proverbs</p>				
<p>Practice to speaking with friends different context should conversation Practice: Translation and transliteration in kannada</p>				

Assignment: Assignment proposed for this course: students should write Alphabet and simple kannada vocabularies in English Transliteration form, students should record audio or video of kannada vocabularies and simple sentence reading.
Practice speaking , self-introduce video with audio or audio , Translation Activities: by telling and giving examples of other Languages if those Lecturer know other languages
Text Book: In the name of Kali kannada first time we will be preparing syllabus. Currently we are using kannada Text book introduced by Vishweshvarayya technology University in the name of kannada kali and balake kannada.
<ol style="list-style-type: none"> 1. Reference books: Spoken Kannada – Publication – Kannada Sahitya parishath Bengaluru. 2. Kannada Kirana – Publication – Bangalore Institute of Languages, Bangalore. 3. Kannada kali 4. Balake kannada
Topics relevant to “SKILL DEVELOPMENT”: Speaking Skills, Writing Skills, Presentation Skills, Interpretation Skills, Group Presentations, Group Discussions and Seminars for Skill Development through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.

Course Code: MAT2004	Course Title: Discrete Mathematical Structures Type of Course: Program Core	L-T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	The course provides insights into the fundamental aspects of mathematical logic and predicate calculus. The course delves deeply into the concepts of algebraic structures, lattices and Boolean algebras which are widely used in computer science and engineering. It also highlights the principles of counting techniques and their applications.					
Course Objective	The objective of the course is <u>Skill Development</u> of student by using <u>Problem Solving Techniques</u> .					

Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain logical sentences through predicates, quantifiers and logical connectives. CO2: Comprehend the basic principles of set theory and different types of relations. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Deploy the counting techniques to tackle combinatorial problems.			
Course Content:				
Module 1	Mathematical Logic and Predicate Calculus			12 classes
Propositional Logic, Propositional Logic Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus.				
Module 2	Algebraic Structures			10 classes
Sets and set-operations, functions, relations and their properties & representations of relation by matrix, closure of different type of relations, equivalence relations, primitive recursive function.				
Module 3	Lattices and Boolean Algebra			11 classes
Partial ordering, Posset, Lattices & Algebraic structures, Sub lattice, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra, cancellation laws and unique complement theorem.				
Module 4	Principles of Counting Techniques			12 classes
Chinese Remainder Theorem, pigeonhole principle, generalized pigeonhole principle, Generalized Permutations and Combinations, Recurrence Relations.				
Targeted Application & Tools that can be used: Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
Assignment 1: Logic Equivalences and Predicate calculus. Assignment 2: Equivalence Relations and Lattices Assignment 3: Recurrence Relations				
Text Books 1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, McGraw-Hill’s 7th Edition, 2011.				

<ol style="list-style-type: none"> 2. Kolman, Bernard; Busby, Robert C; Ross, Sharon Cutler,” Discrete mathematical structures”, Pearson India, 6th Edition, 2015. 3. Liu, C L Mohapatra, D P.,” Elements of Discrete Mathematics a Computer oriented approach”, New Delhi McGraw Hill Education, 4th Edition, 2015. 4. Mott, Joe L; Kandel, Abraham; Baker, Theodore P, ”Discrete Mathematics for Computer Scientists and Mathematicians”, Pearson India, 2nd Edition, 2015. 5. Epp, Susanna S, “Discrete Mathematics with applications”, New Delhi Cengage Learning, 4th Edition, 2016.
References: <ol style="list-style-type: none"> 1. Tremblay, J.P. and Manohar.R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011. 2. Grimaldi, R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, 4th Edition, Pearson Education Asia, Delhi, 2007. 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.

Course Code: PHY1002	Course Title: Optoelectronics and Device Physics Type of Course: 1] School Core & Laboratory integrated	L-T- P-C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	<p>The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.</p>		

Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1: Describe the concepts of semiconductors, magnetic materials and superconductors.</p> <p>CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices.</p> <p>CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers.</p> <p>CO4: Explain the applications of lasers and optical fibers in various technological fields.</p> <p>CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. [Lab oriented].</p>		
Course Objective	<p>The objective of the course is to familiarize the learners with the concepts of “Optoelectronics and device physics “and attain Skill Development through Experiential Learning techniques</p>		
Course Content:			
Module 1	Fundamentals of Materials.	Assignment	Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software.
<p>Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Magnetic materials, Superconductors:</p>			
Module 2	Advanced Devices and applications	Assignment	Data collection on efficiency of solar cells.
<p>Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs</p>			
Module 3	Quantum concepts and Applications	Term paper	Seminar on quantum computers.

Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron. Heisenberg's uncertainty principle. Schrodinger time independent wave equation. Particle in a box			
Module 4	Lasers and Optical fibers	Term paper	Case study on medical applications of Lasers.
<p>Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling.</p> <p>Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.</p>			
<p>List of Laboratory Tasks:</p> <p>Experiment No. 1: Experimental errors and uncertainty using excel</p> <p>Level 1: Calculation of accuracy and precision of a given data</p> <p>Level 2: propagation of errors in addition, subtraction, multiplication and division.</p> <p>Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction.</p> <p>Level 1: Determination of Wavelength of Laser</p> <p>Level 2: Finding the particle size of lycopodium powder.</p> <p>Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier.</p> <p>Level 1: To determine the proportionality of Hall Voltage and magnetic flux density</p> <p>Level 2: To determine the polarity of Charge carrier.</p> <p>Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions.</p> <p>Level 1: To study I–V characteristics of the given Zener diode in reverse bias and to determine break down voltage.</p> <p>Level 2: To study I–V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance.</p> <p>Experiment No. 5: To study input and output characteristics of a given Transistor.</p> <p>Level 1: To determine the input resistance of a given transistor.</p>			

Level 2: To determine current transfer characteristics and transistor parameters of a given transistor.

Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire.

Level 1: Determination of Fermi energy and Fermi temperature of given metal wire.

Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.

Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage.

Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.

Level 2: To measure the photo-current as a function of the irradiance at constant voltage.

Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.

Level 1: To study the I-V characteristics

Level 2: I-R characteristics of a solar cell as a function of the irradiance.

Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .

Level 1: Calculate the numerical aperture.

Level 2: study the losses that occur in optical fiber cable.

Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.

Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.

Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.

Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage.

Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs

Level 2: Determination of knee voltage.

Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.

Level 1: Determination of Stefan's constant

Level 2: Verification of Stefan-Boltzmann Law.
Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM. 2. Origin, excel and Mat lab soft wares for programming and data analysis.
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Assessment Type <ul style="list-style-type: none"> • Midterm exam • Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.) • Quiz • End Term Exam • Self-Learning <ol style="list-style-type: none"> 1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons. 2. Write a report on importance of quantum entanglement in supercomputers.
Text Book <ol style="list-style-type: none"> 1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications, 2018.
References: <ol style="list-style-type: none"> 1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002. 2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011. 3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017. 4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012. 5. Introduction to Quantum Mechanics, David J <u>Griffiths</u>, Cambridge University Press, 2019

E-Resources:

1. <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live>
2. <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live>
3. <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live>
4. <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live>
5. <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live>

Topics relevant to “SKILL DEVELOPMENT”: Fundamentals of materials, Lasers and optical fibers.

for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Course Code: ECE1001	Course Title: Elements of Electronics Engineering Type of Course: School Core Theory & Integrated Laboratory	L-T-P-C	3	0	2	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	Nil					
Course Description	The purpose of this course is to enable the students to learn the fundamental concepts of electronic devices and circuits. The course aims at nurturing the students with the fundamental principles of electronics engineering, prevailing in various engineering applications. The nature of the course is conceptual and analytical which imparts knowledge of electronic components and their behavior under various operating conditions. The course develops thinking skills of the students, encouraging their quest for knowledge about electronic devices and their usage in higher semester courses. The associated laboratory provides an opportunity to validate the concepts taught in theory classes and enable the students to work with basic electronic circuits using electronics components.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Elements of Electronics Engineering and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Identify various electrical and electronic components and basic electrical laws. 2. Explain applications of Diodes and BJTs. 3. Summarize the concepts of Digital Electronics and Communication Systems. 4. Discuss the basic concepts of microprocessor and computer organization. 5. Perform experiments to familiarize various Electrical & Electronic components and equipment. 					

	6. Verify Basic Electrical Circuit configurations and Laws.			
Course Content:				
Module 1	Basic Electrical and Electronic Components	Assignment / Quiz	Identification of Practical electronic and electrical components / Memory Recall based Quizzes	10 Sessions
Topics: ELECTRICAL CIRCUITS AND LAWS: DC Circuits: Classification of Electrical Elements, Ohm's law, Series and Parallel Circuits, Kirchhoff's Voltage and Current laws, Power and Energy, Transformers and their types. ELECTRONIC MATERIALS AND COMPONENTS: Conductors, Insulators, Semi-Conductor Material, P-N Junction diode, Characteristics and Parameters, Ideal Diode approximations, DC load line.				
Module 2	Applications of Diodes and Introduction to BJT	Assignment / Quiz	Simulation Task/ Memory Recall based Quizzes	12 Sessions
Topics: RECTIFIERS: Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filters circuit (only qualitative approach). ZENER DIODE: Zener diode, Zener Characteristics, Zener diode as a voltage regulator. BIPOLAR JUNCTION TRANSISTORS: BJT Construction and Operation, BJT Voltages and Currents, Common Base, Common Emitter Configuration and Characteristics, Current amplification Factor alpha and beta, DC Load line w.r.t. fixed bias circuit (Q-Point), AC Analysis.				
Module 3	Digital Electronics and Communication System	Assignment / Quiz	Simulation Task / Memory Recall based Quizzes	13 Sessions
Topics: NUMBER SYSTEMS: Decimal Number System, Binary Number System, Hexadecimal Number System, Conversions: Binary to and from Hexadecimal; Hexadecimal to and from Decimal; 1's and 2's Complement of Binary Numbers, Binary Addition. BOOLEAN ALGEBRA: Boolean Laws and Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, X-NOR Gate, NAND Gate, NOR Gate. COMMUNICATION SYSTEM: Block diagram of communication system, Modulation: Definition of Modulation, Need of Modulation, Types of Modulation: Amplitude Modulation and Frequency Modulation (Waveforms only).				
Module 4	Microprocessors and Computer Organization	Assignment / Quiz	Memory recall based Quizzes	10 Sessions
Topics: INTEL 8085 MICROPROCESSOR: Basic Architecture and features of 8085 Microprocessor. COMPUTER ORGANISATION: Basic structure of Computer Organisation describing the various Computer types, Functional Units, Basic Operational concepts, Bus Structures, Memory System: RAM and ROM.				
List of Laboratory Tasks: Experiment No. 1: Study of Resistors, Measuring instruments and DC Power Supply. Level 1: Identification of resistor values from color bands and verification with Multimeter. Level 2: Connecting a resistive circuit to a DC Power Supply and observing the input and output values using Voltmeters, Ammeters and hence calculate resistance values. Experiment No. 2: Study of Reactive components, Multimeter, CRO and Function Generator.				

Level 1: Identification of various types of capacitive and inductive components and verification with Multimeter.

Level 2: Connecting a reactive circuit to a function generator and observing the input and output waveform on CRO and calculation of Reactance and Impedance.

Experiment No. 3: Study of Ohm's Law.

Level 1: Rig up the circuit and verify Ohm's Law.

Level 2: Connect a 100Ω Resistor to a Voltage source of 0-5V. Plot a V- I graph by tabulating the Voltage Vs Current Values accordingly. Repeat the experiment for $1K\Omega$ resistor and compare the results.

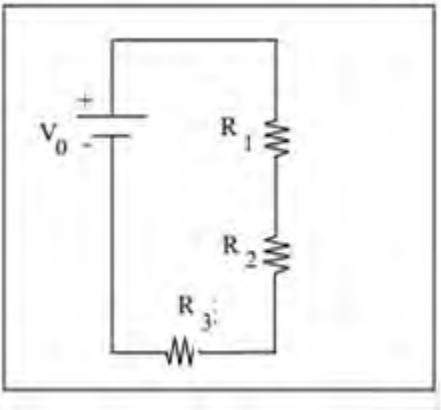
Experiment No. 4: Study of Series and Parallel Resistor Connections.

Level 1: Carry out the equivalent resistance of given four resistors 100Ω each connected in series and parallel combination using breadboard.

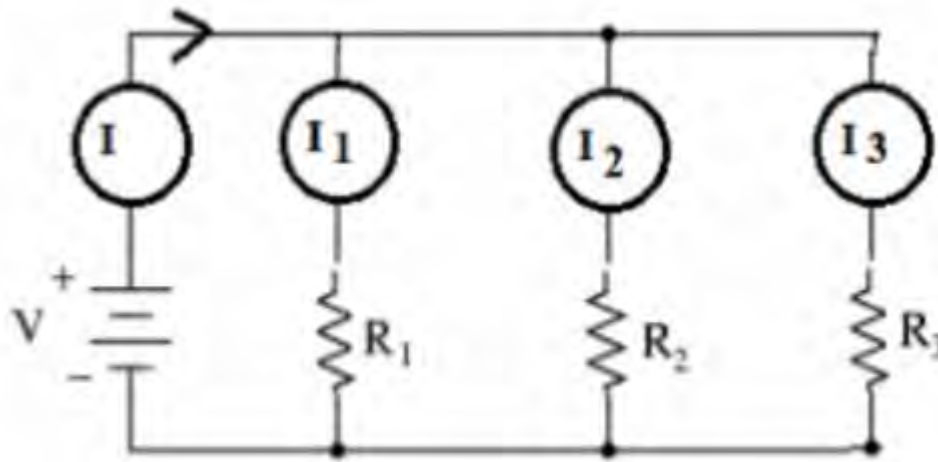
Level 2: Rig up a Current Divider Circuit and a Voltage Divider Circuit and verify the results.

Experiment No. 5: Study of Kirchhoff's Voltage Law and Kirchhoff's Current Law.

Level 1: Verify KVL and KCL with circuit(a) and circuit(b) with #values.

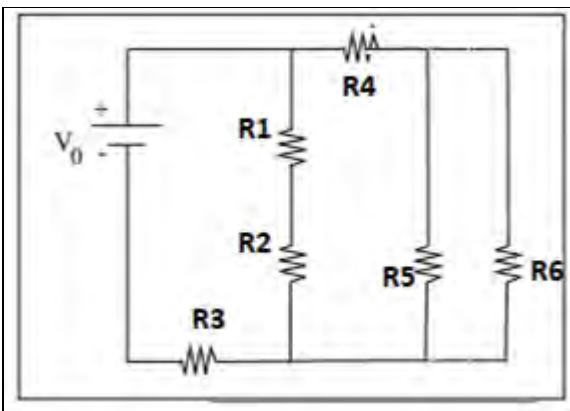


(a)



(b)

Level 2: Verify KCL with the help of given circuit having # values and carry out the equivalent resistance of the circuit by experimental and analytical methods.



Experiment No. 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.

Level 1: Carry out the experiment to find cut-in voltage on forward characteristics for Silicon P-N Junction diode.

Level 2: Carry out experiment to plot VI Characteristics of Silicon P-N Junction Diode in both forward and reverse biased conditions for Si P-N Junction diode.

Experiment No. 7: Study of Bipolar Junction Transistor in different regions of operation.

Level 1: Carry out the experiment to understand the importance of active, cut off and saturation regions.

Level 2: Carry out the experiment to design and analyze the operation of transistor as switch.

Experiment No. 8: Study of basic Digital Logic Gates using Integrated Chips IC's: NOT, AND, OR, XOR, NAND and NOR Gates

Level 1: Carry out the experiment to study and verify the truth table of logic gates using Digital ICs.

Level 2: Implementation of operation of a basic Boolean expression using basic gates.

Experiment No. 9: Study of Computer Organization: Identification of Components on Motherboard: CPU: Processor Chips (Processor Socket), PCI, Parallel Ports, Universal Serial Bus: USB, I/O Connectors, RAM Slots.

Level 1: Carry out the experiment to familiarize a computer system layout and mark the positions of SMPS, Motherboard, FDD, HDD, CD / DVD drive and add on cards.

Level 2: Study of a Desktop PC and its assembling.

Targeted Application & Tools that can be used:

Student will be able to find career opportunities in various domains such as Analog Electronics, Digital Electronics, Microprocessors, VLSI Design, Telecommunication, Computers and Wireless Communication. The students will be able to join a profession which involves basics to high level of electronic circuit design.

Professionally Used Software: MultiSim/ PSpice

Besides these software tools hardware equipment such as Multimeter, Function Generator, Power Supply, Oscilloscope etc., can be used to perform component/circuit testing and analysis.

Textbook(s):

T1. John Hiley, Keith Brown and Ian McKenzie Smith, "*Hughes Electrical and Electronic Technology*", Pearson, 12th Edition

T2. William Stallings, "*Computer Organization and Architecture Designing for Performance*", Pearson Education, 10th Edition.

Reference(s):

Reference Book(s):

R1. Smarajit Ghosh, "*Fundamentals of Electrical and Electronics Engineering*", PHI, 2nd Edition

R2. D.P. Kothari, I. J. Nagrath, "*Basic Electronics*", McGraw Hill Education, 1st Edition

R3. Rajendra Prasad, "*Fundamentals of Electronics Engineering*", Cengage Learning, 3rd Edition

Online Resources (e-books, notes, ppts, video lectures etc.):

1. Video lectures on "BASIC ELECTRONICS" by Prof. Dr. Chitrlekha Mahanta, Department of Electronics and communication Engineering, IIT Guwahati": <https://nptel.ac.in/courses/117/103/117103063/>
2. Lecture Series on " Useful Laws in Basic Electronics" by Prof. T.S.Natarajan, Department of physics, IIT Madras: <https://www.youtube.com/watch?v=vfVVF58FtCc>
3. Lecture Series on "Introduction to Bipolar Junction Transistors BJT " by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=-VwPSDQmdjM&list=PLwjK_ikyK4LLDoFG8FeiKAr3ISrKPSxqg
4. Lecture Series on " PN Junction Diode " by All About Electronics Youtube Channel: <https://www.youtube.com/watch?v=USrY0JspDEg>
5. Lecture Series on "Introduction to Digital Electronics" by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=DBTna2ydmC0&list=PLwjK_ikyK4LLBC_so3odA64E2MLgIRKafI
6. Lecture Series on "Introduction to Microprocessors" by Bharat Acharya Education :<https://www.youtube.com/watch?v=0M74z5jEAyA>
7. Lecture Notes on : "Electronic Devices", Bipolar Junction Transistors, 2nd Chapter, by Shree Krishna Khadka (PDF) [Bipolar Junction Transistor \(researchgate.net\)](https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor)https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor

E-content:

1. V. Milovanovic, R. van der Toorn, P. Humphries, D. P. Vidal and A. Vafanejad, "Compact model of Zener tunneling current in bipolar transistors featuring a smooth transition to zero forward bias current," *2009 IEEE Bipolar/BiCMOS Circuits and Technology Meeting*, 2009, pp. 99-102, doi: 10.1109/BIPOL.2009.5314134. <https://ieeexplore.ieee.org/document/5314134>
2. M. Oueslati, H. Garrab, A. Jedidi and K. Besbes, "The advantage of silicon carbide material in designing of power bipolar junction transistors," *2015 IEEE 12th International Multi-Conference on Systems, Signals & Devices (SSD15)*, 2015, pp. 1-6. <https://ieeexplore.ieee.org/document/7348149>
3. H. Luo, F. Iannuzzo, F. Blaabjerg, X. Wang, W. Li and X. He, "Elimination of bus voltage impact on temperature sensitive electrical parameter during turn-on transition for junction temperature estimation of high-power IGBT modules," *2017 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2017, pp. 5892-5898 <https://ieeexplore.ieee.org/document/8096974>
4. F. Bauer, I. Nistor, A. Mihaila, M. Antoniou and F. Udrea, "Super junction IGBT Filling the Gap Between SJ MOSFET and Ultrafast IGBT," in *IEEE Electron Device Letters*, vol. 33, no. 9, pp. 1288-1290, Sept. 2012 <https://ieeexplore.ieee.org/document/6246672>
5. <https://presiuniv.knimbus.com/user#/home>

Topics relevant to "SKILL DEVELOPMENT": Electrical & Electronic component and laws, Fundamentals of Digital Electronics, Communication Systems, Microprocessors and Computer Organization for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE1001	Course Title: Problem Solving using JAVA Type of Course: Integrated		L-T- P-C	2	0	2	3
Version No.		2.0					
Course Pre-requisites		Basic Programming knowledge.					
Anti-requisites		NIL					
Course Description		This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real time secure applications by applying these concepts and also for effective problem solving. The students interpret and understand the need for object oriented programming to build applications.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes		On successful completion of the course the students shall be able to: C.O. 1: Describe the basic programming concepts. [Knowledge] C.O. 2: Apply the concept of classes, objects and methods to solve problems. [Application] C.O. 3: Apply the concept of arrays and strings. [Application] C.O. 4: Implement inheritance and polymorphism building secure applications. [Application] C.O. 5: Apply the concepts of interface and error handling mechanism. [Application]					
Course Content:							
Module 1	Basic Concepts of Programming and Java	Assignment		Data Collection/Interpretation		12 Sessions	
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.							
Module 2	Classes, objects, methods and Constructors	Case studies / Case let		Case studies / Case let		12 Sessions	
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods. Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.							
Module 3	Arrays, String and String buffer	Quiz		Case studies / Case let		12 Sessions	

Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.					
Module 4	Inheritance and Polymorphism	Quiz	Case studies / Case let		12 Sessions
Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.					
Module 5	Input & Output Operation in Java	Quiz	Case studies / Case let		12 Sessions
Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.					
List of Laboratory Tasks: P1 - Problem Solving using Basic Concepts. P2 - Problem Solving using Basic Concepts and Command Line Arguments. P3 - Programming assignment with class, objects, methods and Constructors. P4 - Programming assignment with method overloading. P5 - Programming assignment with constructor overloading. P6 - Programming assignment with Static members and static methods. P7 - Programming assignment with Nested classes. P8 - Programming assignment using Arrays. P9 - Programming assignment using Strings. P10 - Programming assignment using String Builder. P11 - Programming assignment using Inheritance and super keyword. P12 - Programming assignment using Method overriding and Dynamic method invocation. P13 - Programming assignment using Final keywords. P14 - Programming assignment using Abstract keywords. P15 - Programming assignment using Interface. P16 - Programming assignment using Interface. P17 - Programming assignment CharacterStream Classes P18 - Programming assignment Read/Write Operations with File Channel					
Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.					
Text Book T1 Herbert Schildt, “The Complete Reference Java 2”, Tata McGraw Hill Education.					
References R1: Cay S Horstmann and Cary Gornell, “CORE JAVA volume I-Fundamentals”, Pearson R2: James W. Cooper, “Java TM Design Patterns – A Tutorial”, Addison-Wesley Publishers. E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub)					

Web resources https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q https://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to development of “Skill Development”: <ol style="list-style-type: none"> 1. Static Polymorphism 2. Method overloading, constructors 3. constructor overloading 4. this keyword 5. static keyword and Inner classes 6. Inheritance and Polymorphism. <p>for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: ENG1002	Course Title: Technical English Type of Course: 1] School Core 2] Laboratory integrated	L-T-P-C	1-0-2-2
Version No.	2.0 V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners’ EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING and PARTICIPATIVE LEARNING TECHNIQUES .		
Course Outcomes	On successful completion of the course, the students shall be able to: <ol style="list-style-type: none"> 5. Develop proficiency in using technical vocabulary and terminology. 6. Apply language skills for better speaking skills in technical fields. 7. Write technical descriptions 8. Demonstrate writing skills in writing technical 		

	documents such as reports, manuals, and articles.			
Course Content:				
Module 1	Fundamentals of Technical Communication	Worksheets & Quiz	Vocabulary building	9 Classes
Introduction to Technical English Differences between Technical English and General English Technical Writing Basics Technical Vocabulary				
Module 2	Technical Presentation	Presentations	Speaking Skills	12 Classes
Introduction Planning the Presentation Creating the Presentation Giving the Presentation				
Module 3	Technical Description	Assignment	Group Presentation	12 Classes
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	Technical Writing	Assignment	Writing Skills	12 Classes
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively Technical Report Writing				

Types of technical reports (Lab reports, research reports, etc.)
Components of technical reports
Writing an abstract and executive summary
Structure and content organization
Transcoding: diagrams, charts and images
List of Laboratory Tasks: 5. Module-1 Level 1: Worksheets Level 2: Worksheets 6. Module 2 Level 1: Preparing Presentation Level 2: Giving Presentation (Individual) 7. Module-3 Level 1: Product Description & User Manual Level 2: Process Description & Transcoding 8. Module 4 Level 1: Email Writing Level 2: Report Writing
Targeted Applications & Tools that can be used: 5. Flipgrid 6. Quizzes 7. Youtube Videos 8. Podcast
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course 3. Bring out the essence of technical communication with reference to the conventions of technical communication, with examples 4. Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.
The following individual, as well as group Assignments, will be given to the students. 4. Presentation 5. Describing a product/process 6. Individual Reports
Text Books 3. Kumar, Sanjay; Pushpalatha. <i>English Language and Communication Skills for Engineers</i> . Oxford University Press. 2018. 4. Brieger, Nick and Alison Paul. <i>Technical English Vocabulary and Grammar</i> . https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf
Reference Book: 5. Chauhan, Gajendra Singh, and Kashmiramka, Smita, <i>Technical Communication</i> . Cengage Publication. 2018. 6. Sunder Jain. <i>Technical Report Writing</i> . Centrum Press, 2013.

<p>7. John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011</p> <p>Comfort, Jeremy et. al. 1984. <i>Business Reports in English</i>. Cambridge University Press.</p> <p>8. Sharma, R.C. and K. Mohan. 2011. <i>Business Correspondence and Report Writing</i>, Fourth Edition. Tata McGraw Hill.</p>
<p>Web Resources:</p> <p>1: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.</p> <p>2: https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdc8f4a5%40redis&bdata=JnNpdGU9ZWWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih</p> <p>3: Last, Suzan, et. al. <i>Technical Writing Essentials</i>. University of Victoria, British Columbia, 2019 (E-Book)</p> <p>4 Wambui, Tabita Wangare, et al. <i>Communication Skills- Volume 1</i>, LAP LAMBERT, USA, 2012 (E-Book)</p>
<p>Topics Relevant to the Development of Employability Skills: Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.</p>

ENG2001	Advanced English	L- T- P- C	1	0	2	2
Version No.	1.3					
Course Pre-requisites	ENG1002 Technical English					
Anti-requisites	NIL					
Course Description	The course emphasizes on technical communication at advanced level by exploring critical reading, technical presentation and review writing. The purpose of the course is to enable learners to review literature in any form or any technical article and deliver technical presentations. Extensive activities in practical sessions equip to express themselves in various forms of technical communications. Technical presentations and the module on career setting focus on learners' area of interests and enhance their English language writing skills to communicate effectively.					
Course Outcome	On successful completion of the course the students shall be able to: 1. Develop a critical and informed response reflectively, analytically, discursively, and creatively to their reading.					

	2. Communicate effectively, creatively, accurately and appropriately in their writing. 3. Deliver technical presentations 4. Design resume and create professional portfolio to find a suitable career			
Course Content: Theory				
Module 1	Critical Reasoning and Writing	Writing Essays	Critical Reading	4 Classes
Topics: <ul style="list-style-type: none">• A Catalog of Reading Strategies• The Myth of Multitasking• A Guide to Writing Essays Speculating about Causes or Effects• Is Google Making Us Stupid (Self Study)				
Module 2	Technical Presentation	Presentation	Oral Skills	3 Classes
Topics: <ul style="list-style-type: none">• Planning the presentation• Creating the presentation• Giving the presentation				
Module 3	Writing Reviews	Prezi	Review Writing	4 Classes
Topics: <ul style="list-style-type: none">• Review Writing• Short film reviews• Advanced English Grammar (Self Study)				
Module 4	Starting your Career	Online Writing Lab	Writing Skills	4 Classes
Topics: <ul style="list-style-type: none">• Preparing a Resume• Writing Effective Application Letter• Creating a Professional Portfolio				
Course Content: Practical Sessions				
Module 1	Critical Reasoning and Writing			8 Classes
1. Reading and Analyzing Level 1 – Annotation Level 2 - Assumptions 2. Writing Narrative Essays Level 1 – Draft 1 Level 2 – Draft 2				

Module 2	Technical Presentation	10 Classes
3. Fishbowl In Fishbowl, students form concentric circles with a small group inside and a larger group outside. Students in the inner circle engage in an in-depth discussion, while students in the outer circle listen and critique content, logic, and group interaction. Level 1 – within group Level 2 – Among 2 group 4. Technical Group Presentation		
Module 3	Writing Reviews	4 Classes
5. Practice Worksheets Level 1 – Eliminating the Passive Voice Level 2 – Simple, compound and complex sentences 6. Writing Short Film Reviews		
Module 4	Starting your Career	6 Classes
7. Collaborative Project Job search and writing report Writing Resume		
Module 1-4	Academic Journal	2 Classes
8. Academic Journal Writing Level 1- Mid Term Level 2 – End Term		
Targeted Application & Tools that can be used: Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com		
Project work/Assignment:		
Academic Journal – Assignment In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.		
References <ol style="list-style-type: none"> 1. Hering, Heik. <i>How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation</i>. Springer. 2. Johnson, Richard. (2010) <i>Technical Communication Today</i>. Pearson, 2015 3. Rice B. Adelrod, Charles R. Cooper and Ellen C. Carillo. (2020) <i>Reading Critically Writing Well: A Reader and Guide</i>. Beford/St. Martin’s Macmillan Learning, New York. 		

4. The Princeton Review. (2010) <i>MCAT Verbal Reasoning & Writing</i> . The Princeton Review, Inc. 5. https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021 6. https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021
Topics Relevant to “employability”: Critical Reasoning, Presentation, Review Writing and Starting Career Topics Relevant to “Human Values and Professional Ethics”: Critical reasoning

Course Code: PPS2001	Course Title: Reasoning and Employment Skills Type of Course: Practical Only Course	L-P-C	0	2	1
Version No.	1.1				
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.				
Anti-requisites	NIL				
Course Description	The course is designed to introduce Engineering students to the importance of reasoning and develop their ability to identify problems, assess and arrive at an informed decision in various situations. The course will benefit learners in quick thinking and adapting and working in a team, handle conflict and think critically. This course is both conceptual and experiential in nature that would help the student to communicate effectively. After successful completion of the Course, the students would be able to participate in team activities effectively, reason and think critically, organize thoughts and express themselves confidently.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of “Reasoning & Employment Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.				

Course Out Comes	On successful completion of the course the students shall be able to: CO1: To demonstrate quick thinking skills CO2: To recognize the skills to work in a team CO3: To Define Conflicts Resolution			
Course Content:				
Module 1	Activity Based Learning – Let's Team Up	Practice & Feedback	Blooms Level - Application	4 Sessions
Topics: Significance of a Team, Characteristics of a Team, Stages of Team formation, Skills of an effective team player				
Module 2	Let's Patch Up Conflict	Practice &	Blooms Level - Application	6 Sessions

Course Code: CSE2067	Course Title: Web Technology Type of Course: Program core Theory Only	L- T- P- C	3	0	0	3
Version No.		2.0				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		This course highlights the basic web design using Hypertext Markup Language and Cascading Style Sheets. Students will be trained in planning and designing effective web pages by writing code using current leading trends in the web domain, enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia. The focus is on popular key technologies that will help students to build Internet- and web-based applications that interact with other applications and with databases.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.				
Course Outcomes		On successful completion of this course the students shall be able to: CO1: Implement web-based application using client-side scripting languages. (Application level)				

		CO2: Apply various constructs to enhance the appearance of a website. (Application level) CO3: Illustrate java-script concepts to demonstration dynamic web site (Application level) CO4: Apply server-side scripting languages to develop a web page linked to a database. (Application level)			
Course Content:					
Module 1	Introduction to XHTML	Quizzes and Assignments		Quizzes on various features of XHTML, simple applications	10 Sessions
	Topics: Basics: Web, WWW, Web browsers, Web servers, Internet. XHTML: Origins and Evolution of HTML and XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic Differences between HTML and XHTML.				
Module 2	Advanced CSS	Quizzes and assignments		Comprehension based Quizzes and assignments; Application of CSS in designing webpages	10 Sessions
	Topics: CSS: Introduction to CSS, Defining & Applying a style, Creating style sheets, types of style sheet, selectors, CSS font properties, border properties, Box model, opacity, CSS pseudo class and pseudo-elements. Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Responsive Design, CSS Frameworks XML: Basics, demonstration of applications using XML				
Module 3	Fundamentals of JavaScript	Quizzes and assignments		Application of JavaScript for dynamic web page designing	10 Sessions
	Topics: JavaScript: Introduction to JavaScript, Basic JavaScript Instructions, Functions, Methods & Objects, Decisions and Loops, Document Object Model, Event handling, handling window pop-ups, JavaScript validation.				
Module 4	PHP – Application Level	Quizzes and assignments		Application of PHP in web designing	15 Sessions
	Topics: PHP: Introduction to server-side Development with PHP, Arrays, \$GET and \$ POST, \$_Files Array, Reading/Writing Files, PHP Classes and Objects, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP.				
	Targeted Application & Tools that can be used: Xampp web server to be used to demonstrate PHP.				
	Project work/Assignment:				

	Assignments are given after completion of each module which the student need to submit within the stipulated deadline.
	Textbook(s): 1] Robert. W. Sebesta, " <i>Programming the World Wide Web</i> ", Pearson Education, 8th Edition, 2015. 2] <i>CSS Notes for Professionals</i> , ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022) 3] Deitel, Deitel, Goldberg, " <i>Internet & World Wide Web How to Program</i> ", Fifth Edition, Pearson Education, 2021.
	References 1] Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st. Edition.2016. 2] Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.
	Topics related to development of "FOUNDATION": 1. Web, WWW, Web browsers, Web servers, Internet. 2. CSS, PHP. 3. Designing for healthcare. for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout. E-References pu.informatics.global , https://sm-nitk.vlabs.ac.in/

Course Code: CHE1018	Course Title: Environmental Science Type of Course: School Core- Theory and Lab	L- T- P- C	1	0	2	2
		Contact hours	1	0	2	3
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education.					

	This course is designed to cater to Environment and Sustainability			
Course Objective	The objective of the course is to familiarize the learners with the concepts of “Environmental Science” and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1) Appreciate the historical context of human interactions with the environment and the need for eco-balance. 2) Describe basic knowledge about global climate change with particular reference to the Indian context. 3) Understand biodiversity and its conservation 4) Develop an understanding on types of pollution and ways to protect the environment 5) Learn about various strategies on Global environmental management systems 			
Course Content:				
Module 1	Humans and the Environment	Assignment	Data Collection	01 class
Topics: The man-environment interaction; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment.				
Self-learning topics: Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Environmental Ethics and emergence of environmentalism.				
Module 2	Natural Resources and Sustainable Development	Assignment		03 Classes
Topics: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. Water resources: Types of water resources- fresh water and marine resources; Soil and mineral resources: Important minerals; Mineral exploitation Soil as a resource and its degradation. Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages.				
Self-learning topics: Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)- targets, indicators, and challenges for SDGs.				
Module 3	Environmental Issues: Local, Regional and Global	Case study		02 Classes

Topics: Environmental Pollution: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans- boundary air pollution; Acid rain; Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change Self-learning topics: Environmental issues and scales					
	Module 4	Conservation of Biodiversity and Ecosystems	Assignment		02 Classes
Topics: Biodiversity -Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities. Self-learning topics: Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.					
	Module 5	Environmental Pollution and Health	Case study		02 Classes
Topics: Pollution, Definition, point and nonpoint sources of pollution, Air pollution - sources, major air pollutants, health impacts of air pollution. Water pollution – Pollution sources, adverse health impacts on human and aquatic life and mitigation, Water quality parameters and standards. Soil pollution and solid waste - Soil pollutants and their sources, solid and hazardous waste, Impact on human health. Self-learning topics: Noise pollution, Thermal and radioactive pollution.					
	Module 6	Climate Change: Impacts, Adaptation and Mitigation	Assignment/case		02 Classes
Topics: Understanding climate change: Natural variations in climate; Projections of global climate change with special reference to temperature, rainfall and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Impacts Vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Indigenous knowledge for adaptation to climate change. Self-learning topics: Mitigation of climate change: Synergies between adaptation and mitigation measures; National and international policy instruments for mitigation.					
	Module 7	Environmental Management	Case study	Data analysis	02 Classes
Topics: Environmental management system: ISO 14001; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability. Self-learning topics: Environmental audit and impact assessment; Eco labeling /Eco mark scheme					
	Module 8	Environmental Treaties and Legislation	Case study	Data analysis	01 Classes

<p>Topics: Major International Environmental Agreements: Convention on Biological Diversity (CBD), Major Indian Environmental Legislations: Environmental Protection Act, Forest Conservation Act, Public awareness.</p> <p>Self-learning topics: Paris Agreement, Conference of the Parties (COP), India's status as a party to major conventions: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act.</p>
<p>List of laboratory tasks : Any eight experiments will be conducted</p> <ol style="list-style-type: none"> 1. Determination of total alkalinity of a water sample (knowledge) 2. Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive) 3. Estimation of copper from industrial effluents by colorimetric method (Comprehensive) 4. Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive) 5. Estimation of nickel from industrial effluents by titrimetric method (Comprehensive) 6. Estimation of chloride in drinking water by titrimetric method (Comprehensive) 7. Estimation of fluoride in ground water by colorimetric method (Comprehensive) 8. Determination of calcium in aqueous solution (Comprehensive) 9. Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge) 10. Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive) 11. Biological oxygen demand of waste water sample (Comprehensive) 12. Determination of dissolved oxygen of an industrial effluent (Comprehensive) 13. Quality monitoring analysis of a soil sample (knowledge) 14. Flame photometric estimation of Sodium and potassium (Application) 15. Gas Chromatographic analysis of volatile organic compounds (Application)
<p>Targeted Application & Tools that can be used: Application areas are Energy, Environment and sustainability Tools: Statistical analysis of environmental pollutants using excel, origin etc.</p>
<p>Project work/Assignment:</p>
<p>Assessment Type</p> <ul style="list-style-type: none"> • Midterm exam • Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.) • Lab evaluation/Assignment • End Term Exam • Self-learning <p>Assignment 1: Write a Statement of Environment report of your town/city/state/country</p>
<p>Assignment 2: Individual students will carry out the analyses of polluted solid, liquid, and gaseous samples and propose suitable mitigation measures. A detailed and in-depth report needs to be submitted for each case. This may include preparation of reagents, sample preparation (extraction), chemical analysis carried out, instruments and tools used, data collected and processed, inferences made and conclusions arrived at. Necessary support is given in the form of lab manual and reference links to e-books.</p>

Text Book

1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
2. Krishnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.
3. Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

Reference Books

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.
3. Sinha N., (2020) Wild and Wilful. Harper Collins, India.
4. www.ipcc.org; <https://www.ipcc.ch/report/sixth-assessment-report-cycle/>
5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
6. Richard A. Marcantonio, Marc Lane (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

E-resources:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_18126
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_8761
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AJ_1_02082022_3333
4. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_3063
5. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_20719
6. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_16824
7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_3954
8. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DO_AB_1_06082022_491
9. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CU_STOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488
10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CU_STOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583
11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SP_RINGER_INDEST_1_171
12. <https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&t=1687427221129>
13. <https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&t=1687427279979>
14. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TE_XTBOOK_LIBRARY01_06082022_395&xIndex=4
15. <https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf>

Topics relevant to Skill Development:

Industrial revolution and its impact on the environment, Environmental impact of over-exploitation of water resources, pollution and ill effects, lab experiments for Skills development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.

All topics in theory component are relevant to Environment and Sustainability.

Course Code: CSE 1002	Course Title: Innovation Project-Arduino Using Embedded C		L-T-P- C	0	0	4	2
	Type of Course: School Core & Practical Only.						
Version No.		1.0					
Course Pre-requisites		NIL					
Anti-requisites		NIL					
Course Description		In this course the students will learn fundamental concepts of 'C' and Embedded C, problem solving using C in a systematic way to read and write the C code and to implement them on Arduino prototype board. The course will also demonstrate how to assemble various sensory devices and program them using Arduino platform as a basis. Students will have the opportunity of gaining real-world experience in handling IoT devices involving hardware and software combinations. The course also offers in-depth knowledge of designing, developing, coding and implementing Arduino projects.					
Course Outcomes		On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1) Acquire the knowledge on Arduino programming language and IDE using Embedded C 2) Understand the main features of the Arduino prototype board 3) Illustrate the hardware interfacing of the peripherals to Arduino system. 4) Demonstrate various projects using Arduino system. 					
Course Content:							
Module 1	Basics of C, Branching and looping	Quiz		Problem Solving		9 CLASSES	

	Topics: Structure of C programs, Variables, Keywords, Datatypes, declaration and Initialization Decision Making and Branching: if, if-else, else-if ladder, switch statement. Decision making and looping: for, while, and do-while statements.				
Module 2	Arrays, functions ,strings	Quiz		Problem Solving	8 CLASSES
	Topics: Arrays: Introduction ,one dimensional array, two dimensional array, Functions: User defined functions, Categories, searching and sorting Strings: Introduction, string handling functions.				
Module 3	Basic concepts of Arduino	Project Development		System Design Task and Analysis	7 CLASSES
	Topics: Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, API's , Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables, Arduino i/o Functions, Arduino Communications, Arduino IDE, Various Cloud Platforms.				
Module 4	Sensory Devices	Project Development		Modeling and Simulation task	6 CLASSES
	Topics: Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor ,Connecting Switches and actuators , sensor interface with Arduino. Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications. Introduction to online Simulators: Tinkercad Simulators and Proteus Android/case study				
	Targeted Application & Tools that can be used: Making it a reality (Arduino Projects) : Projects will include but not limited to : 1) Intelligent home locking system. 2) Intelligent water level management system. 3) Home automation using RFID. 4) Real time clock-based home automation. 5) Intelligent Automatic Irrigation System Professionally Used Software: Arduino IDE.				
	Project work/Assignment/Quiz:				

•	<ul style="list-style-type: none"> • Quiz1- Fundamentals of C-Programs, • Quiz2- Basics of Embedded C and Arduino • Project work
	Text Book(s): 1) E Balagurusamy “ <i>Programming in ANSI C</i> ”, Mc Graw Hill Publications, 7 th Edition. 2) Monk Simon “ <i>Programming Arduino: Getting Started with Sketches</i> ”, Mc Graw Hill Publications Second Edition.
	Reference(s): 1) https://www.tutorialspoint.com/arduino/index.html . 2) https://create.arduino.cc/projecthub/projects/tags/sensor . 3) https://3dprinting.com/what-is-3d-printing .
	Topics relevant to development of “ Foundation SKILLS”: Basic Concepts of C-Programming. Topics related to development of “Creative Thinking”:
Evaluation:	Review-1-10%, Review-2-20%, Review-3-20%, online quiz-30%, Project Expo-20%

Course Code: MAT1002	Course Title: Transform Techniques, Partial Differential Equations and Their Applications Type of Course: School Core	L-T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	MAT1001 - Linear Algebra and Calculus					
Anti-requisites	NIL					
Course Description	This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solution of difference equations using z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations.					
Course Objective	The objective of the course is <u>Skill Development</u> of student by using <u>Problem Solving Techniques</u> .					
Course Outcomes	On successful completion of this course the students shall be able to: CO-1: Express functions in terms of uniformly convergent Fourier series. CO-2: Apply Laplace transform technique to solve differential equations. CO-3: Employ z-transform technique to solve difference equations. CO-4: Solve a variety of partial differential equations analytically.					
Course Content:						
Module 1	Fourier Series					10 CLASSES

<p>Fourier series: Fourier series - Euler's formulae - Dirichlet's conditions - Change of Interval - half range series – RMS value – Parseval's identity – Computation of harmonics. Engineering Applications of Fourier series.</p>				
Module 2	Integral Transforms			15 Classes
<p>Laplace Transform: Definition and Laplace transforms of elementary functions. Properties of Laplace transform. Laplace transform of periodic function, unit-step function and impulse function and the related problems. Inverse Laplace transform of standard functions and problems, initial and final value theorems. Convolution theorem, solution of linear ordinary differential equations, LCR circuit problems.</p> <p>Fourier Transform: Integral transforms, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms. Engineering Applications of Fourier transform.</p>				
Module 3	Z Transform and Difference Equations			8 Classes
<p>Definition of Z-transform, Z transforms of standard functions and the related problems, standard inverse Z transforms and problems, computation of inverse Z-transform by partial fraction and convolution methods, solution of difference equations using Z-transforms. Business and Engineering Applications of Z transform.</p>				
Module 4	Partial Differential Equations			12 Classes
<p>Partial Differential Equations: Formation of PDEs, solution of non-homogeneous PDEs by direct integration, solution of homogeneous PDEs involving derivatives with respect to only one independent variable, method of separation of variables, solution of the Lagrange's PDE of the type $Pp + Qq = R$.</p> <p>Applications of PDEs: Various possible solutions of the one dimensional wave and heat equations by the method of separation of variables, D'Alembert's solution of the wave equation, solution of related boundary value problems.</p>				
<p>Targeted Applications & Tools that can be used: Applications to electrical engineering, vibrational analysis, acoustics, optics, signal processing, image processing, quantum mechanics, econometrics and shell theory by means of Fourier Series and integral transforms. Opens up new approaches in terms of Z-transform to solving one of the central problems of modern science involving difference equations. Finding the solutions of boundary value problems involving PDEs with reference to wave, heat, and Laplace equations.</p>				

Assignment: Mention the Type of Project /Assignment proposed for this course
Two Assignments based on the applications of the concepts leading to a minimum of 5 engineering problems from a common pool of problems.
Text Book 1. Erwin Kreyszig, 2017: “ Advanced Engineering Mathematics”, 10th Edition, John Wiley.
References: 6. B. S. Grewal, 2017: “Higher Engineering Mathematics” 45th Edition, Khanna Publishers. 7. Peter V O'Neil, 2015: “Advanced Engineering Mathematics”, 7th Edition, Cengage Learning. 8. Glyn James, 2016: “Advanced Modern Engineering Mathematics”, 4th Edition, Pearson Education. 9. Michael D. Greenberg, 2018: “Advanced Engineering Mathematics”, 2nd Edition, Pearson Education.
Topics relevant to the development of Foundation Skills: All the solution methods. Topics relevant to development of Employability skills: Use of relevant scientific application packages.

Course Code: CSE 2001	Course Title: Data Structures and Algorithms Type of Course: Integrated	L- P- C	3	2	4
Version No.	1.0				
Course Pre-requisites	Problem Solving Using Java				
Anti-requisites	NIL				
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.				
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques				

Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1: Describe and interpret key data structures and basic algorithms, including their operations and performance analysis [Understand]</p> <p>CO2: se stacks, queues, and arrays to solve practical problems. [Apply]</p> <p>CO3: Utilize single and circular linked lists, along with recursion, to address the given scenario. [Apply]</p> <p>CO4: Apply an appropriate non-linear data structure for a given scenario.[Apply]</p> <p>CO5: Calculate the time and space complexity of the searching and sorting algorithms in different scenarios.[Apply]</p>			
Course Content:				
Module 1	Introduction to Data Structure and Linear Data Structure – Stacks and Queues	Assignment	Program activity	22 Hours
<p>Introduction – Introduction to Data Structures, Types and concept of Arrays.</p> <p>Stack - Concepts and representation, Stack operations, stack implementation using array and Applications of Stack.</p> <p>Queues - Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.</p>				
Module 2	Linear Data Structure- Linked List	Assignment	Program activity	22 Hours
<p>Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list.</p> <p>Recursion - Recursive Definition and Processes, Programming examples.</p>				
Module 3	Non-linear Data Structures - Trees and Graph	Assignment	Program activity	18 Hours

Topics: Trees - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post - Order traversal. Graph - Basic Concept of Graph Theory and its Properties, Representation of Graphs.				
Module 4	Searching & Sorting Performance Analysis	Assignment	Program activity	13 Hours
Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort. Performance Analysis - Time and space analysis of algorithms – Average, best and worst case analysis.				
List of Laboratory Tasks: Lab sheet -1 Level 1: Prompt the user, read input and print messages. Programs using class, methods and objects Level 2: Programming Exercises on fundamental Data structure - Arrays based on Scenario. Lab sheet -2 Level 1: Programming Exercises on Stack and its operations Level 2: Programming Exercises on Stack and its operations with condition Lab sheet -3 Level 1: Programming on Stack application infix to postfix Conversion Level 2: - Lab sheet -4 Level 1: Programming on Stack application – Evaluation of postfix Lab sheet -5 Level 1: Programming Exercises on Queues and its operations with conditions Level 2: - Lab sheet -6 Level 1: Programming Exercises on Linked list and its operations. Level 2: Programming Exercises on Linked list and its operations with various positions Lab sheet -7 Level 1: Programming Exercises on Circular Linked list and its operations. Level 2: Programming Exercises on Circular Linked list and its operations with various positions Lab sheet -8 Level 1: Programming Exercises on factorial of a number Level 2: Programming the tower of Hanoi using recursion Lab sheet -9 Level 1: - Level 2: Programming the tower of Hanoi using recursion Lab sheet -10 Level 1: Programming Exercise on Doubly linked list and its operations				

<p>Level 2: -</p> <p>Lab sheet -11</p> <p>Level 1: Program to Construct Binary Search Tree and Graph</p> <p>Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and post-order) and implement BFS and DFS</p> <p>Lab sheet -12</p> <p>Level 1: Program to Implement the Linear Search & Binary Search</p> <p>Level 2: Program to Estimate the Time complexity of Linear Search</p> <p>Lab sheet -13</p> <p>Level 1: Program to Implement and Estimate the Time complexity of Selection Sort</p> <p>Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort</p> <p>Lab sheet -14 (Beyond syllabus activity)</p> <p>Level 1: Program to Construct AVL Tree</p> <p>Level 2:</p> <p>Lab sheet -15 (Beyond syllabus activity)</p> <p>Level 1: Program to Construct RED BLACK Tree</p>
<p>Targeted Application & Tools that can be used</p> <p>Use of PowerPoint software for lecture slides and use of Modern IDE like VS Code and Eclipse for lab programs to execute.</p>
<p align="center">Project work/Assignment:</p>
<p>Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.</p>
<p>Text Book</p> <p>T1 Narasimha Karumanchi: <i>“Data Structures and Algorithms Made Easy in Java”</i>, 5th Edition, CareerMonk Publications, 2017.</p> <p>T2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: <i>“Data Structures and Algorithms in Java”</i>, 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014.</p>
<p>References</p> <p>R1 Mark Allen Weiss: <i>“Data Structures and Algorithm Analysis in Java”</i>, 4th Edition, Pearson Educational Limited, 2014.</p> <p>R2 Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: <i>“Introduction to Algorithms”</i>, 3rd Edition, PHI Learning Private Limited.</p> <p>Web resources:</p> <ol style="list-style-type: none"> 1. For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview 2. https://puniversity.informaticsglobal.com/login
<p>Topics relevant to development of “Skill Development”:</p> <p>Linked list and stacks</p>

Topics relevant to development of “Environment and sustainability: Queues

Course Code: ECE2007	Course Title: Digital Design Type of Course: Theory &Integrated Laboratory	L- T-P- C	2	0	2	3
Version No.	2.0					
Course Pre-requisites	[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra					
Anti-requisites	NIL					
Course Description	<p>The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.</p> <p>The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.</p>					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: i. Describe the concepts of number systems, Boolean algebra and logic gates. ii. Apply minimization techniques to simplify Boolean expressions. iii. Demonstrate the Combinational circuits for a given logic iv. Demonstrate the Sequential and programmable logic circuits v. Implement various combinational and sequential logic circuits using gates.					
Course Content:						
Module 1	Fundamentals of Number systems- Boolean algebra and digital logic	Application Assignment	Data Analysis task		10 classes	
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations. Introduction to HDL.						
Module 2	Boolean function simplification	Application Assignment	Data Analysis task		10 Classes	
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.						

Module 3	Combinational Logic circuits:	Application Assignment	Programming Task & Data Analysis task	10 Classes
<p>Topics: Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters. HDL Models of Sequential circuits.</p>				
<p>List of Laboratory Tasks: Experiment N0 1: Verify the Logic Gates truth table Level 1: By using Digital Logic Trainer kit Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs</p> <p>Experiment No. 2: Verify the Boolean Function and Rules Level 1: By using Digital Logic Trainer kit Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs</p> <p>Experiment No. 3: Design and Implementations of HA/FA Level 1: By using basic logic gates and Trainer Kit Level 2: By using Universal logic gates and Trainer Kit</p> <p>Experiment No. 4: Design and Implementations of HS/FS Level 1: By using basic logic gates and Trainer Kit Level 2: By using Universal logic gates and Trainer Kit</p> <p>Experiment No. 5: Design and Implementations of combinational logic circuit for specifications Level 1: Specifications given in the form of Truth table Level 2: Specification should be extracted from the given scenario</p> <p>Experiment No. 6: Study of Flip flops</p> <p>Experiment No. 7: Design and Implementations of sequential logic circuit for specifications Level 1: Specifications given in the form of Truth table Level 2: Specification should be extracted from the given scenario</p> <p>Experiment No.8: HDL coding for basic combinational logic circuits Level 1: Gate level Modeling Level 2: Behavioral Modeling</p> <p>Experiment No.9: HDL coding for basic sequential logic circuit Level 1: Gate level Modeling Level 2: Behavioral Modeling</p>				
<p>Targeted Application & Tools that can be used:</p> <p>Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, Home Automation, Communication in systems in industries</p>				

<p>Professionally Used Software: HDL/VHDL/Verilog HDL/ OOPS</p>
<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. Mano, M. Morris and Ciletti Michael D., “<i>Digital Design</i>”, Pearson Education, 6th edition 2. Thomas L. Floyd “DIGITAL LOGIC DESIGN”, Pearson Education, fourth edition.
<p>Reference(s):</p> <p>Reference Book(s):</p> <p>R1. Jain, R. P., “<i>Modern Digital Electronics</i>”, McGraw Hill Education (India), 4th Edition</p> <p>R2. Roth, Charles H., Jr and Kinney Larry L., “<i>Fundamentals of logic Design</i>”, Cengage Learning, 7th Edition</p> <p>Online Resources (e-books, notes, ppts, video lectures etc.): <u>Book Free Download (studymaterialz.in)</u></p> <ol style="list-style-type: none"> 1. eBook1: Mano, M. Morris and Ciletti Michael D., “<i>Digital Design</i>”, Pearson Education. 2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download } 3. eBook2:Floyd “DIGITAL LOGIC DESIGN” fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD abri.engenderhealth.org. 4. NPTEL Course- <u>NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits</u> 5. Digital Logic Design PPT <u>Slide 1 (iare.ac.in)</u> 6. Lab Tutorial: <u>Multisim Tutorial for Digital Circuits - Bing video</u> <p><u>CircuitVerse - Digital Circuit Simulator online</u></p> <p><u>Learn Logisim ➡ Beginners Tutorial Easy Explanation! - Bing video</u></p> <p><u>Digital Design 5: LOGISIM Tutorial & Demo</u></p> <p>7. https://presiuniv.knimbus.com/user#/home</p> <p>E-content:</p> <ol style="list-style-type: none"> 1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168. 2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMura2010 13th International Conference on Computer and Information Technology (ICCIT) 3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029. 4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," 2019 IEEE East-West Design & Test Symposium (EWDTS), 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.
<p>Topics relevant to “SKILL DEVELOPMENT”: Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 2014	Course Title: Software Engineering Type of Course: School Core [Theory Only]	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	<p>The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles.</p> <p>The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development.</p> <p>The course covers software quality, configuration management and maintenance.</p>					
Course Objectives	<p>The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Participative Learning techniques.</p>					
Course Out Comes	<p>On successful completion of this course the students shall be able to:</p> <p>1] Describe the Software Engineering principles, ethics and process models(Knowledge)</p> <p>2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension)</p> <p>3] Understand the Agile Principles(Knowledge)</p> <p>4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application)</p>					
Module 1	Introduction to Software Engineering and Process Models (Knowledge level)	Quiz				09 Hours
<p>Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle</p> <p>Models: Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.</p>						
Module 2	Software Requirements, Analysis and Design (Comprehension level)	Assignment	Development of SRS documents for a given scenario			11 Hours
<p>Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, Software Requirements Specification (SRS), Requirement Analysis and validation. Requirements modelling- Introduction to Use Cases, Activity diagram and Swim lane diagram. CASE support in Software Life Cycle, Characteristics of CASE Tools, Architecture of a CASE Environment.</p> <p>Design: Design concepts, Architectural design, Component based design, User interface design.</p>						
Module 3	Agile Principles & Devops (Knowledge level)	Quiz				09 Hours

Agile: Scrum Roles and activities, Sprint Agile software development methods - Scaling, User Stories, Agile estimation techniques, Product backlogs, Stake holder roles, Dynamic System Development Method. Devops: Introduction, definition, history, tools.				
Module 4	Software Testing and Maintenance (Application Level)	Assignment	Apply the testing concepts using Programing	12 Hours
Software Testing -verification and validation, Test Strategies - White Box Testing, Black box Tes Automation Tools for Testing. Software Quality Assurance -Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management- SCM process, SCM Tools (GitHub). Maintenance - Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models.				
Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
Text Book 1] Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, VII Edition, McGraw-Hill, 2017. 2] Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, VI Edition, Graw-Hill, 2018.				
References Rajib Mall, “Fundamentals of Software Engineering”, VI Edition, PHI learning private limited, 5. Ian Sommerville, “Software Engineering”, IX Edition, Pearson Education Asia, 2011. Agile Software Development Principles, Patterns and Practices.1 st Edition, Wiley, 2002				
Topics Relevant to “Skill Development: Balck box Testing, White box Testing, Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout				

Course Code: CSE2018	Course Title: Theory of Computation	L- T- P-C	3	0	0	3
Type of Course: Program Core & Theory only						
Version No.	2.1					
Course Pre-requisites	MAT 2004 - Discrete Mathematical Structures					
Anti-requisites	NIL					
Course Description	The purpose of Theory of Computation Course is to enable the students to appreciate the study of formal language and the correspondence between language classes and the automata that is recognized. Analytical ability is required					

	for the students to analyze and develop automata. The course is both conceptual and analytical in nature. It imposes fair knowledge of Mathematical and computing fundamentals. The course develops the critical thinking and analytical skills. The simulation using JFLAP makes the student to visualize the automata construction and string parsing. The assignment work given based on simulation helps the students to build any context free grammar and Turing Machine for the Language.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Computational, language models and attain employability through Participative Learning techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Discuss the basic concepts of Automata theory and its applications. [Understand] CO2: Construct different types of Finite Automata with its simulation. [Apply] CO3: Develop the Simplified Grammars in CNF and GNF forms. [Apply] CO4: Solve the Push Down Automata and Turing machine problems for a given language. [Apply]			
Course Content:				
Module 1	Introduction to Automata Theory	Assignment	Problem Solving	06 Sessions
Topics: Introduction to Automata Theory, Basic definitions: Languages, grammar and automata, Representation of automata, Language recognizers, Applications of Automata Theory.				
Module 2	Finite Automata	Assignment	Problem Solving	14 Sessions
Topics: Basic concepts of Finite automata, DFA -Definitions of DFA, Deterministic Accepters Transition Graphs , Languages and DFA's, Regular Languages, NFA- Definition of a Non deterministic Acceptor, Languages and NFA's, Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata, ϵ -NFA - Definition of ϵ -NFA, Conversion of ϵ -NFA to DFA.				

Module 3	Regular Expressions & Context Free Grammar	Assignment	Problem Solving	13 Sessions
Topics: Formal Definition of a Regular Expression, Connection between Regular Expressions and Regular Languages: Regular Expressions denote Regular Languages; Pumping Lemma for regular languages, Context Free Grammars- Examples of Context-Free Languages, Left most and Right most Derivations, Derivation Trees, Ambiguity in Grammars, Pumping lemma for CFL, Grammar Simplification, CNF and GNF.				
Module 4	Push down Automata and Turing Machine	Assignment	Problem Solving	12 Sessions
Topics: Definition of a Pushdown Automaton, Language Accepted by a Pushdown Automaton, Pushdown Automata for Context-Free Languages, Deterministic Pushdown Automata, Definition of a Turing Machine, Turing Machines as Language Accepters. Assignment: Solve Different FA Design Techniques to solve various problems to construct FA (any 3 may be included)				
Targeted Application: Application Area is to Design and Analyzing the efficiency of compilers. This fundamental course is used by all application developers.				
Project work/Assignment:				
Problem Solving: Design different FA Design techniques, Regular Expressions				
Text Book: 1. Peter Linz, “An introduction to Formal Languages and Automata”, 6th Edition, Jones and Bartlett Publications, 2018.				
References 1. Aho, Ullman and Hopcroft, “Theory of Computation”, 3rd Edition, Pearson India, 2008 2. Michael Sipser, “Theory of Computation”, 3rd Edition, Cengage India, 2014 3. NPTEL Link- https://onlinecourses.nptel.ac.in/noc21_cs83/preview 4. JFLAP simulator - https://www.jflap.org/jflaptmp/				

Course Code: CSE 2066	Course Title: Computer Graphics	L-T-P-C	3	0	0	3
Version No.	1.3					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this introductory course is to discuss the basics of graphics and visualization in computer science, enabling students to appreciate how the computer system displays graphics and visual effects on a display device.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Graphics and attain SKILL DEVELOPMENT through PARCITIPATIVE LEARNING techniques.					
Course Out Comes	On successful completion of the course the students shall be able to:		Expected BLOOMS LEVEL			
	CO 1: Apply mathematical expressions for drawing basic primitives like Point, Line and Polygon CO 2: Illustrate 2D Geometric Transformations, viewing and clipping CO 3: Explain 3D Geometric Transformations, viewing and clipping CO 4: Describe planes, Bezier curves and Bezier surfaces		Apply Apply Understand Remember			
Course Content:						
Module 1	Overview: Basics of Computer Graphics:	Assignment	No. of Classes: 15			
An Introduction to Graphics System : Computer Graphics and Its Types, Application of computer graphics, Graphics Systems : Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors and Work Stations, Input Devices, Graphics tools and software. Mathematics for Computer Graphics: Introduction to linear algebra, Matrix, Matrix Equations, Linear equation, Quadratic equation, Calculus, differential geometry. Line drawing algorithms (DDA, Bresenham's), circle generation algorithms (Bresenham's), Basics of 2D and 3D objects. Assignment: Numerical problems based on Matrix equations, Linear equation, Quadratic equation, Calculus, differential geometry.						
Module 2	2D Geometric Transformations, viewing and clipping:	Assignment	No. of Classes : 10			

2D Geometric Transformations: Homogeneous coordinates for translation, scaling and rotation. 2D Composite transformations, General pivot point rotation and scaling. Basics of 2D viewing and Clipping: Basics of viewing and Clipping, 2D viewing pipeline, Viewing Transformation systems, Types of clipping: point, Line and polygon clipping, 2D line clipping algorithms: Cohen-Sutherland and Liang Barsky line clipping, polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm.			
Module 3	3D Geometric Transformations, viewing and clipping:	Assignment	No. of Classes : 10
3D Geometric Transformations: 3D translation, rotation, scaling, composite 3D transformations. Basics of 3D Viewing and Clipping: 3D viewing concepts, 3D viewing coordinate parameters, Transformation from world to viewing coordinates, Projection transformation, orthogonal projections, perspective projections, Three-dimensional line and polygon clipping. Assignment: Numerical problems based on 2D and 3D transformations.			
Module 4	Plane curves and surfaces	Assignment	No. of Classes : 10
Plane Curves: Plane Curves representation, Nonparametric Curves, Parametric Curves, Parametric Representation of a Circle, Parametric Representation of an Ellipse, Parametric Representation of a Parabola, Parametric Representation of a Hyperbola, A Procedure for using Conic Sections, The General Conic Equation Basics of Surfaces Curve: Representation of Space Curves, Cubic Splines, Bezier Curves, Parametric Cubic Curves, Quadric Surfaces, Bezier Surfaces.			
Targeted Application & Tools that can be used: Application Area: Game design and Animation Tools/Simulator/Software used: Visual Studio 17.0 , OpenGL			
Text Book: T1: Donald D. Hearn, M. Pauline Baker and Warren Carither, Computer Graphics with OpenGL, Pearson Education, 4th Edition, 2016.			
Reference Books: R1. John F Hughes, Andries van Dam, Steven K. Feiner, James D. Foley, Morga, Computer Graphics: Principles and Practice, Pearson Education India, Third Edition, 2013 R2. John Kessenich, Graham Sellers, Dave Shreiner , OpenGL Programming guide , Addison-Wesley Ninth Edition,2016 R3. Edward Angel and Dave shreiner, Interactive Computer Graphics, A top down approach with shader based OpenGL, Pearson Education, 6th Edition, 2018			

Course Code: CSE2027	Course Title: Fundamentals of Data Analytics Type of Course: Theory only			L- T-P- C	3	0	0	3
Version No.		2.0						
Course Pre-requisites		NIL						
Anti-requisites		NIL						
Course Description		Fundamentals of Data Analytics is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an intuitive way to analysis the data. This course will help the students to apply the knowledge on data analysis to a wide range of applications.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Fundamentals of Data Analytics and attain SKILL DEVELOPMENT through PROBLEM SOLVING Methodologies.						
Course Out Comes		On successful completion of the course the students shall be able to: 1) Explain different types of data and variables. 2) Interpret data using appropriate statistical methods. 3) Demonstrate the collection, processing and analysis of data for any given application and Illustrate various charts using visualization methods. 4) Apply the Data Analysis techniques by MAT Lab						
Course Content:								
Module 1	Introduction to Data Analysis	Assignment		Data Collection , data analysis	6 Sessions			
	Topics: Introducing Data, overview of data analysis: Data in the Real World, Data vs. Information, The Many “Vs” of Data, Structured Data and Unstructured Data, Types of Data, Data Analysis Defined, Types of Variables, Central Tendency of Data, Scales of Data, Sources of Data, Data preparation: Cleaning the data, Removing variables, Data Transformations.							
Module 2	Statistical functions	Assignment		Data analysis	7 Sessions			
	Topics: Descriptive Statistics, Inferential Statistics (T test, Z test,), Probability Uses In Business and Calculating Probability from a Contingency Tables.							
Module 3	Data Collection, Processing and Analysis	Project based MAT Lab		MAT LAB	6 Sessions			
	Topics: Collection of Primary Data(Observation Method, Interview Method, Collection of Data through Questionnaires ,Collection of Data through Schedule) Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data ,Difference between Survey and Experiment Processing Operations, correlation.							

Introduction: Overview, Classification, Regression, Building a prediction model					
Module 4	Data Visualization and Charting Prediction	Project MAT Lab		Data Collection, visualization and data analysis	6 Sessions
Topics: Types of charts and their significance, Organize data interactively with tables , Visualizing data with charts, Analyzing data with pivot tables, Build presentation ready dashboards and turn real world data into business insights, Tracking trends and making forecasts, Interpretation and report writing					
Module 5	Introduction to MATLAB	Project MAT Lab		Data analysis with optimization	10 Sessions
Topics: Defining Categories of Data, Analyzing Groups within Data, Importing Data from Multiple Files, Review Project ,Images and 3-D Surface Plots, Importing Unstructured Data					
Targeted Application & Tools that can be used: Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc... MAT Lab					
Text Books <ol style="list-style-type: none"> 1. Glenn J. Myatt and Wayne P. Johnson, “Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback”, Import, 22 July 2014. 2. William Menke And Joshua Menke,”Environmental Data Analysis with MAT Lab”, Elsevier, 2012. 3. https://matlabacademy.mathworks.com/details/matlab-for-data-processing-and-visualization/mlvi 					
References <ol style="list-style-type: none"> 1. Paul McFedries , “Excel Data Analysis-visual blue print”,Wiley 4th Edition September 2019. 2. Gerald Knight, “Analyzing Business Data with Excel”,O'Reilly; 1st Edition,13 January 2006. 3. https://people.highline.edu/mgirvin/AllClasses/348/348/AllFilesBI348Analytics.htm 4. Hansa Lysander,”Data Analysis and business modelling using Microsoft Excel”, PHI, 2017. <p>Web Links: https://presiuniv.knimbus.com/user#/home </p>					
Topics relevant to development of “FOUNDATION SKILLS”: <ol style="list-style-type: none"> 1. Statistical Concepts for data, visualization techniques. 2. Data collection for project based assignments. 3. Inferential Statistics (T test, Z test) 4. Probability Calculation for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.					

Course Code: MAT2003	Course Title: NUMERICAL METHODS FOR ENGINEERS			L-T-P-C	1	0	2	2
	Type of Course: School Core							
Version No.	1.0							
Course Pre-requisites	MAT1002 – Transform Techniques, Partial Differential Equations and Their Applications							
Anti-requisites	Nil							
Course Description	The course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration. This course also deals with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of “ NUMERICAL METHODS FOR ENGINEERS” and attain <u>Skill Development Through Problem Solving.</u>							
Course Outcomes	On successful completion of the course the students shall be able to: 1] Solve algebraic and transcendental equations numerically. 2] Adopt numerical techniques to differentiate and integrate functions. 3] Apply numerical methods to solve ordinary differential equations.							
Course Content:								
Module 1	Numerical solution of Algebraic and Transcendental Equations							15 Classes
Algebraic and Transcendental Equations, Regula - Falsi method, Bisection method (Self study), Secant method, Newton-Raphson method, and NR method for non-linear Equations, Fixed-point iteration method. System of Linear Equations: Introduction, LU decomposition method, Gauss-Jacobi method, Gauss-Seidel iteration method, Largest Eigen value and corresponding Eigen vector by Power method & Jacobi Method.								
Module 2	Numerical Interpolation,							15 Classes

	differentiation and Integration			
<p>Numerical Interpolation: Newton's forward and backward interpolation method, Newton's divided difference method, Lagrange's method, numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's Rule.</p> <p>Area between the two curves.</p>				
Module 3	Numerical solution of ODEs and PDEs			15 Classes
<p>Solution of ordinary differential equations: Initial Value problems: Taylor's series method, Picard's method, Euler's Method, Modified Euler's method, Runge-Kutta method, Milne's predictor-corrector formula. Adams -Bashforth method, Boundary value problems - Finite difference methods for ODE. Numerical solution for LCR & damped forced oscillatory equations.</p> <p>Solution of partial differential equations: Schmidt Explicit Formula for Heat Equation, Crank-Nicolson method. Numerical solution to Wave, Laplace & Heat Equation.</p>				
<p>Targeted Application & Tools that can be used:</p> <p>The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics so as to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.</p>				
<p>Assignment:</p> <ol style="list-style-type: none"> 1. Gauss-Jacobi iteration method. 2. Numerical differentiation. 3. Gaussian quadrature rule for numerical integration. 4. Taylor series method for ODEs. 5. Implicit and explicit schemes for PDEs. 				
<p>Text Books</p> <p>T1: M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, 6th Edition, New age Publishing House, 2015.</p> <p>T2: Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons (India), 2014.</p>				
<p>References:</p> <p>R1: B.S. Grewal, Numerical methods in engineering and science, 10th Edition, Khanna publishers, 2016.</p> <p>R2: B.S. Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publishers.</p> <p>R3: Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers," 7th Ed., McGraw-Hill Edition, 2015.</p> <p>R4: C. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill, 2012.</p>				

Topics relevant to SKILL DEVELOPMENT: This course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE3146	Course Title: Advanced Java Programming Type of Course: 1] School Core 2] Laboratory integrated	L- T- P- C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	[1] Problem Solving Using Java (CSE1001) [2] Database Management System (CSE2074) [3] Web Technology (CSE2006) Basic Knowledge about DBMS, Knowledge on Core Java (OOPs Principles), Client-server Architecture, HTML					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students to Java Advanced API enhanced by Design Patterns and SOLID Principles. The course is both conceptual and analytical and is understood with JDK 8 software & IntelliJ IDE. This course develops critical thinking skills by augmenting the student's ability to develop distributed model for control of various modern management systems like banking management system, student information management system, , Library Management System etc. <i>with</i> the necessary API for communication with database enhanced by the current industrial approach of Java's SOLID principle and design patterns. This course also involves essential core java concepts like multithreading, file handling, event handling etc.					
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques. Please add as per what the course covers in the criteria1 NAAC Template.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the benefits of Design-Pattern & SOLID principle in java based applications. 2. Understand Concurrent Programming using Java Multi-Threading. 3. Apply Communication mechanisms of Java with DBMS. 4. Implement Web MVC application using Servlet and JSP Technology.					

		5. Test JPA Implementation using Hibernate.			
Course Content:					
Module 1	Multi-Threading (Comprehension)	Assignment	Knowledge Ability		10 Hours
Topics: Multi-Threading in Java: Understanding Threads , Needs of Multi-Threaded Programming ,Thread Life-Cycle, Thread Priorities ,Synchronizing Threads, Inter Communication of Threads ,Critical Factor in Thread –DeadLock, The Executor Framework.					
Module 2	Input & Output Operation in Java (Comprehension)	Assignment	File Operations		10 Hours
Topics: Java I/O Operations : Input/Output Operation in Java(java.io Package),Streams and the new I/O Capabilities ,Understanding Streams, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.					
Module 3	Collection and Database programming using JDBC (Comprehension)	Assignment	Data Storage		10 Hours
Topics: Collection - The Collection Framework : Collections of Objects , Collection Types, Sets , Sequence, Map, Understanding Hashing, Uses of ArrayList & Vector , Comparable and Comparator Interfaces. Database Programming using JDBC- Introduction to JDBC, JDBC Drivers & Architecture, CRUD operation Using JDBC, Connecting to non-conventional Databases.					
Module 4	Distributed Programming with Servlet (Application)	Assignment	Distributed Programming		10 Hours
Topics: Servlet - Web Application Basics, Architecture and challenges of Web Application, Introduction to servlet, Servlet life cycle, Developing and Deploying Servlets, Create and compile servlet					

source code, start tomcat, start a web browser and request the servlet, servlet API, Handling HTTP Requests and Responses: Handling HTTP GET requests and POST request, Session Tracking, Simple Servlet Program to fetch database records					
Module 5	Distributed Programming with JSP (Application), Introduction to Spring Framework (Application)	Assignment	Distributed Programming		10 Hours
<p>Topics:</p> <p>JSP - Introduction to JSP, Creating simple JSP Programs, How JSP is processed, JSP Scripting Constructs, Predefined Variables, JSP Directives, Simple JSP Program to fetch database records. Spring CORE, Overview of Spring, Spring Architecture, bean life cycle, Java and XML Configuration on Spring, Spring Different Modules.</p> <p>Spring JPA, JPA Specification, Classes and Interfaces, Object Relational Mapping using JPA, JPA implementation with Hibernate, Simple JPA-Hibernate program to Create Database schemas.</p> <p>List of Laboratory Tasks:</p> <p>Labsheet -1 [4 + 1 Practical Sessions] Experiment No 1: Level 1: Demonstration of Thread Class and Runnable Interface. Level 2 – Implementation of Producer-Consumer Problem.</p> <p>Labsheet -2 [3 +1 Practical Sessions] Experiment No. 1: Level 1 – Usages of Java.io.* package. Level 2 – File operations with a case study.</p> <p>Labsheet – 3 [3 +1 Practical Sessions] Experiment No. 1: Level 1 – Practicing classes and methods in java.util.collection. Level 2 – Scenario based questions to apply all collections. [Group wise]</p> <p>Labsheet – 4 [3 + 1 Practical Sessions] Experiment No. 1: Level 1 – JDBC complete Demonstration with Student Database Level 2 – Implementation of Student Information Management (Standalone). [Group wise]</p> <p>Labsheet – 5 [3 + 1 Practical Sessions] Experiment No. 1: Level 1 – Web page creation using HTML, Dynamic web page using java.servlet and JDBC Level 2 – Implementation of Student Information Management (WEB based). [Group wise]</p>					

Labsheet – 6 [3 + 1 Practical Sessions] Experiment No. 1: Level 1 – Web page creation using HTML, Dynamic web page using java.servlet , JSP and JDBC Level 2 – Implementation of Student Database using JPA Hibernate	
Targeted Application & Tools that can be used: Java 8 / MYSQL 8 / Eclipse /IntelliJ (IDE)	
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course	
Build a Standalone database application using Java Swing as Front End. Indicative areas include; TimeTable Management, Student Expense Tracker, Important Mail Fetcher, etc. Build a real time database application using J2EE as Front End. Indicative areas include; health care, education, industry, Library, Transport and supply chain, etc.	
Text Books 1. Cay S Horstmann and Gary Cornell, “CORE JAVA volume II-Advanced Features, 9 th Edition.	
References 1. Herbert Schildt, “Java 2: The Complete Reference”, Tata McGraw-Hill Education, 6 th Edition. 2. Y.Daniel Liang, “Introduction to Java programming Comprehensive Version”, Pearson Education, 10 th Edition. 3. Core and Advanced Java Black Book, Dream Tech Press. 4. Spring in Action , Graig Walls, 5 th Edition 5. Java Persistence with Hibernate , Christian Bauer & Gavin King, 2 nd Edition 6. https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2	

Course Code: CSE2009	Course Title: Computer Organization and Architecture	L- P- C	3	0	3
Version No.	2.0				
Course Pre-requisites	CSE 2015 Digital Design				
Anti-requisites	NIL				
Course Description	This course introduces the core principles of computer architecture and organization from basic to intermediate level. This theory based course emphasizes on understanding the interaction between computer hardware and software. It equips the students with the intuition behind assembly-level instruction set architectures. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.				

Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Organization and Architecture and attain Skill Development through Participative Learning techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: 1] Describe the basic components of a computer, their interconnections, and instruction set architecture [Comprehension] 2] Apply appropriate techniques to carry out selected arithmetic operations 3] Explain the organization of memory and processor sub-system			
Course Content:				
Module 1	Basic Structure of computers	Assignment	Data Analysis task	12 Classes
Topics: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Computer systems RISC & CISC, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Arithmetic Operations on Signed numbers. Instructions and Instruction Sequencing, Instruction formats, Memory Instructions.				
Module 2	Instruction Set Architecture and Memory Unit	Assignment	Analysis, Data Collection	12 Classes
Topics: Instruction Set Architecture: Addressing Modes, Stacks and Subroutines. Memory System: Memory Location and Addresses, Memory Operations, Semiconductor RAM Memories, Internal Organization of Memory chips, Cache memory mapping Techniques.				
Module 3	Arithmetic and Input/output Design	Case Study	Data analysis task	10 Classes
Topics: Arithmetic: Carry lookahead Adder, Signed-Operand Multiplication, Integer Division, and Floating point operations. Input/output Design: Accessing I/O Devices, I/O communication, Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits				
Module 4	BPU and Pipelining	Assignment	Analysis, Data Collection	11 Classes
Topics: Basic Processing Unit: Fundamental Concepts, Single Bus organization, Control sequence, Execution of a Complete Instruction, Multiple Bus Organization. Pipelining: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Hazards.				
Targeted Application & Tools that can be used: Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job				

profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc.

Tools:

- Virtual Lab, IIT KGP
- Tejas – Java Based Architectural Simulator, IIT Delhi

Text Book

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, “Computer Organization”, Fifth Edition, McGraw-Hill Higher Education, 2016 reprint.

References

1. William Stallings, “Computer Organization & Architecture – Designing for Performance”, 11th Edition, Pearson Education Inc., 2019
2. David A. Patterson & John L. Hennessy, “Computer Organization and Design MIPS Edition- The Hardware/Software Interface”, 6th Edition, Morgan Kaufmann, Elsevier Publications, November 2020.

Web References:

1. NPTEL Course on “Computer architecture and organization” IIT Kharagpur By Prof. Indranil Sengupta, Prof. Kamalika Datta. <https://nptel.ac.in/courses/106105163>
2. NPTEL Course on “Computer Organization”, IIT Madras By Prof. S. Raman. <https://nptel.ac.in/courses/106106092>
3. <https://puniversity.informaticsglobal.com:2229/login.aspx>

Topics relevant to “SKILL DEVELOPMENT”: Generation of Computers, CISC and RISC processors, Bus Arbitration, Collaboration and Data collection for Term assignments and Case Studies for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2010_v02	Course Title: Operating Systems		3	0	0	3
	Type of Course: Program Core and Theory Only	L-T- P- C				
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization, Problem solving using C Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					

Anti-requisites	NIL			
Course Description	This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies.			
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain Employability through Problem Solving Methodologies .			
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the fundamental concepts of operating Systems and case studies. [Knowledge] 2] Demonstrate various CPU scheduling algorithms. [Application] 3] Apply various tools to handle synchronization problems. [Application] 4] Demonstrate deadlock detection and recovery methods [Application] 5] Illustrate various memory management techniques. [Application]			
Course Content:				
Module 1	Introduction to Operating System	Assignment	Programming	9 Hours
Topics: Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system				
Module 2	Process Management	Assignment/Case Study	Programming/Simulation	12 Hours
Topics: Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority.				
Module 3	Process Synchronization and Deadlocks	Assignment	Programming	12 Hours
Topics: The Critical-Section Problem- Peterson’s Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher’s Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock.				
Module 4	Memory Management	Assignment	Programming/Simulation	12 Hours

Topics:

Introduction to Memory Management, Basic hardware-Base and Limit Registers, Memory Management Unit(MMU), Dynamic loading and linking, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Virtual Memory and Demand Paging – Page Faults and Page Replacement Algorithms, Copy-on-write, Allocation of Frames, Thrashing

Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.

Targeted Application:

Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.

Software Tools:

1. Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install and work on multiple guest Operating Systems on top of a host OS.
2. Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.

Project work/Assignment

1. **Demonstrate process concepts in LINUX OS.**
2. **Simulation of CPU scheduling algorithms.**
3. **Develop program to demonstrate use of Semaphores in threads.**
4. **Develop program to demonstrate use of deadlock avoidance algorithms.**
5. **Develop program to demonstrate use of page replacement algorithms.**
6. **Simulation of memory allocation strategies [first fit, best fit and worst fit].**

Text Book

1. Silberschatz A, Galvin P B and Gagne G , “Silberschatz's Operating System Concepts”, Paperback, Global Edition Wiley, 2019
- 2.

References

1. Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 10th edition Wiley, 2018.
2. William Stallings, “Operating Systems”, Ninth Edition, By Pearson Paperback ,1 March 2018.
3. Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, “ Cracking the Operating System skills”, Dreamtech, paperback, 2020
4. Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , “Operating Systems: Three Easy Pieces, Amazon digital Services”, September 2018.

E-resources/Weblinks

5. <https://www.os-book.com/OS9/>
6. <https://pages.cs.wisc.edu/~remzi/OSTEP/>
7. <https://codex.cs.yale.edu/avi/os-book/OS10/index.html>

Catalogue prepared by	Dr.Madhusudhan M V and Ms Namrata Das
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Course Code: CSE2011		Course Title: Data Communications and Computer Networks Type of Course: Program Core - Theory		L-T-P-C	3	0	0	3
Version No.		1						
Course Pre-requisites		NIL						
Anti-requisites								
Course Description		This is the first course on data communication and computer networks. This course gives a thorough introduction to all the layers of a computer network following the top-down approach. Application, Transport, Network, and data link layer protocols are taught with analysis wherever applicable. All-important concepts required to take up advanced courses and to face placement tests by an undergraduate student will be covered in this course. This course also covers necessary foundational topics pertaining to data communications. This course can be followed up with an advanced computer network by the student to get a complete understanding of this domain.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain Skill Development through Participative Learning techniques.						
Course Outcomes		1. Explain the concepts of Computer Networks and Working Principles of Application Layer and Transport Layer (Comprehension) 2. Apply the Knowledge of IP Addressing and Routing Mechanism in Computer Networks. (Application) 3. Discuss the functionalities of Data Link Layer (Comprehension) 4. Explain the Basic Concepts of Data communication. (Comprehension)						
Course Content:								
Module 1		Overview, Application and Transport Layers.		Assignment	Comprehension		13 Sessions	
	Introduction: Computer Networks, Topologies, OSI Reference Model, TCP/IP model. Principles of Network Applications, The Web and HTTP, DNS—The Internet’s Directory Service, Socket Programming: Creating Network Applications. Introduction and Transport-Layer Services, Connection-less Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control.							
Module 2		Network Layer		Assignment	Application		12 Sessions	
	Overview of Network Layer, Forwarding and Routing, The Data and Control Planes.The Internet Protocol (IP): IPv4, Addressing, IPv6, IPv4 Datagram Format, IPv4 Addressing, Network Address Translation (NAT), IPv6. Introduction Routing Algorithms: The Link-State (LS) Routing Algorithm.							

	The Distance-Vector (DV) Routing Algorithm, Intra-AS Routing in the Internet, OSPF Routing Among the ISPs: BGP, Introduction to BGP. ICMP: The Internet Control Message Protocol.			
Module 3	Data Link Layer	Assignment	Comprehension	10 Sessions
	Introduction to the Link Layer, The Services Provided by the Link Layer, Error-Detection and -Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC), Multiple Access Links and Protocols. Switched Local Area Networks, Link-Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks (VLANs),DHCP,UDP,IP and Ethernet.			
Module 4	Physical Layer with Data Communication	Assignment	Comprehension	10 Sessions
	Data communications: Components, Data Representation, Data Flow, Analog and Digital Signals, Periodic Analog Signals: Sine Wave, Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signals, Transmission Impairment, Data Rate Limits: Noiseless Channel, Nyquist Bit Rate, Noisy Channel: Shannon Capacity, Performance: Bandwidth, Throughput, Latency (Delay), Bandwidth-Delay Product, Parallel/Serial Transmission, Multiplexing: Frequency-Division Multiplexing, Wavelength-Division Multiplexing, Synchronous Time-Division Multiplexing.			
	Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. Instant Messaging 2. Telnet 3. File Transfer Protocol 4. Video Conferencing 			
	Textbooks: T1. James F. Kurose, Keith W. Ross, “ <i>Computer Networking A Top down Approach</i> ”, 8 th Edition, Pearson, 2021. T2. Behrouz A. Forouzan, “ <i>Data Communications and Networking</i> ”, 6 th Edition, Tata McGraw-Hill, 2021.			
	References: R1. William Stallings: “ <i>Data and Computer Communication</i> ”, 10th Edition, Pearson Education, 2017. R2. Larry L. Peterson and Bruce S. Davie: <i>Computer Networks – A Systems Approach</i> , 4th Edition, Elsevier, 2012. Web references: Digital Learning Resources (Library Resources) W1. https://puniversity.informaticsglobal.com/login https://nptel.ac.in/courses/105106053			
	Topics relevant to “Skill Development”: Virtual Local Area Networks (VLANs), DHCP, UDP, IP and Ethernet for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.			

Course Code: CSE2007	Course Title: Design and Analysis of Algorithms	L- T- P- C	3	0	0	3
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	Type of Course: THEORY Only						
Version No.	2.0						
Course Pre-requisites	CSE2001- Data Structure and Algorithms						
Anti-requisites							
Course Description	This Course introduces techniques for the design and analysis of efficient algorithms and methods of applications. Deals with analyzing time and space complexity of algorithms, and to evaluate trade-offs between different algorithms.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analysis of Algorithms and attain Skill Development through Problem Solving Methodologies .						
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the efficiency of a given algorithm. (Understand) 2. Illustrate the Brute Force Technique used for solving a problem. (Apply) 3. Apply divide and conquer technique for searching and sorting problems. (Apply) 4. Apply the Dynamic Programming Algorithm used for solving a problem. (Apply) 5. Demonstrate Back tracking technique and limitations of Algorithms. (Apply)						
Course Content:							
Module 1	Introduction to Algorithms	Assignment	Simulation/Data Analysis			8L Sessions	
Important Problem types, Asymptotic Notations and its properties, Basic Efficiency classes, Mathematical analysis for Recursive and Non-recursive algorithms.							
Module 2	Algorithm design techniques-Brute force	Assignment	Numerical from E-Resources			9L Sessions	
Selection Sort, sequential search, Uniqueness of Array, Exhaustive search: Travelling Salesman, Knapsack Problem.							
Module 3	Divide-and-conquer	Term paper/Assignment	Simulation/Data Analysis			9L Sessions	
Master Theorem, Merge sort, Quick sort, Binary search.							
Module 4	Dynamic programming and greedy technique	Term paper/Assignment	Simulation/Data Analysis			11L Sessions	

Introduction, Coin changing problem, Multi stage graph – Optimal Binary Search Trees, warshall's, floyds, 0/1 Knapsack, Prim's, Kruskal's, Dijkstra's Algorithm.				
Module 5	Complexity Classes	Term paper/Assignment	Simulation/Data Analysis	8L Sessions
Complexity Classes- P, NP- NP Hard and NP Complete - Boolean Satisfiability Problem (SAT). Hamiltonian Path Problem, M Coloring Problem. Backtracking, - Backtracking – n-Queens problem.				
Text Book <ol style="list-style-type: none"> 1. Anany Levitin, “<i>Introduction to the Design and Analysis of Algorithms</i>”, 3rd edition, Pearson Education, 2018. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “<i>Introduction to Algorithms</i>”, 4th edition, MIT Press, 2022. 				
References <p>R1. J. Kleinberg and E. Tardos, “Algorithm Design”, Addison-Wesley, 2005.</p> <p>R2. Tim Roughgarden, “Algorithms Illuminated” (books 1 through 3), “Operating Systems Design and Implementation”, Soundlikeyourself Publishing, 2017-2019.</p> <p>R3. AV Aho, J Hopcroft, JD Ullman, “The Design and Analysis of Algorithms”, Addison-Wesley, 1974.</p>				
E-Resources <p>NPTEL course – https://onlinecourses.nptel.ac.in/noc19_cs47/preview https://www.coursera.org/learn/analysis-of-algorithms https://puuniversity.informaticsglobal.com</p>				
Topics relevant to “SKILL DEVELOPMENT”: knapsack, prims, kruskals algorithm, quick sort, binary search for Skill Development through Problem Solving methodologies . This is attained through assessment component mentioned in course handout.				

Course Code: CSE3001	Course Title: Artificial Intelligence and Machine Learning Type of Course: Integrated	L-T-P- C	2	0	2	3
Version No.	2.0					
Course Pre-requisites	CSE1003 Innovation Project - Raspberry Pi Using Python					
Anti-requisites	NIL					

Course Description	<p>This course introduces the basic concepts of artificial intelligence. It introduces students to the basic concepts and techniques of Machine Learning (ML), a subset of Artificial Intelligence (AI), is an important set of techniques and algorithms used for solving several business and social problems. The objective of this course is to discuss machine learning model development using Python.</p> <p>Topics include: Working with Collections and Data Frames; Regression algorithms; Classification algorithms; Optimization techniques – Gradient Descent algorithm, Gradient Descent for simple Linear Regression; Ensemble Learning – Random Forest, Boosting techniques – AdaBoost and Gradient Boosting; Grid Search for optimal parameters; Clustering algorithms; Forecasting with Time-Series data : Auto-Regressive Integrated Moving Average Models, Recommender Systems : Association Rule Mining, Collaborative Filtering, Text Analytics – Sentiment Classification using Naïve Bayesian model.</p>				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Machine Learning and attain Skill Development through experiential Learning techniques.				
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1: To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents. [Comprehension]</p> <p>CO2: Produce machine learning models for predictive analytics. [Application]</p> <p>CO3: Apply ensemble learning, optimization and hyper parameter tuning techniques for machine learning algorithms. [Application]</p> <p>CO4: Demonstrate different types of clustering techniques. [Application]</p> <p>CO5: Employ time series forecasting techniques/models for real world problems. [Application]</p>				
Course Content:					
Module 1	Introduction to Artificial Intelligence and Knowledge based systems	Assignment		Theory	6 Sessions
	Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agent, Structure of Intelligent agent and its functions, Agents and Environment; Introduction to Knowledge representation, approaches and issues in knowledge representation, Introduction to searching algorithm in AI, Conceptual graphs, Methods for Logic representation (POL, FOL).				
Module 2	Supervised Machine Learning Algorithms	Assignment		Programming activity	15 Sessions
	Topics: Introduction to the Machine Learning (ML) Framework, types of ML, types of variables/features used in ML algorithms, Feature engineering-Normalization, One-hot encoding, Simple Linear Regression, Multiple Linear Regression, Validation and Accuracy measures for Regression models. Classification models – Decision Tree algorithms using Entropy and Gini Index as measures of node impurity, model				

	evaluation metrics for classification algorithms, Logistic regression, Naïve Bayes Classifiers and Naive Bayes model for sentiment classification – an introduction..				
Module 3	Advanced Machine Learning Concepts	Assignment		Programming activity	14 Sessions
	Topics: Nearest Neighbor techniques, Cost functions and Optimization Technique – introduction to Gradient Descent, its applications on Linear Regression. C.Ensemble Learning algorithms – Bagging (Random Forest), Boosting(AdaBoost), XGBoost.				
Module 4	Clustering and Forecasting with Time-Series Data	Assignment		Programming activity	10 Sessions
	Topics: Partitioned Clustering – K-means and Hierarchical Clustering techniques, cluster validity measures, Components of Time Series data, Basic Concepts of Forecasting , An introduction to Forecasting from Time Series Models, calculating forecast accuracy, Association Rule Mining, Collaborative Filtering – User based and item based similarity, closed and maximal frequent item sets.				
	List of Laboratory Tasks: Lab sheet -1 Level 1: A review of Python programming - Introduction to Python Stack for Data Science, Core Python Libraries for data analysis, Anaconda platform and its installation, Executing programs on Jupyter IDE/ Colab. Level2: Programming exercises to revise variables, control statements and collections – lists, list comprehension Lab sheet -2 Level 1 - Programming exercises on Tuples Level 2- Nested data structures Lab sheet -3 Level 1: Introduction to Numpy, Pandas, Level 2: Scikit-learn and Visualization techniques. Lab sheet -4 Level 1 - Dictionaries, dictionary comprehension. Level 2 - Introduction to Data Frames using Pandas and working with frames Lab sheet -5 Level 1- Regression Models Simple linear regression, outlier detection. Level 2 - multiple linear regressions – model evaluation, multi-co linearity and handling multi-co linearity, outlier detection. Lab sheet -6 Level 1- Decision Tree Classifiers - Decision Tree classifier using Gini Index- measuring test accuracy, displaying the tree, confusion matrix and ROC. Level 2- Decision Tree Classifier using Entropy. Lab sheet -7 Level 1 - Optimization Techniques Developing a Gradient Descent Algorithm for linear regression – using NumPy and using sklearn. Level 2 - cohen_kappa_score. Lab sheet -8				

	<p>Level 1- Hyper parameter Tuning methods Hyper parameter tuning using Grid Search for Nearest Neighbor Classifiers and</p> <p>Level 2- Hyper parameter tuning using Grid Search for Decision Tree Classifiers.</p> <p>Lab sheet -9</p> <p>Level 1 - Hyper parameter Tuning for Ensemble models Ensemble Learning – Random Forest – Building the model, Grid Search for optimal parameters,</p> <p>Level 2 - Feature Importance. Ada Boost Classifiers and Gradient Boosting Classifiers</p> <p>Lab sheet -10</p> <p>Level 2 - Clustering – Kmeans – cluster centers and interpreting the clusters, finding the optimal number of clusters using Elbow Curve method.</p> <p>Level 2 - Agglomerative Hierarchical Clustering – Compare the clusters formed by kmeans and Agglomerative Clustering</p> <p>Lab sheet -1 1</p> <p>Level 1 – Probability theory(Conditional Probability)</p> <p>Level 2 - Naïve Bayes Model</p> <p>Lab sheet -12</p> <p>Level 1- Models forecasting Applications</p> <p>Level 2 - Models for Forecasting Time Series data</p> <p>Lab sheet -13</p> <p>Level 1- Recommender Systems - Association Rule Mining using Apriori for frequent Itemset Generation.</p> <p>Level 2 - Recommender Systems – user based similarity</p>
	<p>Targeted Application & Tools that can be used</p> <p>Use of PowerPoint software for lecture slides and use of Google’s Colab cloud service https://www.tutorialspoint.com/google_colab/index.html for executing and sharing of lab exercises.</p>
	Project work/Assignment:
	<p>Assignment:</p> <p>1. Programming: Implementation of given scenario using Python and Colab.</p> <p>Assignment: Learning courses for 4 Hours from the following link https://learn.datacamp.com/courses?topics=Machine%20Learning</p>
	<p>Text Book</p> <p>T1. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2016</p> <p>T2. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall.</p>
	<p>References</p> <p>R1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining”, Pearson Education, 2016.</p> <p>R2. Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017.</p>

	<p>R3. Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning Using Python”, Wiley, First Edition 2019.</p> <p>E-References</p> <p>https://presiuniv.knimbus.com/user#/home</p>
	<p>Topics relevant to development of “Skill Development”:</p> <ol style="list-style-type: none"> 1. Regression Models 2. Decision Tree Classifiers 3. Hyper parameter Tuning methods 4. Agglomerative Hierarchical clustering 5. Decision tree classifiers <p>for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: PPS4002	Course Title: Introduction to Aptitude Type of Course: Practical Only Course	L- P- C	0	2	1
Version No.	1.0				
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English				
Anti-requisites	Nil				
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.				

Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1] Recall all the basic mathematical concepts they learnt in high school.</p> <p>CO2] Identify the principle concept needed in a question.</p> <p>CO3] Solve the quantitative and logical ability questions with the appropriate concept.</p> <p>CO4] Analyze the data given in complex problems.</p> <p>CO5] Rearrange the information to simplify the question</p>			
Course Content:				
Module 1	Quantitative Ability	Assignment	Bloom's Level : Application	12 Hours
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes				
Module 2	Logical Reasoning	Assignment	Bloom's Level : Application	18 Hours
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning				

Course Code: CSE3082	Course Title: Object-Oriented Analysis and Design Type of Course: Program Core, Theory based	L- T-P- C	3	0	0	3
Version No.						
Course Pre-requisites		<ul style="list-style-type: none"> • CSE3146, Java Programming • CSE2014, Software Engineering 				
Anti-requisites		NIL				
Course Description		This course covers the analysis and design methodology in sufficient depth to convey a good understanding of object-oriented analysis and design using the unified process. Students will be able to design a use case model, identify the classes and their responsibilities, use interaction models to capture the interdependence among objects/classes and design an efficient solution. The application of the design axioms and the iterative nature of the process are emphasized. This course will enable students to apply object-oriented concepts in all the stages of the software development life cycle.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of course Object-Oriented Analysis and Design and attain Skill Development through Participative Learning techniques.				

Course Outcomes		On successful completion of the course the students shall be able to: 1] Identify the basics of object-oriented system development [Remember] 2] Classify the various techniques for object-oriented analysis techniques [Understand] 3] Use the design axioms to create e appropriate UML diagrams. [Apply] 4] Use the design process to develop implementation models. [Apply]		
Course Content:				
Module 1	Introduction to Object oriented system	Surprise Test		12 Sessions
	Topics: Object Basics-Object Oriented System Development Life Cycle- Use case driven approach-Rumbaugh Object Model- Booch Methodology-Jacobson Methodology-Unified Approach, Static and Dynamic Modeling-Unified Modeling Language.			
Module 2	Object oriented analysis	Case Study 1	Use-Case Diagram using StarUML	11 Sessions
	Topics: Identifying use cases-Object Analysis-Classification: Theory-Approaches for Identifying Classes: Noun Phrase approach, Common Class pattern approach, use case driven approach, Classes, Responsibilities and Collaborators- Identifying Object relationships: Associations, Super-sub class relationships, Aggregation. UML diagrams: Use case Diagram, Class diagram.			
Module 3	Introduction to axiomatic design	Case Study 2	Sequence diagram, State-chart diagram and Activity diagram	11 Sessions
	Topics: Object Oriented Design Axioms-Designing Classes -Class visibility -Refining attributes -Designing methods and protocols -Packages and managing classes, UML Diagrams: Interaction diagram, Sequence diagram, Collaboration diagram, State-chart diagram, Activity diagram.			
Module 4	Object oriented Design process	Presentation	Revision of the entire syllabus	11 Sessions
	Topics: Access Layer- Object Storage Persistence - Object oriented Database System-Designing view layer classes -Macro level process -Micro level process- Prototyping the user interface UML diagrams: component diagram, Deployment diagram, Quality Assurance Tests-Testing Strategies.			
	Targeted Application & Tools that can be used: The targeted employment sector includes software development firms, enterprise application development companies, and IT solution providers. This encompasses roles such as Software Engineer, Systems Analyst, Application Architect, Software Developer, and Quality Assurance Engineer. Tools:			

	<ol style="list-style-type: none"> 1. Rational Rose: A modeling tool for visualizing, designing, and documenting object-oriented systems. 2. Enterprise Architect: A comprehensive modeling tool used for UML and object-oriented design. 3. StarUML: Open-source software for creating UML diagrams and designing OO systems. 4. ArgoUML: A Java-based modeling tool for creating and analyzing OO designs.
	Project work/Assignment:
	Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments
	Textbook(s): <ol style="list-style-type: none"> 1. Ali Bahrami, “Object Oriented Systems Development using the Unified Modeling Language”, McGraw Hill International Edition, July 2017.
	References <ol style="list-style-type: none"> 2. Craig Larman, “Applying UML and Pattern s”, Pearson Education,3rd Edition,2004. 3. Grady Booch, “Object Oriented Analysis and Design with Applications”, Addison-Wesly,3rd edition,2007. 4. Simon Bennett, Steve McRobb, Ray Farmer, “Object Oriented Systems Analysis and Design using UML”, McGrawHill Education 4th edition, 2010. <p>Web References:</p> <ol style="list-style-type: none"> 1. https://online.visual-paradigm.com/features/uml-tool/ 2. http://www.uml.org/ 3. https://www.tutorialspoint.com/uml/ 4. https://onlinecourses.nptel.ac.in/noc19_cs48/preview (NPTEL course on Object oriented analysis and design by By Dr. Partha Pratim Das, IIT Kharagpur).
	Topics relevant to “SKILL DEVELOPMENT”: Use case Diagram, Sequence diagram, State-chart diagram and Activity diagram for Skill Development through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3075	Mobile Applications and Development & CSE 3075	L- T- P- C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	The student needs to have fundamental understanding of object-oriented programming concepts with Java.					
Anti-requisites						
Course Description	<p>The course deals with the basics of android platform and application life cycle. The goal of the course is to develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server.</p> <p>Topics include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android</p>					

	application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Mobile Applications and Development as mentioned above and attain Employability Skills through Experiential Learning Techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: <ol style="list-style-type: none"> 1. Discuss the fundamentals of mobile application development and its architecture. (Understand) 2. Illustrate mobile applications with appropriate android view. (Apply) 3. Demonstrate the use of services, broadcast receiver, Notifications and content provider (Apply) 4. Apply data persistence techniques, to perform CRUD operations. (Apply) 5. Use multimedia and internet services for mobile applications. (Apply) 			
Course Content:				
Module 1	Introduction and Architecture of Android	Assignment	Case Study	10 Sessions
Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.				
Module 2	User Interfaces, Intent and Fragments	Assignment	Case Study	15 Sessions
Views, Layout, Menu, Intent and Fragments.				
Module 3	Components of Android	Term paper/Assignment	Case Study	15 Sessions
Activities, Services, Broadcast receivers, Content providers				
Module 4	Notifications and Data Persistence	Term paper/Assignment	Case Study	15 Sessions
Notification, Shared Preferences, SQLite database.				
Module 5	Advanced app Development	Term paper/Assignment	Case Study	20 Sessions
Basic Types and Variables, Functions, Classes and Objects, Subclasses and Superclasses, Abstract classes and Interfaces, Data Classes, Nulls and Exceptions, Generics and Lambda Graphics and Animation, Location, Places, Mapping, Custom Views,				
List of Laboratory Tasks <ol style="list-style-type: none"> 1.a. Design an app to read user inputs using edit text and display the result of arithmetic operations using toast message. 1.b. Create an android app to calculate the current age of yourself, select your DOB using date picker. 				

<p>2.a. Design an app to input your personal information. Use autocomplete text view to select your place of birth.</p> <p>2.b. Design an app to select elective course using spinner view and on click of the display button, toast your ID and selected elective course.</p> <p>3. Design a restaurant menu app to print the total amount of orders.</p> <p>4. Develop an android app that uses intent to maintain the following scenario. Check the eligibility criteria for voting. Input the Aadhar no., Name & age in the first activity. If the age is above 18, display the voter's detail in the second activity. Else, display, "You are not eligible to vote" in the second Activity.</p> <p>5. Demonstrate the use of fragment with list of buttons representing various colors, and on click of these buttons, the appropriate color is filled in the next fragment. Create an Android application to input the vitals of a person (temperature, BP). If the vitals are abnormal, give proper notification to the user.</p> <p>6. Create an android app to for movie ticket booking. Save the user name of the customer using shared preferences. After completion of booking, retrieve the username from the shared preferences and print the ticket details.</p> <p>7. Create an android application to manage the details of students' database using SQLite. Use necessary UI components, which perform the operations such as insertion, modification, removal and view. Presidency University needs an APP for Admission eligibility checking for students, for that you need to take the following information from the Student: registration ID, physics, chemistry and mathematics marks (PCM), fees is allotted as below criteria.</p> <table><tr><td>PCM (Total marks %)</td><td>Fee concession</td></tr><tr><td>90 above</td><td>80 %</td></tr><tr><td>70 to 89</td><td>60 %</td></tr><tr><td>Below 69 %</td><td>no concession</td></tr></table> <p>On click on the button "Registration" details should be stored in the database using SQLite. Create button DISPLAY ALL (full students list) on click on the button it should display the students list per the fee concession.</p> <p>8. A company need to design an app that plays soft music automatically in the background. Create an app to achieve this functionality.</p> <p>9. Create an android application such that your view object in the Activity can be Animated with fade-in effect. Create an appropriate XML file named fade-in and write the application to perform the property animation.</p> <p>10. Create an app using Kotlin language with all android components.</p> <p>11. Create an android application to transfer a file using WiFi. Create an android application "Where am I" with an Activity that uses the GPS Location provider to find the device's last known location.</p>	PCM (Total marks %)	Fee concession	90 above	80 %	70 to 89	60 %	Below 69 %	no concession
PCM (Total marks %)	Fee concession							
90 above	80 %							
70 to 89	60 %							
Below 69 %	no concession							
<p>Targeted Application & Tools that can be used: Android Studio, Java, Kotlin</p>								
<p>Text Book</p> <p>T1. Dawn Griffiths, David Griffiths, "Head First Android Development", O'Reilly, 3rd Edition, November 2021</p> <p>T2. Dawn Griffiths, David Griffiths, "Head First Kotlin, Kotlin", O'Reilly, 1st Edition, November 2019</p>								
<p>References</p>								

<p>R1. Barry Burd, “Android Application Development” All-in-one Dummies, Wiley, 3rd Edition, January 2021</p> <p>R2. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley, 2016.</p> <p>R3. Pradeep kothari, “Android Application Development - Black Book”, DreamTech Press, May 2014</p> <p>R4. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley, 2014.</p> <p>R5. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley, 2014</p> <p>E-Resources: https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/</p>
<p>Topics relevant to the development of SKILLS: Graphics and Animation, App Widgets Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 3078	Course Title: Cryptography and Network Security Type of Course: Program Core & Theory only	L-T-P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		“Data Communications and Computer Networks”.				
Anti-requisites		NIL				
Course Description		<p>The Course covers the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet.</p> <p>Topics: The cryptographic tools such as shared key encryption, public key encryption, key exchange, and digital signature are explored. The use and utilization of the internet protocols and applications such as SSL/ TLS, IPSEC, Kerberos, PGP, and S/ MIME, SET are reviewed. System security issues such as viruses and firewalls are also explored.</p>				
Course Objective		The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques.				

Course Outcomes		<p>On successful completion of this course the students shall be able to:</p> <p>CO1: Identify the basic concept of Cryptography (Understand)</p> <p>CO2: Apply the concepts of cryptographic algorithms (Apply)</p> <p>CO3: Illustrate the Public key Cryptographic Techniques for various applications.</p> <p>(Apply)</p> <p>CO4: Examine the network security concepts during their implementation of different applications</p> <p>(Apply)</p>			
Course Content:					
Module 1	Introduction to Cryptography and types of Ciphers	Problem Solving	Identify the basic concept of Cryptography		10 Sessions
	<p>Topics:</p> <p>Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: Active attacks, Passive attacks, Services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution techniques: Caesar cipher, Monoalphabetic cipher, Polyalphabetic cipher, Play-fair and Hill Cipher, Transposition techniques: Rail fence, Basics of Steganography.</p>				
Module 2	Symmetric Key Cryptography and Number Theory	Problem Solving & Participative Learning	Apply the concepts of cryptographic algorithms		13 Sessions
	<p>Topics:</p> <p>Introduction to Block Cipher and Stream Cipher, Feistel Structure, Symmetric Encryption Algorithms: Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, Primality testing: Miller-Rabin algorithm, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese Remainder Theorem</p>				
Module 3	Public Key Cryptography and its Applications	Problem Solving & Participative Learning	Describe the Public key Cryptographic Techniques for various applications.		12 Sessions
	<p>Topics:</p> <p>Asymmetric Encryption and Decryption: Overview of Public Key Cryptography, Distribution of public keys, X.509 certificates, RSA, Diffie-Hellman Key exchange,</p>				

	Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature-case studies.				
Module 4	Network Security	Flip class	Explain the network security concepts during their implementation of different applications		10 Sessions
	Topics: Network Security applications: Authentication: Kerberos, PKI.E-mail security: PGP, S/MIME. Web Security: Secure Socket Layer (SSL), Transport Layer Security (TLS). IP Security: IP Sec Policy, Encapsulating Security Payload (ESP).				
	Targeted Application & Tools that can be used: Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.				
	PEDAGOGY PLANNED WITH TOPICS:				
	Problem Solving: Playfair and Hill cipher Problem Solving & Participative Learning: DES, AES, RSA & Diffie Hellman Self-learning: Man in the Middle attack. Flip Class: Network security and Email security				
	Textbooks: 1. William Stallings, "Cryptography and Network Security - Principles and Practices", Pearson Education, 8 th Edition, 2023. Reference Books: 1. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, third edition, 2010. 2. R.Rajaram, "Network Security and Cryptography" SciTech Publication.3 rd Edition, 2014. 3. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2 nd Edition, 2019. 4. BruceSchneier, "Applied Cryptography", John Wiley and Sons Inc. Second Edition, 2015.				
	Web References: 1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview 2. e-pgpathshala UGC lecture series : E-Series and Self learning Materials. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ== 3. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=10133&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security 4. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5875&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security .				

	Topics relevant to “Skill Development”: Symmetric and Asymmetric Encryption Algorithms and its problem & Solutions.
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Course Code: PPS4005		Course Title: Aptitude For Employability Type of Course: Practical Only			L- T-P- C	0	0	2	1
Version No.			1.0						
Course Pre-requisites			Students should have the basic concepts of Quantitative aptitude, Verbal ability along with its applications in real life problems.						
Anti-requisites			Nil						
Course Description			This course is designed to enable the students to enhance their skills in quantitative aptitude and verbal ability skills.						
Course Objective			The objective of the course is to familiarize the learners with concepts in Quantitative Aptitude and Verbal ability through problem solving techniques suitable for their career development.						
Course Outcomes			On successful completion of the course the students shall be able to: CO1] Recall all the basic mathematical concepts CO2] Identify the principle concept needed in a question CO3] Solve the quantitative and logical ability questions with the appropriate concept.						
Course Content:									
Module 1		Quantitative Ability	Lab-10hrs		Platform Assessment-10hrs		20 Hours		
	Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Simple Interest and Compound Interest, Probability, Permutation and Combination.								
Module 2		Verbal Ability	Lab-5hrs		Platform Assessment-5hrs		10 Hours		
	Topics: - Parts of Speech, Subject Verb Agreement, Spotting Error, Cloze Test, Verbal Analogies, Reading Comprehension, Idioms & Phrases, Para Jumbles								

	Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS
Evaluation	Continuous Evaluation <ul style="list-style-type: none"> • Topic wise evaluation

Course Code: CSE2015	Course Title: Data Analysis and Visualization Type of Course:1] Program core 2] Lab Integrated Course	L- T- P- C	2	0	4	4
Version No.	1.0					
Course Pre-requisites	Python Programming					
Anti-requisites	NIL					
Course Description	<p>The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts.</p> <p>The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization.</p> <p>With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.</p>					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Analysis and Visualization and attain EMPLOYABILITY through Experiential Learning techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Understand the various types of data, apply and evaluate the principles of data visualization. 2. Acquire skills to apply visualization techniques to a problem and its associated dataset. 3. Create interactive visualization for better insight using various visualization tools. 4. Handle data occurring in large volumes 5. Implement the visualization concepts practically using Python 					
Course Content:						

Module 1	Introduction to Data Visualization (Comprehension)	Assignment	Programming activity	20 Hours
<p>Topics: Data collection, Data Preparation Basic Models- Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Interacting with Databases, Data Cleaning and Preparation, Handling Missing Data, Data Transformation.</p> <p>Python Libraries: NumPy, pandas, matplotlib, GGplot, Introduction to pandas Data Structures</p>				
Module 2	Data Visualization Techniques (Application)	Assignment	Programming activity	30 Hours
<p>Topics: Scalar and point techniques – vector visualization techniques – matrix visualization, Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data, Visual Variables- Networks and Trees - Map Color and Other Channels- Manipulate View- Heat Map.</p>				
Module 3	Visual Analysis of data from various domain (Application)	Assignment	Programming activity	20 Hours
<p>Topics: Time-oriented data visualization – Spatial data visualization, Text data visualization – Multivariate data visualization and case studies, Finance- marketing-insurance-healthcare etc.</p>				
Module 4	Visualization of Streaming Data (Application)	Assignment	Programming activity	20 Hours
<p>Topics: Guidelines for designing successful visualizations, Data visualization dos and don'ts, Best practices of Data Streaming, processing streaming data for visualization, presenting streaming data, streaming visualization techniques, streaming analysis.</p> <p>List of Laboratory Tasks: Labsheet -1 [4 Practical Sessions] Working with Numpy Functions and Pandas functions Acquiring and plotting data.</p> <p>Labsheet -2 [4 Practical Sessions] Practicals based on Data Cleaning and Preparation Practicals based on Data Wrangling Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance</p> <p>Labsheet – 3 [4 Practical Sessions] Practicals based on Data Visualization using matplotlib</p>				

<p>Visualization of various massive dataset - Finance - Healthcare - Census</p> <p>Labsheet – 4 [4 Practical Sessions] Practical based on Time Series Data Analysis-stock market Market-Basket Data analysis-visualization Text visualization using web analytics</p> <p>Labsheet -5 [4 Practical Sessions] Financial analysis using Clustering, Histogram and HeatMap Visualization on Streaming dataset (Stock market dataset, weather forecasting)</p> <p>Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note</p> <p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p> <ol style="list-style-type: none"> 1. Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard. 2. Programming: Implementation of the chosen dashboard <p>Text Book</p> <ol style="list-style-type: none"> 1. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media. 2. Tamara Munzer, Visualization Analysis and Design, CRC Press 2014. 3. Aragues, Anthony. Visualizing Streaming Data: Interactive Analysis Beyond Static Limits. O'Reilly Media, Inc., 2018 4. Dr. OssamaEmbarak,“Data Analysis andVisualization Using Python”, Apress,(2018) <p>References</p> <p>R1. Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.</p> <p>R2. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020</p> <p>3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.</p> <p>R3. García Salvador, LuengoJulian, & Herrera, F. “Data preprocessing in Data Mining”, Springer,(2015)</p> <p>R4. Stephen Few, “Information Dashboard Design: the effective visual communication of data”, Oreilly, 2006</p> <p>R5. Belorkar, A, “Interactive Data Visualization with Python” - [S.I.]: Packt Publishing, Second Edition. (2018)</p> <p>Web links</p> <p>R1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/</p> <p>R2. Google Data Analytics Professional Certificate Coursera</p> <p>R3. Learning Python for Data Analysis and Visualization Ver 1 Udemy</p> <p>R4. Data Science, Analytics and Visualization (DS) Courses Chaminade University - PROD [Integrated] Catalog</p> <p>R5. Data Visualization Training and Certification Courses Koenig Solutions (koenig-solutions.com)</p> <p>Topics relevant to “Employability”: Visual Analysis and Streaming of Data for Employability through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.</p>
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Course Code: CSE3077	Course Title: Compiler Design Type of Course: Theory & Integrated Laboratory	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	C Programming [CSE1004], Theory of Computation [CSE2018]					
Anti-requisites	NIL					
Course Description	The Course is intended to teach the students the basic techniques that underlie the practice of Compiler Construction. The Course will introduce the theory and tools that can be employed in order to perform syntax-directed translation of a high-level programming language into an executable code. Topics consist of: Introduction to Compilers, Language translators: compilers and interpreters. Lexical Analysis, Role of the parser, semantic analysis, Intermediate Code Generation, Code Optimization, DAG representation of Basic Blocks, Global optimization, Peephole Optimization.					
Course Objectives	The objective of the course is to familiarize the Learners with the concept of Compiler Design Techniques and attain Employability through Experiential Learning Techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the various phases of compiler (Understand). 2. Apply parsing techniques to check the syntax of given statement. (Apply). 3. Produce intermediate code for the given statement. (Apply). 4. Apply the optimization techniques to reduce the intermediate code size (Apply).					
Course Content:						
Module 1	Introduction and Lexical Analysis	Assignme nt	Programming using C			18(L-6 P-12) Sessions
Compilers – Cousins of the Compiler - Phases of a compiler - Analysis of the source program - Grouping of phases –Compiler construction tools – Lexical Analysis – Role of the Lexical Analyzer – Specification of tokens – Recognizer						
Module 2	Syntax Analysis	Assignme nt	Programming using C			21Sessions (L-9 P-12)

<p>Topics:</p> <p>Role of the parser - Top-down parsing - Recursive decent parser - Predictive parser - Bottom-up parsing - reduce parser - LR parser – SLR parser – Canonical parser – LALR parser - YACC programming.</p>				
Module 3	Semantic Analysis & Intermediate Code Generation	Assignment	Programming using C	11 Sessions (L-7 P-4)
<p>Topics:</p> <p>Introduction to syntax directed translation - Synthesis and inherited attributes - Type Checking - Type Conversions - Intermediate languages – Three address statements - Declarations – Assignment Statements – Boolean Expressions – Case Statements – Looping statements.</p>				
Module-4	Code Optimization and Code Generation	Assignment	Programming using C	10 Sessions (L-8 P-2)
<p>Topics:</p> <p>Basic Blocks and Flow Graphs – Principal sources of optimization – Peephole optimization - Optimization of basic Blocks - DAG representation of Basic Blocks - Issues in the design of code generator – A simple code generator.</p>				
Assignment:				
<ol style="list-style-type: none"> 1. Assignment 1 on (Module 1 and Module 2) 2. Slip Test on (Module 1 to Module 4) 				
<p>List of Laboratory Tasks:</p> <p>Lab 1: Lexical Analyzer</p> <p>Objective: Explore Lexical Analysis Techniques</p> <p>Tasks: Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.</p> <p>Lab 2: Lexical Analyzer</p> <p>Objective: Explore Lexical Analysis Techniques</p> <p>Task: Write a C program to identify whether a given line is a comment or not.</p>				

Lab 3: Lexical Analyzer

Objective: Explore Lexical Analysis Techniques

Task: Write a C program to recognize strings under 'a', 'a*b+', 'abb'.

Lab 4: Lexical Analyzer

Objective: Explore Lexical Analysis Techniques

Task: Write a C program to test whether a given identifier is valid or not.

Lab 5: Lexical Analyzer

Objective: Explore Lexical Analysis Techniques

Task: Write a C program to simulate lexical analyzer for validating operators.

Lab 6: Lexical Analyzer

Objective: Explore Lexical Analysis Techniques

Task: Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.

Lab 7: Syntax Analyzer

Objective: Explore Syntax Analysis Techniques

Task: Write a C program for implementing the functionalities of predictive parser.

Lab 8: Syntax Analyzer

Objective: Explore Syntax Analysis Techniques

Task: Write a C program for constructing of LL (1) parsing.

Lab 9: Syntax Analyzer

Objective: Explore Syntax Analysis Techniques

Task: Write a C program for constructing recursive descent parsing.

Lab 10: Syntax Analyzer

Objective: Explore Syntax Analysis Techniques

Task: Write a C program to implement operator precedence parsing

Lab 11: Semantic Analysis

Objective: Explore Semantic Analysis Techniques

Task: Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value.

Lab 12: Code Optimization

Objective: Explore Code Optimization Techniques

Task: Convert the BNF rules into Yacc form and write code to generate abstract syntax tree.

Lab 13: Code Generation

Objective: Explore Code Optimization Techniques

Task: Write a C program to generate machine code from abstract syntax tree generated by the parser.

REFERENCE MATERIALS:

TEXTBOOKS

T1. Alfred V. Aho, Jeffrey D Ullman, "*Compilers: Principles, Techniques and Tools*", Pearson second Edition, 2013.

T2. Allen I. Holub, "*Compiler Design in C*", PHI publications, 1992 First Edition.

REFERENCES

R1. Jean Paul Tremblay, Paul G Serenson, "*The Theory and Practice of Compiler Writing*", BS Publications, 2005 First Edition.

R2. C. N. Fischer and R. J. LeBlanc, "*Crafting a compiler with C*", Benjamin Cummings, 2003 First Edition.

- R3. HenkAlblas and Albert Nymeyer, “*Practice and Principles of Compiler Building with C*”, PHI, 2001 First Edition.
- R4. Kenneth C. Loudon, “*Compiler Construction: Principles and Practice*”, Thompson Learning, 2003 First Edition.
- R5. Dhamdhere, D. M., “*Compiler Construction Principles and Practice*”, Macmillan India Ltd, 2008 First Edition.

WEB RESOURCES:

1. NPTEL Course on “Compiler Design”, Prof. Santanu Chattopadhyay
https://onlinecourses.nptel.ac.in/noc22_cs14/preview
2. NPTEL Course on “Compiler Design”, Prof. Y.N. Srikanth
<https://nptel.ac.in/courses/106108052>
3. NPTEL Course on “Compiler Design”, Prof. Rupesh Nasre
<https://archive.nptel.ac.in/courses/106/106/106106237/>
4. UnacademyCourse on “Complete Course on Compiler Design”, Subbarao Lingamgunta
<https://unacademy.com/course/complete-course-on-compiler-design-302/617317U1>
5. Alfred V. Aho, Jeffrey D Ullman, “*Compilers: Principles, Techniques and Tools*”, Pearson Edition, 2001.
https://dlscrib.com/queue/principles-of-compiler-design-a-v-aho-j-d-ullman-pearson-education_5888b7096454a72f2d35c068_pdf?queue_id=598d7fb2dc0d607d0d300d1c
6. Presidency University Library Access - Alfred V. Aho, Monica S Lam, Jeffrey D Ullman, Ravi Sethi, “*Compilers: Principles, Techniques and Tools*”, Pearson Education India; 2nd edition, 2013.
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5814&query_desc=kw%2Cwordl%3A%20compiler

Course Code: PPS 3018	Course Title: Preparedness for Interview		L- T- P- C	0	0	2	1
	Type of Course: Practical Only Course						
Version No.		1.0					
Course Pre-requisites		Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites		NIL					

Course Description		This course is designed to enable students to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring.		
Course Objective		The objective of the course is to familiarize the learners with the concepts of “Preparing for Interview” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.		
Course Out Comes		<p>On successful completion of this course the students shall be able to:</p> <p>CO1: Develop professional Resumes</p> <p>CO2: Illustrate Resumes effectively</p> <p>CO3: Apply skills and knowledge learnt for active and effective Group Discussions and Interview</p>		
Course Content:				
Module 1	Resume Building	Classroom activity		30 Hours
	<p>Topics: Resume structure, use of templates, Do's and Don'ts, ATS methods, Cover Letter and Video Resume</p> <p>Activity: Real world scenarios</p>			

Discipline Electives

Course Code: CSE2036	Course Title: Programming in C++ Type of Course: Discipline Elective Theory & Integrated Laboratory		L-T-P-C	1	0	4	3
Version No.		2.0					
Course Pre-requisites		C with Arduino CSE 1002					
Anti-requisites		Nil					
Course Description		The main goal of this course is to study the fundamentals of object-oriented paradigm with concepts of streams, classes, functions, data, and objects. The course aims to provide the basic characteristics of OOP through C++, to impart skills on various kinds of overloading and inheritance, to introduce pointers and file handling in C++ together with exception handling mechanism.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Programming in C++ and attain Employability through Experiential Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Explain the need and features of OOP and idealize how C++ differs from C. 2. Understand knowledge on various types of overloading and streams. 3. Choose suitable inheritance while proposing solution for the given problem. 4. Implement the concept of pointers and effective memory management, illustrate the application of pointers in virtual functions. 5. Apply the attained knowledge by applying the learned techniques to solve various real-world problems.					
Course Content:							
Module 1	Introduction to object-oriented programming	Quiz		Programming/ Problem Solving		12 Hours	
	Topics: Beginning with C++ and its features: Introduction to C++, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, Control structures, arrays, Functions, Inline function, function overloading. [Blooms ‘level selected: Comprehension]						
Module 2	Classes and Objects, Static member	Lab evaluation		Programming/ Problem Solving		12 Hours	
	Topics:						

	Functions, classes and Objects: Define class, data members and member functions (methods), method overloading, arrays within a class, array of objects, static members, pointers in C++, new and delete. [Blooms 'level selected: Comprehension]				
Module 3	Constructors, Destructors and Operator overloading, Strings	Lab evaluation		Programming/Problem Solving	12 Hours
	Topics: Constructors, Destructors and Operator overloading: Constructors, constructor overloading, copy constructor, Destructors, Polymorphism: operator overloading, Overloading Unary and binary operators, friend function, operator overloading using friend function, strings and its operators. [Blooms 'level selected: Application]				
Module 4	Inheritance, Virtual Functions, Polymorphism	Lab evaluation/ Assignment		Programming/Problem Solving	12 Hours
	Topics: Inheritance, Pointers, Virtual Functions, Polymorphism: Define inheritance, base and derived Classes, types of inheritance: Single, multilevel, multiple inheritance, Multi-Path inheritance, Pointers to objects and derived classes, "this" pointer, Run time polymorphism: Virtual functions and pure virtual functions. [Blooms 'level selected: Application]				
Module 5	Streams and Working with files, Templates, Manipulators	Assignment		Programming /Problem Solving	07 Hours
	Topics: Streams and Working with files: Controlling output with manipulators, Templates: Function templates and class templates. [Blooms 'level selected: Comprehension]				
	List of Laboratory Tasks: Experiment No 1: Demonstrate control structures, arrays, inline functions. [2 hours: Application Level] Level 1: Demonstrate control structures in C++. Level 2: Use of arrays in C++. Experiment No. 2: Demonstrate the use of functions, inline functions and function overloading. [2 hours: Application Level] Level 1: Use of functions and inline function. Level 2: Use of function overloading. Experiment No. 3: Demonstrate the working of classes, objects, member functions and method overloading.[2 hours: Application Level] Level 1: Understand use of classes, objects, member functions. Level 2: Use of method overloading. Experiment No. 4: Demonstrate the working of array of objects, static members, new and delete. [2 hours: Application Level] Level 1: Understand use of array of objects.				

	<p>Level 2: Use of static members, new and delete.</p> <p>Experiment No. 5: Implement the concept of constructors, destructors, constructor overloading and copy constructor. [2 hours: Application Level] Level 1: Understand the concept of constructors and destructors and strings. Level 2: Understand the concept of constructor overloading and copy constructor.</p> <p>Experiment No. 6: Implement the concept of operator overloading and friend function. [2 hours: Application Level] Level 1: Use of binary operator overloading. Level 2: Importance of friend function in operator overloading.</p> <p>Experiment No. 7: Implement the use of inheritance. [2 hours: Application Level] Level 1: Understand the concept of single, multi-level inheritance. Level 2: Passing arguments to base and derived classes using constructors.</p> <p>Experiment No.8: Implement the use of Virtual functions. [2 hours: Application Level] Level 1: Understand the concept of constructor in derived class. Level 2: Understand the concept of virtual function.</p> <p>Experiment No.9: Apply the knowledge of manipulators and function templates [2 hours: Application Level] Level 1: Understand the concept manipulators. Lever 2: Understand the concept of function template.</p> <p>Experiment No.10: Apply the knowledge of class templates. [2 hours: Application Level] Level 1: Understand the class templates. Lever 2: Real time scenario problem to cover all the concepts.</p>
	<p>Targeted Application & Tools that can be used: Application Area is to understand and apply concept of object oriented concepts using C++. Tools/Simulator used: GCC compiler/ Linux terminal.</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
1.	<p>2. Problem Solving: Understanding different OOPS and implementation of programs. 2. Programming: Implementation of given scenario using C++.</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. Herbert Schildt, “C++: The Complete Reference”, McGraw Hill Education, 4th Edition, 2017. 2. Behrouz A. Forouzan, Richard F. Gilberg, “ C++ Programming: An Object-Oriented Approach”, McGraw Hill Education, 1st edition, 2022.
	<p>References</p> <ol style="list-style-type: none"> 1. Robert Lafore, “Object Oriented Programming using C++”, Galgotia publication, 2010. 2. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Education, 2004. 3. Stanley B. Lippman and Josee Louie, “C++ Primer”, Pearson Education, 2003. 4. K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, “Mastering C++”, TMH, 2003. 5. E. Balaguruswamy, “Object Oriented Programming with C++”, TMH, 6th Edition, 2013.

	Topics relevant to “ EMPLOYABILITY SKILLS ”: Object, Class, Inheritance, Polymorphism, Abstraction, Encapsulation for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.
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Course Code: CSE2052	Course Title: DISTRIBUTED SYSTEM Type of Course: Theory based	L-T-P- C	3	0	0	3
Version No.		2.0				
Course Pre-requisites		Operating systems				
Anti-requisites		NIL				
Course Description		This course is designed to provide the knowledge of the concepts related to distributed system. The course is aimed at understanding the foundations of distributed systems. It also deals with Peer to peer services and to understand about the system level and support required for distributed system. Further, it focuses on Synchronization, Process and Resource Management. Students will also learn the overview of Distributed system.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of DISTRIBUTED SYSTEMS and attain EMPLOYABILITY through using PARTICIPATIVE LEARNING techniques.				
Course Outcomes		On successful completion of this course the students shall be able to: CO1: Describe the functional characteristics and challenges in distributed system (Knowledge level) CO2: Summarize the mechanism of inter process, indirect communication techniques. (Comprehensive level) CO3: Discuss the features of peer to peer services and file systems. (Comprehensive level) CO4: Apply synchronization techniques. (Application level) CO5: Explain the different process and resource management approaches. (Comprehensive level)				
Course Content:						
Module 1	INTRODUCTION TO DISTRIBUTED SYSTEM	Quiz		Knowledge based Quizzes and assignments;		9 sessions
	Topics: Introduction - Trends in Distributed Systems – Focus on resource sharing- Distributed System model – Challenges-Examples of Distributed Systems -Case study: World Wide Web.					
Module 2	COMMUNICATION IN DISTRIBUTED SYSTEM	Quizzes and assignments		Comprehension based Quizzes and assignments		9 sessions

	Topics: System Model – Models of Communication networks- Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Indirect Communication: Group communication – Publish-subscribe systems – Message queues – Shared memory approaches.				
Module 3	PEER TO PEER SERVICES AND FILE SYSTEM	Quizzes and assignments		Comprehension based Quizzes and assignments	9 sessions
	Topics: Peer-to-peer Systems – Introduction – Peer-to-peer – Middleware – Routing overlays. Distributed File Systems –Introduction – File service architecture – Andrew File system- Tapestry. File System: Features-File model -File accessing models.				
Module 4	SYNCHRONIZATION	Quizzes and assignments		Application based Quizzes and assignments	9 sessions
	Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Snapshot algorithm for FIFO channels -Global states – Coordination and Agreement– Distributed mutual exclusion – Shared memory mutual exclusion -Elections				
Module 5	PROCESS AND RESOURCE MANAGEMENT	Quizzes and assignments		Comprehension based Quizzes and assignments	9 sessions
	Process Management: Process Migration, Resource Management: Introduction- Load Balancing Approach – Load Sharing Approach- Deadlocks-Models of Deadlock-Deadlock Detection in distributed systems.				
	Targeted Application & Tools that can be used: LINUX				
	Textbook(s): 1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.				
	References 1. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Ninth edition, Prentice Hall of India, 2007. 2. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Second Edition, Pearson Education, 2007. 3. Liu M.L., “Distributed Computing, Principles and Applications”, First Edition, Pearson Education, 2004. 4. Nancy A Lynch, “Distributed Algorithms”, Second Edition, Morgan Kaufman Publishers, USA, 2003. Web Resources: W1. NPTEL Videos- https://nptel.ac.in/courses/106/106/106106107/ W2. https://www.youtube.com/watch?v=2L7jnaXuOc8 W3. https://onlinecourses.nptel.ac.in/noc21_cs87 W4. https://presiuniv.knimbus.com/user#/home				

	Topics relevant to “EMPLOYABILITY SKILLS”: Synchronization, Resource Management, Deadlocks for developing Employability Skills through Participative Learning techniques for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout
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Course Code: CSE3073	Course Title: Game design and Development		L-T-P-C	2	0	2	3
		Type of Course: Program Core					
Version No.		1.0					
Course Pre-requisites		Nil					
Anti-requisites		NIL					
Course Description		The Game Design and development course is a hands-on learning experience that focuses on teaching students how to design, develop, and test game prototypes. Students will learn game design concepts such as player engagement, game mechanics, and game balance, and the basics of game art, sound, and programming. Throughout the course, students will work in teams to develop and refine their game prototypes, receiving feedback and guidance from the instructor and their peers. Topics covered include prototyping tools, sample game engines, and the creation of simple 2D and 3D game prototypes. The course will culminate in a final project where students will present and demonstrate their completed game prototypes to the class.					
CourseObjective		This course is designed to develop ENTREPRENEURIAL SKILLS by USING EXPERIENTIAL LEARNING Techniques.					
Course OutComes		At the end of the course the student should be able to: CO1 Recall the elements of Game Mechanics. CO2Distinguish between several types of prototypes. CO3 Employ the concepts to create prototypes of games.					
CourseContent:		Game mechanics, emergence and progression, resource mechanics, feedback structures.Uses and importance of prototyping, distinct types of prototypes, stages of prototyping, identifying key features, create functioning prototypes.					
Version No.		1.0					
Module 1	Game Mechanics	Assignment		Evolution of prototyping		No.of Classes:20	
	Topics:						

	Introduction to Game Mechanics, distinct types of game mechanics and applications, concepts of emergence and progression, Resource mechanics and economics, level design and progression in levels, feedback structures and semiotics.				
Module 2	Designing	Case Study		Importance of prototyping	No.of Classes:20
	Topics: Introduction to prototyping, uses and importance of prototyping. Distinct types of prototypes such as paper, physical, playable, art and sound prototypes, interface, low fidelity and high-fidelity code, core game and complete game prototypes.				
Module 3	Creating and Testing Prototypes	Assignment		Prepare physical prototype of a popular game	No. ofClasses:20
	Topics: Documentation, identifying key features, stages of prototyping, testing and feedback, application of different prototyping techniques such as paper, physical, playable, art and sound prototypes, interface, code, low fidelity and high-fidelity prototyping techniques to create functioning prototypes.				
	Targeted Application & Tools that can be used: Algodoo				
	Project work/Assignment:				
1.	2. 2D Platformer Design 2. Game Development 3. UI/UX Design				
	Textbook(s): 1. Jeremy G. Bond, “Introduction to Game Design, Prototyping, and Development”, 2nd Edition, Addison-Wesley Professional, 2017.				
	References 1. Ennio De Nucci, Adam Kramarzewski, “Practical Game Design : Learn the Art of Game Design Through Applicable Skills and Cutting-edge Insights”, Packt Publishing, 2018. 2. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012. Weblinks: https://learn.unity.com/ https://starloopstudios.com/rapid-game-prototyping-why-is-it-important-in-game-development/ [Text Wrapping Break]				

Course Code: CSE2040	Course Title: Cyber threats for IOT and Cloud	L-T- P- C	3	0	0	3
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	Type of Course:1] Program Core 2] Theory Only					
Version No.	1.0					
Course Pre-requisites	CSE2060 Information Security and Management Systems					
Anti-requisites	NIL					
Course Description	The objective of the course is to understand the most important cyber threats for IOT and Cloud. Cyber attackers discover new possibilities in the areas of Internet of Things and cloud services. It mainly focuses on multiple security challenges facing the IoT and cloud computing especially concerns surrounding privacy and cyber security threats of the users and the how can the cyber risks relating to them be mitigated.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Cyber threats for IOT and Cloud and attain Employability through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Describe the fundamental concepts of IoT and Cloud.• Understand and familiarize with various types of cyber-attacks, cybercrimes, vulnerabilities, and remedies.• Demonstrate different types of cyber threats using tools.• Implement cyber security mechanisms for the protection of information technology assets.					
Course Content:						
Module 1	Introduction to IOT and Cloud computing	Assignment	Programming Task	13 Sessions		
Topics What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IOT Architecture and protocols, Various platforms for IoT, Real-Time examples of IoT, Overview of IoT components and IoT communication Technologies. Introduction to Cloud Computing: The Vision of Cloud Computing, defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Distributed Systems, Virtualization, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies. Assignment:						

Module 2	Cyber Threats	Assignment	Programming Task	10 Sessions
Topics What are Cyber Security Threats? Common Sources of Cyber Threats, Types of Cyber security Threats-Malware attacks, Social Engineering attacks, Supply chain attacks, Man-in-the middle Attack, Threat Detection Tools, Cyber Defense for Individuals. Quiz/Case study/ Presentation				
Module 3	Cyber Threats in Internet of Things	Assignment	Programming/Data analysis task	11 Sessions
Topics IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats-Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats. Certification				
Module 4	Cyber Threats in Cloud computing	Assignment	Programming/Data analysis task	11 Sessions
Topics Cybersecurity Threats to Cloud Computing-Identity First Security, Cloud misconfiguration, Denial of Service, Insider Threats, Reduced Infrastructure Visibility, Unauthorized use of Cloud workloads, Insecure API's, Compliance and regulation issues, Mitigating cyber risks in cloud computing Assignment:				
Text Books T1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensic And Legal Perspectives", Wiley India Pvt Ltd,2013 T2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743) T3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education				

References

R1. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018

R2. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014

R3. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9

Weblinks:

<https://www.coursera.org/learn/cloud-security-basics>

<https://www.imperva.com/learn/application-security/cyber-security-threats/>

<https://presiuniv.knimbus.com/user#/home>

Topics relevant to "SKILL DEVELOPMENT":

Cyber threats in IoT and Cloud Computing for **skill development** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3078	Course Title: Cryptography and Network Security Type of Course: Program Core & Theory only	L-T-P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		"Data Communications and Computer Networks".				
Anti-requisites		NIL				
Course Description		The Course covers the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet. Topics: The cryptographic tools such as shared key encryption, public key encryption, key exchange, and digital signature are explored. The use and utilization of the internet protocols and applications such as SSL/ TLS,				

		IPSEC, Kerberos, PGP, and S/ MIME, SET are reviewed. System security issues such as viruses and firewalls are also explored.			
Course Objective		The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques.			
Course Outcomes		<p>On successful completion of this course the students shall be able to:</p> <p>CO1: Identify the basic concept of Cryptography (Understand)</p> <p>CO2: Apply the concepts of cryptographic algorithms (Apply)</p> <p>CO3: Illustrate the Public key Cryptographic Techniques for various applications.</p> <p>(Apply)</p> <p>CO4: Examine the network security concepts during their implementation of different applications</p> <p>(Apply)</p>			
Course Content:					
Module 1	Introduction to Cryptography and types of Ciphers	Problem Solving	Identify the basic concept of Cryptography		10 Sessions
	<p>Topics:</p> <p>Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: Active attacks, Passive attacks, Services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution techniques: Caesar cipher, Monoalphabetic cipher, Polyalphabetic cipher, Play-fair and Hill Cipher, Transposition techniques: Rail fence, Basics of Steganography.</p>				
Module 2	Symmetric Key Cryptography and Number Theory	Problem Solving & Participative Learning	Apply the concepts of cryptographic algorithms		13 Sessions
	<p>Topics:</p> <p>Introduction to Block Cipher and Stream Cipher, Feistel Structure, Symmetric Encryption Algorithms: Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, Primality testing: Miller-Rabin algorithm, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese Remainder Theorem</p>				

Module 3	Public Key Cryptography and its Applications	Problem Solving & Participative Learning	Describe the Public key Cryptographic Techniques for various applications.		12 Sessions
	Topics: Asymmetric Encryption and Decryption: Overview of Public Key Cryptography, Distribution of public keys, X.509 certificates, RSA, Diffie-Hellman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature-case studies.				
Module 4	Network Security	Flip class	Explain the network security concepts during their implementation of different applications		10 Sessions
	Topics: Network Security applications: Authentication: Kerberos, PKI.E-mail security: PGP, S/MIME. Web Security: Secure Socket Layer (SSL), Transport Layer Security (TLS). IP Security: IP Sec Policy, Encapsulating Security Payload (ESP).				
	Targeted Application & Tools that can be used: Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.				
	PEDAGOGY PLANNED WITH TOPICS:				
	Problem Solving: Playfair and Hill cipher Problem Solving & Participative Learning: DES, AES, RSA & Diffie Hellman Self-learning: Man in the Middle attack. Flip Class: Network security and Email security				
	Textbooks: 1. William Stallings, "Cryptography and Network Security - Principles and Practices", Pearson Education, 8 th Edition, 2023. Reference Books: 1. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, third edition, 2010. 2. R.Rajaram, "Network Security and Cryptography" SciTech Publication.3 rd Edition, 2014. 3. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2 nd Edition, 2019. 4. BruceSchneier, "Applied Cryptography", John Wiley and Sons Inc. Second Edition, 2015.				
	Web References: 1. https://onlinecourses.nptel.ac.in/noc22_cs90/preview 2. e-pgpathshala UGC lecture series : E-Series and Self learning Materials. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ==				

	<p>3. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=10133&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security</p> <p>4. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5875&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security.</p>
	<p>Topics relevant to “Skill Development”: Symmetric and Asymmetric Encryption Algorithms and its problem & Solutions.</p>

Course Code: CSE3150	Course Title: Front-end Full Stack Development Discipline Elective	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	WEB TECHNOLOGIES-CSE2067					
Anti-requisites	NIL					
Course Description	This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Front-end Full Stack Development and attain Employability Skills through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1. Design and develop static web pages using HTML5 elements and CSS3 [Apply] CO2.Develop responsive web pages using CSS, JavaScript and bootstrap. [Apply] CO3.Demonstrate the concepts of Angular.js to develop a web front-end. [Apply] CO4.Illustrate the concepts of React.js to develop a web front-end. [Apply]					
Course Content:						
Module 1	Introduction to web technology	Project	Programming	15Sessions [7L +8P]		
Topics: HTML5 – Syntax,Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform.						
Module 2	Responsive web design	Project	Programming	15 Sessions [7L+8P]		

Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, JavaScript – Core syntax, HTML DOM, objects, classes, HTML DOM, objects, classes, Async; Ajax ,jQuery Introduction. Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society.				
Module 3	JavaScript Frameworks	Project	Programming	20 Sessions [10L+10P]
Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Data binding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Angular Animations; Adding Offline Capabilities with Service Workers; React.js ; Developing single page application Assignment: Develop a software tool to do inventory management in a warehouse.				
Module 4	Fundamentals of DevOps and Project Management	Project	Programming	10 Sessions [6L+4P]
Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control. Deploying an Angular/React App; Unit Testing in Angular Apps (Jasmine, Karma). Assignment: Develop a web-based application to book movies/events (like bookmyshow).				

List of Laboratory Tasks:(7 X 2= 14 Sessions)

Experiment No. 1: [3 + 1 Practical Sessions]

- **Level 1:** Familiarization of HTML and CSS basics.
 - **Level 2:** Create an HTML webpage showcasing biodata with CSS styling.
-

Experiment No. 2: [3 + 1 Practical Sessions]

- **Level 1:** Design an interactive web page for a new restaurant using CSS3 features.
 - **Level 2:** Create a simple web form to gather user information.
-

Experiment No. 3: [4 + 1 Practical Sessions]

- **Level 1:** Practice basic JavaScript exercises, including creating a canvas drawing application.
 - **Level 2:** Implement JavaScript exercises for form validation.
-

Experiment No. 4 [3 + 1 Practical Sessions]

- **Level 1:** Create a student registration form using JavaScript.
 - **Level 2:** Design an RSVP form using Bootstrap form controls.
-

Experiment No. 5 [3 + 1 Practical Sessions]

- **Level 1:** Create a responsive image grid using Bootstrap 5.
- **Level 2:** Write a JavaScript program using AJAX to dynamically load content and implement jQuery effects like fading.

Experiment No. 6 [3 + 1 Practical Sessions]

- **Level 1:** Create an AngularJS application module and controller in app.js.
- **Level 2:** Design an "AngularJS Solar System Explorer" for planet data visualization.

<p>Targeted Application & Tools that can be used:</p> <p>Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.</p> <p>Professionally Used Software: Replit</p>
<p>Project work/Assignment:</p> <ol style="list-style-type: none"> 1. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.
<p>Text Book:</p> <p>T1. Fender, Young, “<i>Front-end Fundamentals</i>”,Leanpub, 2015</p> <p>T2. Northwood, Chris, “<i>The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer</i>”,APress, 2018</p>
<p>References:</p> <p>R1. Flanagan D S, “<i>Javascript : The Definitive Guide</i>” 7th Edition. 7th ed. O'Reilly Media; 2020.</p> <p>R2. Alex Libby, Gaurav Gupta, and AsojTalesra. “<i>Responsive Web Design with HTML5 and CSS3 Essentials</i>”,Packt Publishing, 2016</p> <p>R3. Duckett J Ruppert G Moore J. “<i>Javascript&Jquery : Interactive Front-End Web Development.</i>”; Wiley; 2014.</p> <p>R4. Greg Sidelnikov, “<i>React.js Book_ Learning React JavaScript Library</i>”, 1 edition, Scratch-River Tigris LLC 2016</p> <p>R5. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhx_o_jxIY_uTWA&index=2 </p>

Course Code: CSE3151	Course Title: Java Full Stack Development	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	CSE3152 .NET Full Stack Development					

Course Description	This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.			
Course Objectives	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.			
Course Outcomes	On successful completion of the course the students shall be able to: 1] Practice the use of Java for full stack development [Apply] 2] Implement web applications using Java EE. [Apply] 3] Solve simple applications using Java Persistence and Hibernate [Apply] 4] Apply concepts of Spring to develop a Full Stack application. [Apply] 5] Demonstrate automation tools like Maven, Selenium for Full Stack development. [Apply]			
Course Content:				
Module 1	Introduction	Project	Programming	12 Sessions
Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.				
Module 2	Java EE Web Applications	Project	Programming	12 Sessions
Topics: Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App Assignment: Develop an application for managing HR policies of a department.				
Module 3	Java Persistence using JPA and Hibernate	Project	Programming	12 Sessions

Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society.				
Module 4	Spring Core	Project	Programming	12 Sessions
Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development Assignment: Develop a software tool to do inventory management in a warehouse.				
Module 5	Automation tools	Project	Programming	12 Sessions
Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup – Command line and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands Assignment: Illustrate the use of automation tools in the development of a small software project.				
Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.				
Project work/Assignment:				
1. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.				
Text Book: T1 : Mayur Ramgir, “Full Stack Java Development with Spring MVC, Hibernate, jQuery , and Bootstrap”, 1 st Edition, Wiley Publication, 2020.				
References R1: Chris Northwood, “The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Developer”, 1st edition, APress,2018.				

R2: Herbert Schildt, “Java The complete reference” , 11th Edition, ORACLE, 2020

Course Code: CSE3152	Course Title: .NET Full Stack Development Type of Course: Theory Integrated Lab Course		L-T-P-C	2	0	2	3
Version No.	1.0						
Course Pre-requisites	NIL						
Anti-requisites	NIL						
Course Description	The course aims to provide the advanced level concepts and skills required to perform full stack development using .NET with emphasis on employability skills. The course focuses on topics using .NET and the related technologies/tools like C#, ASP.NET, ADO.NET, Entity Framework Core, etc.						
Course Objective	On successful completion of the course the student shall be able to emphasis on employability skills in .NET full-stack development through Experimental Learning techniques. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc.						
Course Outcomes	On successful completion of the course, the students shall be able to CO1: Describe the concepts of C# for developing a few applications CO2: Explain the applications using Entity Framework and ADO.NET. CO3: Illustrate simple web applications that use SQL and ASP.NET MVC CO4: Demonstrate the full-stack applications using ASP.NET						
Course Content:							
Module 1	C# Programming for Full Stack Development	Assignment/ Problem Solving	Remember [L1]	22 Session (L- 12 & P-10)			
Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework.							
Module 2	Entity Framework Core 2.0	Assignment/ Problem Solving	Understand [L2]	18 Session (L- 8 & P-10)			
Topics: Entity Framework Core 2.0 Code First Approach; Introduction to Entity Framework and EDM; Querying the EDM; Working with Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET.							
Module 3	MVC	Assignment/ Problem Solving	Apply [L3]	10 Session			

				(L- 5 & P-5)
Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working with Data in Asp.Net, Razor View Engine, State Management in Asp. Net MVC & Layouts.				
Module 4	ASP.NET	Assignment/ Problem Solving	Apply [L3]	10 Session (L- 5 & P-5)
Topics: Introduction To Models, Validations in Asp.Net MVC, Authentication and Authorization in Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application.				
Project work/Assignment:				
1. Assignments: The assignments will be a mix of in-class and out-of-class laboratory exercises. They will usually require some kind of procedural work (we will provide instructions), as well as some reflection on the work done, such as researching processes and procedures. 2. Lab experiments: The student should perform the laboratory exercises during the lab hours as instructed by the instructor. At the end of each lab session the scores will be allotted according to the student's performance.				
Text Book(s): T1. Benjamin Perkins, Jon D. Reid, <i>"Beginning C# and .NET"</i> , Wiley, 2021 T2. Dustin Metzgar, <i>"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"</i> , Manning, 2017 T3. Valerio De Sanctis, <i>"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"</i> , 4th Edition, Packt, 2021.				
Reference(s): R1. Piotr Gankiewicz, <i>"Full Stack .NET Web Development"</i> , Packt, 2017. R2. Tamir Dresher, Amir Zuker, Shay Friedman, <i>"Hands-On Full-Stack Web Development with ASP.NET Core"</i> , Packt, 2018.				
Online Resources (e-books, notes, ppts, video lectures etc.): W1. https://www.javatpoint.com/csharp-programs W2. https://www.tutorialsteacher.com/articles/asynchronous-programming-with-async-await-task-csharp W3. https://learn.microsoft.com/en-us/aspnet/mvc W4. https://learn.microsoft.com/en-us/aspnet/entity-framework W5. https://learn.microsoft.com/en-us/aspnet/core/mvc/views/razor W6. https://www.javatpoint.com/asp-net-mvc				
Topics related to development of "SKILL/EMPLOYABILITY DEVELOPMENT": Entity Framework Core 2.0, ASP.NET Core, Data Access with ADO.NET, Razor View Engine, Advanced Asp.Net MVC, Microsoft Testing Framework – Unit Testing the .NET Application				

Course Code: CSE3188	Course Title: Natural Language Processing Type of Course: Program Core	L-T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE3001 – Artificial Intelligence and Machine Learning					
Anti-requisites	NIL					
Course Description	<p>This course introduces the basics of Natural Language Processing methods with specific emphasis on modern applications. The course will teach students different concepts of natural language processing, such as word representations, text representations, part-of-speech tagging, word sense disambiguation, parsing, etc.</p> <p>Topics: Word representations, Part-of-Speech tagging, chunking, parsing, text classification, sentiment analysis, named entity recognition, and machine translation.</p>					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none">1. Define different problems related to natural language processing. [Remember]2. Discuss using NLP techniques for different applications. [Understand]3. Propose solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply]4. Learn to use different NLP tools and packages. [Apply]					
Course Content:						
Module 1	Introduction to Natural Language Processing				No. of sessions:14 [L8 + P6]	
Definition of Natural Language Processing; Description of various NLP tasks; Sentence and word boundary detection; Introduction to word representation, PoS tagging, Chunking and Parsing, and text classification; Introduction to NLP applications like Sentiment Analysis, Named Entity Recognition, and Machine Translation						
Module 2	Word and Text Representation				No. of sessions:16 [L8 + P8]	
Introduction to Word Embeddings; Creation of word embeddings using Skipgram; Using word embeddings like GloVe / fastText; Cross-lingual word embeddings (Eg. MUSE); Pre-trained monolingual and multilingual language models. Text Representations Using BoW, feature-based, Kernel, embedding-based representations.						
Module 3	Part-of-Speech Tagging, Chunking and Parsing				No. of sessions:16 [L8 + P8]	
Sequence Labeling and Hidden Markov Model; Viterbi Algorithm; Part-of-Speech Tagging; Using						

NLTK and Spacy for PoS Tagging; Building a PoS Tagger; Chunking and Constituency Parsing; Using Parser from NLTK.				
Module 4	NLP Applications			No. of sessions:14 [L6 + P8]
Lexical Resource Creation – Creation and evaluation. Agreement metrics Sentiment Analysis – Definitions, Challenges (Sarcasm, Thwarting, etc.) Named-Entity Recognition – Definition, Relationship between NER and PoS tagging Machine Translation – Definition, Challenges, Approaches and Paradigms, Evaluation Techniques.				
List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Introduction to Using Word Representations and NLP Tools 2. Complex Word Identification 3. Sentiment Analysis and Named Entity Recognition 4. Lexical Simplification 5. Cross-Lingual NLP 6. Extracting PoS features 7. Building PoS Tagger 8. Machine Translation Using Transformers 				
Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • Google Colab • NLTK • Huggingface Transformers 				
Project work/Assignment:				
<ol style="list-style-type: none"> 1. Group project on some NLP Task like text classification, sentiment analysis, etc. 				
Textbook(s): <ol style="list-style-type: none"> 1. Daniel Jurafsky, James H. Martin. “<i>Speech and Language Processing: An Introduction to Natural Language Processing</i>”, Computational Linguistics and Speech, Pearson Publication, 2024 (3rd Edition Draft). 2. Aditya Joshi, Pushpak Bhattacharyya. “<i>Natural Language Processing</i>”, Wiley Publication, 2023 (1st Edition). 				
References: <ol style="list-style-type: none"> 1. Chris Manning and Hinrich Schütze. “<i>Foundations of Statistical Natural Language Processing</i>”, MIT Press. Cambridge, MA. 1999 (1st Edition). Weblinks: <ul style="list-style-type: none"> • NPTEL online course: https://nptel.ac.in/courses/106106211 • Latest edition of Text Book: https://web.stanford.edu/~jurafsky/slp3/ 				

Course Code: CSE3189	Course Title: Deep Learning Type of Course: Theory & Integrated Laboratory	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE 3001-Artificial Intelligence and Machine Learning					
Anti-requisites	NIL					
Course Description	This course introduces students to the concepts of deep neural networks and state of the art approaches to develop deep learning models. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. It will help to design and develop an application-specific deep learning models and also provide the practical knowledge handling and analyzing end user realistic applications. Topics include Fundamental concepts of deep neural networks, Convolutional Neural Networks, Recurrent Network structures, Deep Unsupervised Learning, Generative Adversarial Networks and applications in various problem domains.					
Course Objective	This course is designed to improve the learners <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 5. Learn the Fundamental Principles of Deep Learning. (Remember). 6. Identify the Deep Learning Algorithms for learning tasks in various related domains (Apply). 7. To understand and apply deep generative models. (Understand). 8. Apply deep learning architectures to image and audio data. (Apply)					
Course Content:						
Module 1	Introduction to Deep Learning and Neural Networks	Assignment				13[7L+6P] Sessions
Topics: Fundamentals of Deep Learning, Perceptron, Multilayer Perceptron, Optimizing Perceptions using Activation Functions, Loss Functions, Gradient Descent. Feedforward Neural Network, Training Neural Network with Back-propagation, Hyper parameters, Regularization, Dropouts, Batch Normalization, Practical Issues in Neural Network Training -The Problem of Overfitting, The Vanishing and Exploding Gradient Problems						

Module 2	Common Deep Learning Architectures:	Assignment		18[8L+10P] Sessions
Topics: Convolutional Neural Network, Transfer learning Techniques, Variants of CNN: DenseNet, ResNet Sequence Modelling: Recurrent Neural Network and its variants - Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU)				
Module 3	Deep Generative Models	Assignment		16[8L+8P] Sessions
Topics: Generative Adversarial Networks, Kohonen Networks, Autoencoders, Boltzmann Machine, Restricted Boltzmann Machine, Deep Belief Network				
Module-4	Advanced Deep Learning Architectures	Assignment		13[7L+6P] Sessions
Topics: Hopfield Network, Probabilistic Neural Network, Deep Reinforcement Learning - The Basic Framework of Reinforcement Learning Deep Learning applications: Image segmentation, Object detection, Speech Recognition, Video Analytics				
Project work/Assignment:				
3. Assignment 1 on (Module 1 and Module 2) 4. Assignment 2 on (Module 3 and Module 4)				
List of Laboratory Tasks: Lab 1: Working with Deep Learning Frameworks Objective: Explore various Deep Learning Frameworks Tasks: Identify deep learning frameworks (Keras, Tensorflow, Matplotlib, etc) Activity: Practice with various methods available in DL Frameworks to develop a Model.				

Lab 2: Build a Basic Artificial Neural Network

Objective: Create a ANN with DL frameworks.

Task: Identify suitable ANN Layers using Keras and Tensorflow.

Activity: Design a basic Artificial Neural Networks using Keras with TensorFlow (pima-indians-diabetes)

Lab 3 and Lab 4: Build a MultiLayer Perceptron

Objective: Create a MLP for classification task.

Task: Identify suitable model for house price prediction.

Activity: Design a MLP for implementing classification and fine-tuning using House price.csv

Lab 5: Build a Convolutional Neural Network

Objective: Create a CNN model.

Task: Build CNN architecture for Dog-Cat classification problem.

Activity: Implement a Convolution Neural Network (CNN) for dog/cat classification problem using keras

Lab 6 and Lab 7: Build a Time-Series Model

Objective: Create a RNN and LSTM Model

Task: Build RNN/LSTM Model for predicting time series data.

Activity Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes

Lab 8: Build a Gated Recurrent Unit architecture.

Objective: Create a Time Series Model.

Task: Build GRU Architecture for predicting time series data.

Activity: Implement a GRU architecture for language translations.

Lab 9 and Lab 10: Build a Transfer Learning Model.

Objective: Create a Seq2Seq Model

Task: Create Hugging-face API using Transfer learning model.

Activity: Implement Transfer Learning models for classification problems Exploring Hugging-face API

Lab 11: Build an Auto-Encoder model

Objective: Create an Unsupervised Deep Learning Model.

Task: Create AutoEncoder network Output Translations.

Activity: implement an Encoder-Decoder Recurrent neural network model for Neural Machine Translation.

Lab 12: Build Generative Adversarial Networks.

Objective: Create an Unsupervised Deep Learning Model.

Task: Design GAN Architecture for Image generations.

Activity: Design a Age Prediction model by Applying Generative Adversarial

REFERENCE MATERIALS:

TEXTBOOKS

1. François Chollet, “Deep Learning with Python”, 2nd Edition, Manning Publications, 2022
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.

REFERENCES

1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra , “Deep Learning”, Pearson Publication, 2021.
2. David Foster, “Generative Deep Learning” O’Reilly Publishers, 2020.
3. John D Kellehar, “Deep Learning”, MIT Press, 2020.

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and Learning Systems
<https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385>
2. IEEE Transactions on Pattern Analysis and Machine Intelligence

https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34 http://ijaerd.com/papers/special_papers/IT032.pdf	3. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x
SWAYAM/NPTEL/MOOCs:	
4. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview	
5. Coursera – Neural Networks and Deep Learning Andrew Ng	
6. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera	

Course Code: CSE 2054	Course Title: Storage Area Networks Type of Course: Theory Only Course	L- T-P- C	3	0	0	3
Version No.	2					
Course Pre-requisites	CSE2009-Computer Organization and Architecture					
Anti-requisites	NIL					
Course Description	The course aims to equip students with basic introduction to Storage Area Networks, including storage architectures, logical and physical components of a storage infrastructure, managing and monitoring the data center and basic Disaster Recovery principles.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Storage Area Networks and to attain Skill Development through Participative Learning techniques.					
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1 Describe key challenges in managing information and different storage networking technologies. [Understand]</p> <p>CO2 Explain physical and logical components of a storage infrastructure of RAID, and intelligent storage systems.[Understand]</p> <p>CO3 Describe Object, Content addressed storage and storage virtualization. [Understand]</p> <p>CO4 Apply business continuity solutions—backup and archive for managing fixed content. [Apply]</p>					

Course Content:						
Module 1	Storage System: Introduction to Information Storage	Surprise Test/ Assignment		Data Collection/Interpretation	No of Classes:12	
	Topics: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application					
Module 2	Data Protection – RAID, Intelligent Storage Systems	Quiz /Case studies		Case studies / Case let	No of Classes:11	
	Topics: RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison. Intelligent Storage Systems: Components of an Intelligent Storage System, Types of Intelligent Storage Systems.					
Module 3	Object-Based and Unified Storage	Quiz/ Seminar		Case studies / Case let	No of Classes:10	
	Topics: Object-Based Storage Architecture: Components of OSD, Object Storage and Retrieval in OSD, Benefits of Object-Based Storage, Content-Addressed Storage. Virtualization in SAN: Block-level Storage Virtualization, Virtual SAN (VSAN)					
Module 4	Backup and Archive, Replication	Seminar		Case studies / Case let	No of Classes:12	
	Topics: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments. Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas.					
	Targeted Application & Tools that can be used: NA					

	Project work/Assignment:
	Assignment: Group Seminar/Quiz/Case Study
	Textbook T1. G. Somasundaram, Alok Shrivastava. “ <i>Information Storage and Management</i> ”, EMC Education Services, Wiley India. 2 nd Edition.2012. https://download.e-bookshelf.de/download/0000/5732/07/L-G-0000573207-0002358484.pdf (Text book Download)
	References R1. Ulf Troppens, Rainer Erkens and Wolfgang Muller. “ <i>Storage Networks Explained</i> ”, Wiley India. 2 nd Edition.2015. R2. Rebert Spalding. “ <i>Storage Networks The Complete Reference</i> ”, Tata McGraw Hill, Indian Edition.2017. R3. Richard Barker and Paul Massiglia. “ <i>Storage Area Networks Essentials A Complete Guide to Understanding and Implementing SANs</i> ”, Wiley. 1 st Edition.2008. Web resources: 1. https://www.ibm.com/topics/storage-area-network and EMC ² “ Storage Area Network Essentials ” A Complete Guide to Understanding and Implementing SANs by Richard Barker, Paul Massiglia
	Topics relevant to “Skill Development”: Data Protection – RAID, Data center, Back up and replication for: Skill Development through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3079	Course Title: Parallel Computing Type of Course: Theory only	L- T- P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	CSE2009-Computer Organization and Architecture, CSE2007-Design and Analysis of Algorithms and CSE2010-Operating Systems					
Anti-requisites	NIL					

Course Description	This is an introductory course to Parallel Computing. The purpose of this Course is to understand the motivation for Parallel Computing and the concept of Parallel Computing. It also exposes various Models of Parallel Computers and their interconnections and how computations can be performed using Parallel Algorithms and Parallel Programming Models like OpenMP and MPI.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Parallel Computing and attain Employability through Problem Solving techniques			
Course Out Comes	On successful completion of this course the students shall be able to: 1] Describe Parallel Systems[Remember] 2] Explain a Parallel Algorithm for the given Problem [Understand] 3] Illustrate various parallel algorithm design [Apply] 4] Demonstrate the usage of Parallel Programming Tools [Apply]			
Course Content:				
Module 1	Motivation, History & Scope of Parallel Computing, Concurrency	Assignment	Parallel computing application areas	13 Sessions
Topics: The significance of parallel computing, Motivating parallelism, scope and applications, types of computing – concurrent, parallel and distributed computing; Types of Parallel Systems: Shared Memory Systems and Distributed Memory Systems; Parallelism in uniprocessor systems – Implicit parallelism - pipelining and superscalar execution, Parallel processing mechanisms, Parallel Computer structures – pipeline computers, array processors, multiprocessor systems				
Module 2	Parallel Hardware	Assignment	Programming activity using OpenMP	12 Sessions
Topics: Flynn's Classification – SIMD , MIMD, interconnection networks, Performance evaluation criteria, The Effect of Granularity on Performance, Message-Passing Programming, Send and Receive Operations, Interconnection networks, Shared memory interconnects: Bus, Crossbar; Distributed Memory Model, Basic communication operations-One to all Broadcast and All to one Reductions, Ring, Mesh, Hypercube				

Module 3	Parallel Algorithm Design	Quiz	Parallel computing Decomposition methods	10 Sessions
Topics: Introduction to Decomposition, tasks and dependency graphs; granularity, concurrency and task interaction; Processes and mapping; processes versus processors; Decomposition techniques – recursive decomposition, data decomposition, exploratory decomposition, speculative decomposition, hybrid decomposition; Characteristics of tasks and interactions; Parallel algorithm models – data parallel, task graph, work pool, master slave, producer-consumer, hybrid models				
Module 4	Parallel Programming	Assignment	Programming activity using MPI	10 Sessions
Topics: Parallel Programming Models: Shared Memory Model and Distributed Memory Model, Shared Memory Model Programming with OpenMP: Parallel for loops, Declaring private variables, , Critical sections, Reductions, Performance Improvements, More General Data Parallelism, Functional Parallelism Overview of Distributed Memory Programming Model using MPI: Message Passing Model, Message Passing Interface, Circuit Satisfiability: MPI_Init, MPI_Comm_rank, MPI_Finalize, Compiling MPI Programs, Running MPI programs, Introducing Collective Communication: MPI_Reduce, Benchmarking Parallel Performance; MPI_Wtime, MPI_Wtick, MPI_Barrier.				
Targeted Application & Tools that can be used: OpenMP programming				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
1] Programming: problem solving and implement it using OpenMP. 2] Implementation of Blended learning through Live Demos of Parallel Programs using OpenMP.				
Text Book 1] T. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, “Introduction to Parallel Computing”, 4th edition. Noida, India: Pearson Education, Ltd., 2020. 2] T2. Peter Pacheco, “An Introduction to Parallel Programming-Morgan Kaufmann publishers, 2021.				
E Book Link 1. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=13770&query_desc=ti%2Cwrdl%3A%20parallel%20computing				
Web Links:				

1. Technology Enabled Learning - NPTEL offers as Course on “Introduction to Parallel Programming in OpenMP” by Yogish Sabharwal, IIT, Delhi. 2. https://swayam.gov.in/nd1_noc19_cs45/preview
References 1] Michael J Quinn, “Parallel computing: Theory and Practice”, 2nd edition. New Delhi, India: Tata MacGraw Hill Education Private Limited, 2002. 2] Michael J Quinn, “Parallel Programming in C with MPI and OPENMP”, Indian edition. Chennai, India: Tata MacGraw Hill Education (India) Private Limited, 2004. 3] Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing”, Indian edition, New Delhi, India: MacGraw Hill Education (India) Private Limited, 2012 4] Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan Kaufmann, Burlington, USA, 2011. 5] V.Rajaraman, C. Siva Ram Murthy, ”Parallel Computers: Architecture and Programming”, 2nd edition, PHI Learning Private Limited, Delhi, India, 2016.
Topics relevant to development of “Skill Development”: OpenMP and MPI programming

Course Code: CSE2025	Course Title: Business Continuity and Risk Analysis Type of Course: Theory	L-T- P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Through the study of incident response and contingency planning, including incident response plans, disaster recovery plans, and business continuity plans, this course aims to help students comprehend the principles of risk management.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Business Continuity and Risk Analysis and attain Employability through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe concepts of risk management [Remember] 2. Define and be able to discuss incident response options [Remember] 3. Design an incident response plan for sustained organizational operations [Apply]					

	4. Demonstrate and recommend contingency strategies, including data backup and recovery and alternate site selection for business resumption planning. [Apply]	
Course Content:		
Module 1 Sources of disaster and types of disasters		10 Sessions
	Disaster Recovery Operational cycle of disaster recovery, disaster recovery cost, incidents that requires disaster recovery plans, evaluating disaster recovery - methods, team, phases, objectives, checklist. Best practices for disaster recovery - Business continuity - Business continuity vs. disaster recovery	
Module 2 Business continuity management:		12 Sessions
	Introduction - Elements of business continuity management. Business continuity plan – Business continuity planning and strategies - BCP standards and guidelines - BCP Project Organization - Crisis communication plan - Emergency response plan - Contingency planning	
Module 3 Managing, assessing and evaluating risks:		12 Sessions
	Importance of risk management - Risk management methodology - Attack methods and Countermeasures - Cost benefits analysis of risk management - Risk assessment responsibilities - Responsibilities of security professional - Information system auditing and monitoring – Verification tools and techniques.	
Module 4 Risk control policies and Counter measures		11 Sessions
	Introduction - Counter measures - Risk control policy development factors- Development of information assurance principles and practices - Laws and procedures in information assurance policy implementation, Security test and evaluation, Automated security tools, Cost benefit analysis, Developing a risk assessment methodology, Security requirements, Information categorization, Risk management methodologies to develop life cycle management policies and procedures, Education, training and awareness. Policy development Information security policy, change control policies, system acquisition policies and procedures, Risk analysis policies and General risk control policies.	
	Text Book <ol style="list-style-type: none"> 1. John W. Rittinghouse and James F. Ransome, Business Continuity and Disaster Recovery for Info Sec Managers. Elsevier: Elsevier Digital Press, 2005. (ISBN: 978-0-52-119019-0) 2. EC Council Press. Disaster Recovery, 1st Ed. Course Technology, 2011. (ISBN: 978-1-55558-339-2) 	

	<p>References</p> <ol style="list-style-type: none"> 1. ISO 27001:2013 A specification for an information security management system 2. David Alexander, Amanda Finch, David Sutton, Andy Taylor. Information Security Management Principles, 2nd Ed. BCS Shop, 2013. (ISBN: 9781780171753) 3. Mark Talabis, Jason Martin. Information Security Risk Assessment Toolkit Practical Assessments through Data Collection and Data Analysis. Syngress Imprint, 2013. (ISBN: 978-1-59-749735-0). <p>Web resources: http://pu.informatics.global</p>
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Business continuity vs. disaster recovery, risk management, Storage disaster recovery services tools, Verification tools and techniques for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE2051	Course Title: Information Retrieval	L- P- C	3	0	3
	Type of Course: Theory Only Course				
Version No.	1				
Course Pre-requisites	Basic Knowledge in Data Structures and algorithms and probability and statistics, background in machine learning				
Anti-requisites	NIL				
Course Description	The course studies the theory, design and implementation of Text- based information systems. The Information Retrieval core concepts of the course include statistical characteristics of text, representation of information needs and documents. Topics Include Several important retrieval models (Basic IR Models, Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model, Latent Semantic Indexing Model, Neural Network Model). Retrieval Evaluation, Retrieval Metrics, Text Classification and Clustering algorithms, Web Retrieval and Crawling. Recommender Systems: Basics of Content-based Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Information Retrieval and attain SKILL DEVELOPMENT through Participative Learning techniques				

Course Out Comes	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval. [Remember] CO2: Identify the effectiveness and efficiency of different information retrieval methods. [Apply] CO3: Explain different indexing methodology requirements. [Understand] CO4: Classify different recommender system and its aspect. [Understand]			
Course Content:				
Module 1	Introduction to Information Retrieval	Assignment	Data collection	9 Sessions
Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes				
Module 2	Modeling and Retrieval Evaluation	Assignment	Problem solving	12 Sessions
Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.				
Module 3	Indexing & Web-Retrieval	Term paper/Assignment	Data analysis	16 Sessions
Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing. The Web – Search Engine Architectures – Cluster based Architecture - Search Engine Ranking – Link based Ranking – Simple Ranking Functions, Evaluations — Search Engine Ranking – Applications of a Web Crawler.				
Module 4	Recommender System	Term paper/Assignment	Problem solving	8 Sessions
Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models.				
Targeted Application & Tools that can be used: Information Retrieval System, Collaborative Filtering System, Feedback System, Evaluation Metrics				
Assignment:				
Group discussion, Quiz				
Text Book T1 Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —” Modern Information Retrieval: The Concepts and Technology behind Search”, Third Edition, ACM Press Books, 2018. Link: https://people.ischool.berkeley.edu/~hearst/irbook/				

T2 Ricci, F, Rokach, L. Shapira, B.Kantor, —"Recommender Systems Handbook", Fourth Edition, 2018.
References R1 Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —" <i>Information Retrieval: Implementing and Evaluating Search Engines</i> ", The MIT Press, 2017. R2 Jian-Yun Nie Morgan & Claypool – " <i>Cross-Language Information Retrieval</i> ", Publisher series 2011. R3 Stefan M. Rüger Morgan & Claypool – " <i>Multimedia Information Retrieval</i> ", Publisher series 2014. R4 B. Liu, Springer, - " <i>Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data</i> ", Second Edition, 2013. R5 C. Manning, P. Raghavan, and H. Schütze, —"Introduction to Information Retrieval", Cambridge University Press, 2015. Link: https://nlp.stanford.edu/IR-book/ Web Based Resources and E-books: https://puniversity.informaticsglobal.com/login
Topics relevant to the development of SKILLS: Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3347	Course Title: Optimization Techniques for Machine Learning Type of Course: Discipline Elective		L- T-- P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		CSE3001 – Artificial Intelligence and Machine Learning					
Anti-requisites		NIL					
Course Description		<p>This course introduces a range of machine learning models and optimization tools that are used to apply these models in practice. Course will introduce what lies behind the optimization tools often used as a black box as well as an understanding of the trade-offs of numerical accuracy and theoretical and empirical complexity.</p> <p>For the students with some optimization background this course will introduce a variety of applications arising in machine learning and statistics as well as novel optimization methods targeting these applications.</p>					

Course Objective		The objective of the course is to familiarize the learners with the concepts of Optimization Techniques for Machine Learning and attain Skill Development through Participative Learning techniques.			
Course Outcomes		<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate simple examples to illustrate how Machine Learning is applied in real-world scenarios. [Understand]. 2. Implement Machine Learning models (e.g., decision trees, linear regression, neural networks) using tools or programming languages. [Apply]. 3. Determine the suitability of convex optimization in solving problems like portfolio optimization, machine learning, or network design. [Apply]. 4. Solve convex optimization problems with real or simulated data, such as minimizing a cost function or optimizing resource allocation. [Apply]. 			
Course Content:					
Module 1:	Fundamentals of Machine learning	Quiz		Knowledge based Quiz	10 Sessions
	Topics: Machine Learning Paradigm, Empirical Risk Minimization, Structural Risk Minimization, Learning Guarantees, Introduction of VC-Dimension, Dimensionality Reduction Techniques.				
Module 2:	Machine learning models	Quiz		Comprehension based Quiz	12 Sessions
	Topics: Logistic Regression, Support Vector Machines, Sparse Regression, Low Dimensional Embedding, Low Rank Matrix Factorization, Sparse PCA, Multiple Kernel Learning, Loss Functions, Entropy, Cross-Entropy Loss				
Module 3	Convex optimization models	Assignment		Batch-wise Assignments	13 Sessions
	Topics: Linear Optimization, Convex Quadratic Optimization, Second Order Cone Optimization, Semi-definite Optimization, Convex Composite Optimization.				
Module 4:	Methods for convex optimization	Assignment and Presentation		Batch-wise Assignment and Presentations	10 Sessions
	Topics: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient.				
	Targeted Application & Tools that can be used: Use of Google Colab				
	Project work/Assignment: Survey on Methods for convex optimization Survey on Machine learning models related to optimization				

	Text Book T1. Charu C. Aggarwal, “ <i>Linear Algebra and Optimization for Machine Learning</i> ”, Springer, 2020. T2. Sra Suvrit, Nowozin Sebastian, and Wright Stephen J, “ <i>Optimization for Machine Learning</i> ”, The MIT Press, 2012.
	References R1. Guanghui Lan, “ <i>First-order and Stochastic Optimization Methods for Machine Learning</i> ”, Springer Cham, 2020. Web References W1. https://sm-nitk.vlabs.ac.in/ W2. https://nptel.ac.in/courses/
	Topics relevant to SKILL DEVELOPMENT: Concepts of Convex optimization models and Methods for convex optimization for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE3034	Course Title: BIG DATA SECURITY AND PRIVACY Type of Course: Elective in Big Data Basket Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE3002 Big Data Technologies					
Anti-requisites	NIL					
Course Description	The purpose of this course is to sensitize security in Big Data environments. This course will discover cryptographic principles, mechanisms to manage access controls in Big Data system. This course teaches the principles and practices of big data for improving the privacy and the security of computing systems. Big data is being applied in areas where there is great commercial advantage to be had, and consequently, attacks and failures have become a serious concern. It delves into a set of techniques for defending big data techniques against breaching of bigdata (the privacy aspect) and against malicious attacks (the security aspect).					
Course Objective	This course is designed to develop learners Employability Skills by learning Kerberos configuration for Hadoop ecosystem components – Pig, Hive, Oozie, and Flume.					
Course Outcomes	On successful completion of this course the students shall be able to: <ul style="list-style-type: none"> Define cryptographic principles and mechanisms to manage access controls in Big Data system (Remember) Explain security risks and challenges for Big Data system (Understand) Recognize all security related issues in big data systems (Understand) Apply Kerberos configuration for Hadoop ecosystem components (Apply) 					

Course Content:				
Module 1	Big Data Security Overview	Assignment/Quiz	Big data security-organizational security	9 Sessions
Topics: Introduction: Security Overview – Confidentiality – Integrity – Availability – Authorization – Accounting – Hadoop Security .				
Module 2	Securing Distributed Systems	Assignment	communication protocols for each of the Hadoop ecosystem components	14 Sessions
Topics: Threats Categories, Unauthorized Access, Insider Threats, Denial of Service, Threats to Data, Threat and Risk assessment, User Assessment, Environment Assessment, Vulnerabilities.				
Module 3	Hadoop Security Design, Hadoop Ecosystem Security	Case study	Kerberos configuration for ecosystem tools	10 Sessions
Topics: Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop. Assignment: Kerberos configuration for Hadoop ecosystem tools				
Module 4	Data Security & Event Logging	Case study	Event monitoring in Hadoop cluster	12 Sessions
Topics: Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in Hadoop cluster , Securing Sensitive Data in Hadoop, Securing Data at Rest, Securing data in motion, Implementing data encryption in Hadoop, Event Logging & Common Logarithms summation.				
Assignment:				
1. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link . 2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				

Text Book(s):	
<ol style="list-style-type: none"> 1. Sudheesh Narayanan: Securing Hadoop, PACKT Publications , 2020. 2. Ben Spivey, Joey Echeverria, “Hadoop Security Protecting Your Big Data Problem”, O’Reilly,2015 3. Stephen W. Mancini: Automating Security Protocol Analysis, Storming Media,2012 	
Reference(s):	
Reference Book(s):	
<ol style="list-style-type: none"> 1. Mark Van Rijmenam, “Think Bigger: Developing a Successful Big Data Strategy for Your Business”, Amazon, 1 edition , 2014 2. Frank Ohlhorst John Wiley & Sons, “Big Data Analytics: Turning Big Data into Big Money”, John Wiley & Sons,2012. 3. Sherif Sakr, “Large Scale and Big Data: Processing and Management”, CRC Press,2014. 	
Weblinks:	
W1: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii	
W2: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live	
W3: https://www.exabeam.com/explainers/siem/siem-implementation-in-4-steps/	
W4: https://www.ibm.com/docs/en/cloud-paks/cp-management/2.3.x?topic=guide-audit-logging-in-your-cluster	
W5: https://www.geeksforgeeks.org/hadoop-components-functionality-and-challenges-in-big-data/	
Topics relevant to “SKILL DEVELOPMENT”: Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	

Course Code: CSE 3345	Course Title: Blockchain security and performances Type of Course: Program Core Theory and Laboratory Integrated	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of Blockchain, Data structures, Cryptography and data security, Networks					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students to security and privacy techniques in blockchain based systems. The course provides a comprehensive understanding of blockchain security, risks, methods, and best practices. The course					

	develops critical thinking skills by augmenting the student's ability to tackle security related issues of blockchain The associated laboratory provides an opportunity to validate the concepts taught as well as enhances the ability to visualize real-world problems in order to provide a solution using various tools and techniques.			
Course Objectives	The objective of the course is to familiarize the learners with the concepts of blockchain security & performance and attain Employability through Experiential Learning techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Comprehend security and performance perspective of blockchain technology. [Understand] CO2: Apply cryptographic techniques to enhance security in blockchain based systems [Apply] CO3: Implement secure transaction models. [Remember] CO4: Apply security techniques to blockchain systems that provide solutions to some real-world problems. [Apply]			
Course Outcome	The objective of the course is to familiarize the learners with the concepts of blockchain security & performance and attain Employability through Experiential Learning techniques.			
Course Content:				
Module 1	Fundamentals of Privacy And Security Techniques In Blockchain	Assignment	Programming	19hours [9 T + 10P]
Introduction to Blockchain Technology, Cyber Security Threats and incidents on blockchain networks, Categorization of blockchain threats and vulnerabilities: Client vulnerabilities, Consensus Mechanism vulnerabilities, Mining Pool vulnerabilities, Network vulnerabilities, Smart Contract vulnerabilities; Privacy and security techniques: Mixing, Anonymous Signatures, Homomorphic Encryption, Attribute-Based Encryption, Secure Multi-Party Computation, Non-Interactive Zero-Knowledge (NIZK) Proof, TEE Based Smart Contracts, Game-Based Smart Contracts.				
Module 2	Cryptography	Assignment	Programming	22hours [12T+10P]
Cryptography, Public Key Cryptography and Cryptocurrency, Private Keys, Generating a Private Key from a Random Number, Public Keys, Elliptic Curve Cryptography, Elliptic Curve Arithmetic Operations, Generating a Public Key, Elliptic Curve Libraries, Cryptographic Hash Functions,				

Ethereum's Cryptographic Hash Function: Keccak-256, Ethereum Address and Formats, Inter Exchange Client Address Protocol				
Module 3	Transaction Model	Assignment	Programming	19hours [9T+10P]
Topics: Blockchain Level Transaction Models : UTXO, Account-Based Online Transaction Model, CAP Properties in Blockchain, Security and Privacy Requirements of Online Transactions, Basic Security Properties: Consistency, Tamper-Resistance, Resistance to DDoS attacks, Resistance to Double-Spending attacks, Resistance to the Consensus attacks, Pseudonymity; Additional Security and Privacy Properties of Blockchain: Unlinkability, Confidentiality of Transactions and Data Privacy, Consensus Algorithms, BFT based Consensus Algorithms, Sleepy Consensus, Proof of Elapsed Time, Proof of Authority, Proof of Reputation, Comparison of Consensus Algorithms				
<p>List of Laboratory Tasks:</p> <p>Lab sheet -1</p> <p>Level 1: Create a Block class with the following attributes: index, previous_hash, timestamp, data, hash.</p> <p>Level 2: Implement and demonstrate a simple consensus algorithm.</p> <p>Simulate Proof of Work (PoW) or Proof of Stake (PoS).</p> <p>Validate the chain by achieving consensus among multiple nodes.</p> <p>Lab sheet -2</p> <p>Level 1: A Genesis file contains the properties that define the Blockchain. A Genesis file is the start-point of the Blockchain and so, it is mandatory to create the Genesis file to create a Blockchain.</p> <p>Level 2: Program to Simulate and Detect Vulnerabilities in Blockchain Client Interactions</p> <p>Tasks:</p> <ul style="list-style-type: none"> i) Create scenarios for potential attacks like phishing or keyloggers. ii) Demonstrate secure key management techniques. <p>Lab sheet -3</p> <p>Level 1: Analyze vulnerabilities in consensus mechanisms. Tasks: Simulate a 51% attack or double-spending scenario in a blockchain network. Demonstrate countermeasures to mitigate these vulnerabilities.</p> <p>Level 2: Create several accounts and make some transactions between these accounts and Test properties of cryptographic hashing</p> <p>Lab sheet -4</p> <p>Level 1: To understand and implement cryptographic hash functions and explore their properties.</p> <p>Level 2: To implement a simple demonstration of inter-exchange address format validation using Protocol (IXCAP).</p>				

<p>Lab sheet -5</p> <p>Level 1: Generate an Ethereum Account address using Keccak-256</p> <p>Level 2: To generate a Bitcoin address and validate its checksum.</p> <p>Lab sheet -6</p> <p>Level 1: To implement a simple UTXO (Unspent Transaction Output) model for tracking cryptocurrency transactions.</p> <p>Level 2: To simulate an account-based transaction model for cryptocurrency systems.</p> <p>Lab sheet -7</p> <p>Level 1: To demonstrate the CAP theorem in blockchain systems and analyze consistency, availability, and partition tolerance.</p>
<p>Targeted Application & Tools that can be used:</p> <ul style="list-style-type: none"> • Python (with libraries: ecdsa, cryptography, PyCryptodome, hashlib, web3.py, pysimplechain) • IDE: PyCharm, VS Code, or Jupyter Notebook • Blockchain Simulators: Ganache (for Ethereum-based tasks)
<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course Mini Projects like Cryptocurrency Wallet Simulation, Blockchain Security Analyzer, Secure Voting System Using Blockchain etc..</p>
<p>After completion of each module a programming-based Assignment/Assessment will be conducted.</p> <p>On completion of Module 3, student will be asked to develop a Project.</p>
<p>Textbook(s):</p> <p>T1. Antonopoulos, Andreas M., and Gavin Wood. <i>Mastering ethereum: building smart contracts and dapps</i>. O'reilly Media, 2018.</p> <p>T2. Howard E. Poston, Blockchain Security from the Bottom Up: Securing and Preventing Attacks on Cryptocurrencies, Decentralized Applications, NFTs, and Smart Contracts, <u>John Wiley & Sons</u>, 2022.</p> <p>T3. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2nd Edition, Packt Publishing Ltd, March 2018.</p>

References R1. Parisi, Alessandro. <i>Securing Blockchain Networks like Ethereum and Hyperledger Fabric: Learn advanced security configurations and design principles to safeguard Blockchain networks</i> . Packt Publishing Ltd, 2020. Web Based Resources and E-books: Digital Learning Resources (Library Resources) W1: NPTEL : https://nptel.ac.in/courses/106/104/106104220/# W2: UDEMY : https://www.udemy.com/course/build-your-blockchain-az/ W3 : Book https://www.google.co.in/books/edition/Blockchain_By_Example/ci59DwAAQBAJ?hl=en&gbpv=1 W4 : Book https://www.insiderintelligence.com/insights/blockchain-technology-applications-use-cases/ W6: https://www.analyticsinsight.net/real-world-applications-of-blockchain-technologies/ W7:PU Library Link : https://puniversity.informaticsglobal.com/login Or : http://182.72.188.193/
Topics relevant to “SKILL DEVELOPMENT”: Real time data analysis used for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3088	Course Title: Business Intelligence and Analytics Type of Course: 1] Theory	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE1002: Programming using Python CSE2012: Database Management Systems					
Anti-requisites	NIL					
Course Description	The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective. Business Intelligence (BI) is a set of architectures, theories, methodologies and technologies that transform structured, semi-structured and unstructured data into meaningful and useful information. Students will analyze enterprise data requirements to develop queries, reports and build OLAP cubes that use business analytics to answer complex business questions.					
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					

Course Out Comes		On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Discuss the impact of Business Intelligence (BI) theories, architectures, and methodologies on the organizational decision-making process. [Remembering] 2. Develop Ad hoc queries, reports, spread sheets, dashboards and BI applications. [Applying] 3. Understand big data , roles and responsibilities and big data analytics. [Understanding] 4. Relate the concepts of BI to understand latest trends and the impact of BI on businesses. [Understanding] 			
Course Content:					
Module 1	An Overview of Business Intelligence, Analytics (Remembering)	Assignment			10 Hours Remember
	Topics: A Framework for Business Intelligence (BI). Intelligence Creation Use and BI Governance. Transaction Processing Versus Analytic Processing. Successful BI Implementation. Analytics Overview. Brief introduction to Big Data Analytics.				
Module 2	Business Reporting, Visual Analytics and Business Performance (Applying)	Assignment			12Hours Apply
	Topics: Management Business Reporting Definitions and Concepts. Data and Information Visualization. Different Types of Charts and Graphs. The Emergence of Data Visualization and Visual Analytics. Performance Dashboards. Business Performance Management. Performance Measurement. Balanced Scorecards. Six Sigma as a Performance Measurement System.				
Module 3	Big Data and Analytics (Understanding)	Assignment			12 Hours Understand
	Topics: Definition of Big Data. Fundamentals of Big Data Analytics. Big Data Technologies. Data Scientist. Big Data and Data Warehousing. Big Data Vendors. Big Data and Stream Analytics. Applications of Stream Analytics.				
Module 4	Emerging Trends and Future Impacts (Understanding)	Assignment			11 Hours Understand
	Topics: Location-Based Analytics for Organizations. Analytics for Consumers. Recommendation Engines. The Web 2.0 Revolution and Online Social Networking. Cloud Computing and BI. Impacts of Analytics in Organizations: An Overview. Issues of Legality, Privacy, and Ethics. The Analytics Ecosystem.				

	Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note					
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
	<ol style="list-style-type: none"> 1. Gain an immersive understanding of the practices and processes used by a junior or associate data analyst in their day-to-day job 2. Learn key analytical skills (data cleaning, analysis, & visualization) and tools (spread sheets, SQL, R programming, Tableau) 					
	Text Book <ol style="list-style-type: none"> 1. Ramesh Sharda, Dursun Delen, Efraim Turban “Analytics, Data Science, & Artificial Intelligence (10th ed.). Upper Saddle River, NJ: Pearson. ISBN- 9781292341552, Second Edition 6 March 2020 2. Ramesh Sharda “Business Intelligence Analytics And Data Science A Managerial Perspective” 4Th Edition , Pearson India, April 2019 					
	References <p>R1. C. Albright and W. L. Winston “ Business Analytics: Data Analysis & Decision Making ”, Cengage Learning India Pvt. Ltd ; Sixth Edition , September 2019</p> <p>R2. S. Christian, and L.Wayne, “Business Analytics: Data Analysis and Decision Making with MindTap”. Second Edition , September 2022</p> <p>R3. Jose, J. and Lal, S.P. :Introduction to Computing & problem solving with Python, Khanna Book Publishing First edition 2019</p> <p>R4. B. Mt Wan “ Data Analytics using Python ”, 9th Edition, published by Pearson Education 2020.</p> Web links <p>R1. http://owl.english.purdue.edu/owl/resource/560/01/</p> <p>R2. http://myregisapp.regis.edu/Citrix/StoreWeb/</p> <p>R3. https://in.coursera.org/courses?query=business%20intelligence</p> <p>R4. https://www.coursera.org/learn/business-intelligence-data-analytics</p> <p>R5. https://www.udemy.com/course/business-intelligence-and-data-analytics/</p>					
	Topics relevant to development of “Employability”: Business Intelligence, Big Data Analytics, Data Scientist.					

Course Code: CSE3157	Course Title: Artificial Intelligence and Machine Learning Type of Course: 1 Program Core 2 Laboratory integrated		L-T-P-C	3	0	2	4
Version No.		1.0					

Course Pre-requisites		Python Programming		
Anti-requisites		NIL		
Course Description		<p>This course introduces the basic concepts of artificial intelligence(AI) and Machine Learning (ML) which is a subset of Artificial Intelligence. AI & ML provides important set of techniques and algorithms for solving several real world business and social problems. The objective of this course is to discuss machine learning model development using Python.</p> <p>Topics include: Working with Collections and Data Frames; History, Application and Agents of AI; Knowledge Representation ; Hill Climbing, A* and SMA* algorithms; Knowledge representation - Approaches and Issues, Knowledge-Based Systems; Knowledge representation using Propositional logic and Predicate Logic, Unification and lifting, Forward chaining, Backward chaining.</p> <p>Introduction to the Machine Learning (ML) - Framework, types of ML, Concept Learning: Concept learning task, Find-S algorithm, Candidate Elimination Algorithm, Neural and Bayesian Belief networks – Perceptron, Multi-layer feed forward networks, Back propagation algorithm. Nearest Neighbor techniques, Support Vector Machines; Supervised Learning – Classification & Regression – Algorithms; Unsupervised Learning - Clustering & Association – Algorithms</p>		
Course Objective		The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Machine Learning Employability through Problem Solving Methodologies.		
Course Out Comes		<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Describe the basic understanding of the AI and concepts of searching for AI problems (Understand) 2. Develop knowledge base for representing the given real world data using logic and reasoning methods (Apply) 3. Apply concept learning and Artificial Neural Network techniques for the given problems. (Apply) 4. Articulate Machine Learning model using Supervised and Unsupervised learning algorithms. (Apply) 		
Course Content:				
Module 1	Introduction to Artificial Intelligence and Searching	Assignment	Programming Activity	16 Hours
	<p>Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agent, Structure of Intelligent agent and its functions, Agents and Environment; Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first; A* - SMA* algorithms.</p>			

Module 2	Knowledge Representation	Assignment	Programming activity	18 Hours
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	Topics: Introduction to Knowledge representation, approaches and issues in knowledge representation, Knowledge-based agent and its Structure, Knowledge-Based Systems; Knowledge representation using Propositional logic and Predicate Logic- First-Order Logic - Syntax and Semantics, Knowledge Engineering - Unification and lifting, Forward chaining, Backward chaining			
Module 3	Introduction to Machine Learning, Supervised & Unsupervised Learning	Mini Project	Programming activity	22 Hours
	Topics: Introduction to the Machine Learning (ML) Framework, types of ML, types of variables/features used in ML algorithms, Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm. Supervised Learning – Classification & Regression - Decision Tree Learning, Random Forest - Support Vector Machines ; Simple Linear Regression Algorithm, Multivariate Regression Algorithm			
Module 4	Machine Learning & Neural Network	Assignment	Programming activity	19 Hours

	<p>Topics: Unsupervised Learning – Clustering & Association - K-Means Clustering algorithm , Mean-shift algorithm , Apriori Algorithm, FP-growth algorithm</p> <p>Neural and Belief networks - Perceptron - Multi-layer feed forward networks - Bayesian belief networks, Back propagation algorithm.</p> <p>List of Laboratory Tasks:</p> <p>Lab sheet -1 A review of Python programming - Anaconda platform and its installation, Executing programs on Jupyter IDE/ Colab. Programming exercises on Tuples, Nested data structures</p> <p>Lab sheet -2 Introduction to Numpy, Pandas, Scikit-learn and Visualization techniques. Dictionaries, dictionary comprehension , Data Frames using Pandas and working with frames</p> <p>Lab sheet - 3 Search Algorithms – A* & SMA *</p> <p>Lab sheet -4 Tic-tac-toe game simulation using search and heuristics. Describe the Sudoku game and represent the actions using First-order / Propositional logic. Sorting algorithms employing forward chaining.</p> <p>Lab sheet -5 Find-S Algorithm Candidate Elimination Algorithm Back Propagation Algorithm</p> <p>Lab sheet -6 Support Vector Machines ; Simple Linear Regression Algorithm Multivariate Regression Algorithm</p> <p>Lab sheet -7 K-Means Clustering algorithm Mean-shift algorithm Apriori Algorithm</p> <p>Mini Project / Case Study – Real Time Project</p>
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	<p>Targeted Application & Tools that can be used: Use of PowerPoint software for lecture slides and use of Google's Colab cloud service https://www.tutorialspoint.com/google_colab/index.html for executing and sharing of lab exercises.</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
	<p>1] Programming: Implementation of given scenario using Python and Colab. 2] Assignment: Learning courses for 4 Hours from the following link https://learn.datacamp.com/courses?topics=Machine%20Learning</p>

	Text Book <ol style="list-style-type: none"> 1. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall 2021. 2. Tom Mitchell, “Machine Learning”, First Edition, Tata McGraw Hill India, 2017.
	References <ol style="list-style-type: none"> 1. Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017. 2. Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning Using Python”, Wiley, First Edition 2019. 3. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2016 4. Elaine Rich, Kevin K and S B Nair, “Artificial Intelligence”, 3rd Edition, McGraw Hill Education, 2017. 5. Pattern Classification 2nd Edition by Richard O. Duda , Peter E. Hart , David G. Stork

Course Code: CSE3011	Course Title: Reinforcement Learning Type of Course:1] Program Core 2] Laboratory integrated	L-T-P-C	2 0	2	3
Version No.	1.0				
Course Pre-requisites	CSE3001: Artificial Intelligence and Machine Learning				
Anti-requisites	NIL				
Course Description	<p>For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. It is of utmost importance to come up with innovative solutions for scenarios that are highly stochastic. The objective of this course, is to introduce different reinforcement learning techniques which is a promising paradigm for stochastic decision making in the forthcoming era. Starting from the basics of stochastic processes, this course introduces several RL techniques that are as per the industry standard.</p> <p>With a good knowledge in RL, the students will be able to develop efficient solutions for complex and challenging real-life problems that are highly stochastic in nature.</p>				
Course Objectives	This course is designed to improve the learners ‘EMPLOYABILITY SKILLS’ by using <u>EXPERIENTIAL LEARNING</u> techniques.				

Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Apply dynamic programming concepts to find an optimal policy in a gaming environment [Application] 2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy in a reinforcement learning environment. [Application] 3. Apply Temporal Difference learning techniques to the Frozen Lake RL environment [Application] 4. Apply various exploration-exploitation strategies of the Multi-Armed Bandit (MAB) problem[Application] 			
Course Content:				
Module 1	Introduction to Reinforcement Learning	Assignment	Programming using the OpenAI Gym environment	L – 8 P – 8 Sessions
Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types, episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope				
Module 2	Monte-Carlo(MC) methods	Assignment	Programming using the OpenAI Gym environment	L-7 P-8 Sessions
Topics: Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method.				
Module 3	Temporal Difference(TD) Learning	Assignment/Quiz	Programming using the OpenAI Gym environment	L-7 P – 8 Sessions
Topics: Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing the optimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods.				
Module 4	Multi-Armed Bandit (MAB) problem	Assignment	Programming using the OpenAI Gym environment	L-7 P – 7 Sessions

Topics: Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits, introduction to Deep Reinforcement Learning(DRL) Algorithm – Deep Q Network (DQN)

List of Laboratory Tasks:

1 .Software Setup :installalling Anaconda, OpenAI Gym and Universe.

Basic simulations of some gaming environments in Gym

2. Working with Gym environments to create agents with random policy

2.1 Create the Frozen Lake GYM environment and explore the states, action, transition probability, reward functions and generating episodes.

2.2 Create an agent for the Cart-Pole environment using a random policy and record the game

3. Finding the optimal policy for the agent using Dynamic Programming

3.1 Compute the optimal policy for the Frozen Lake Environment using value iteration method

3.2 Compute the optimal policy for the Frozen Lake Environment using policy iteration method

4. Implementing Monte Carlo prediction method using blackjack game

4.1 Every-visit MC prediction

4.2 First-visit MC prediction

5. Implementing on-policy MC control method using the epsilon-greedy policy for the blackjack game

6. Implementing Temporal Difference prediction for the Frozen lake environment for a random policy

7. Computing the optimal policy using on-policy TD control – SARSA

8. Computing the optimal policy using off-policy TD control – Q-learning

9. Multi-Armed Bandit problem

9.1 Creating a MAB in Gym

9.2 Compute the best arm using various exploration strategies such as epsilon-greedy and softmax exploration method.

10. Application of MAB – Finding the best advertisement banner for a web site using MAB
Targeted Application & Tools that can be used : <ol style="list-style-type: none"> 1. Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or Jupyter Notebook. 2. Laboratory tasks will be implemented using the necessary libraries available in Python
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Students can be given group assignments to develop different gaming environments and implement the RL algorithms
Text Book <ol style="list-style-type: none"> 1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018. 2. SudharshanRavichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020
References <ol style="list-style-type: none"> 1. LaurraGraesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022 2. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

Course Code: CSE3086	Course Title: Information Theory and Coding Type of Course: Theory	L-T-P-C	3	0	0	3
Version No.		1				
Course Pre-requisites		[1]Probability, Calculus and Linear Algebra MAT1001 [2] Data Structures and Algorithms CSE2001				
Anti-requisites		NIL				
Course Description		The Information Theory and Coding course delves into fundamental concepts and techniques essential for the efficient transmission and storage of information in digital communication systems. This course explores the mathematical foundations of information theory including entropy, mutual information and channel capacity. The course covers various coding techniques such as error-correcting codes, block codes, convolutional codes, and their applications in data compression and error detection/correction. Emphasis is placed on understanding how these principles are applied in modern communication systems, ensuring practical skills for designing robust and efficient communication protocols.				

Course Objective		The Information Theory and Coding course offers a deep theoretical understanding of concepts like entropy, mutual information and channel capacity, focusing on their application in designing and analyzing efficient communication systems. Employability is emphasized through Problem Solving , where students engage in collaborative exploration of advanced coding techniques and their theoretical implications.			
Course Outcomes		On successful completion of this course, the students shall be able to: [1] Fundamental information theory concepts and their practical applications by explaining key principles such as entropy, mutual information, and channel capacity, and interpreting their roles in designing and analyzing communication systems. [Understand] [2] Fundamental information theory concepts by implementing efficient coding solutions using Shannon, Shannon-Fano, Huffman, Arithmetic, and LZ algorithms in practical scenarios. [Apply] [3] Knowledge of information theory by analyzing channel entropies, mutual information, and capacities, and examining Shannon's Law and its limitations in practical communication systems.[Apply] [4] Methods for error detection and correction by constructing Hamming codes and performing syndrome decoding. Utilize binary cyclic codes by employing algebraic structures and executing encoding and syndrome calculations with (n-k) bit shift registers.[Apply]			
Course Content					
Module 1	Information Theory	Assignment			11 Sessions
Topics: Introduction, Measure of information, Average information content (entropy) of symbols in long independent sequences, Information rate, Properties of entropy, Extension of discrete memory less (zero-memory) sources, Average information content (entropy) of symbols in long dependent sequences, Mark off statistical model for information source, Entropy and information rate of Mark off sources.					
Module 2	Source Coding	Quiz	Surprise Test-1		12 Sessions
Topics: Properties of codes- Block codes, on-singular codes, Uniquely decodable codes. Instantaneous codes and Optimal codes, Prefix of a code, Test for instantaneous property, Construction of Instantaneous code, Decision tree, Kraft's inequality, Source coding theorem (Shannon's Noiseless coding theorem),					

Shannon's encoding algorithm, Shannon Fano Algorithm, Huffman minimum redundancy code (binary, ternary and quaternary), Code efficiency and redundancy, Extended Huffman Coding, Arithmetic Codes, Lempel – Ziv Algorithm.				
Module 3	Channels and Mutual Information		Assignment	12 Sessions
Topics: Introduction, Discrete communication channels, Representation of a channel, Probability relations- Apriori, Posteriori entropy, Equivocation, Mutual information, Properties, Rate of information transmission over a discrete channel, Capacity of a discrete memoryless channel, Shannon's theorem on channel capacity (Shannon's second theorem), Special channels- Symmetric, Binary symmetric, Binary erasure, Noiseless, Deterministic and cascaded channels, Estimation of channel capacity by Muroga's method, Continuous channels, Shannon-Hartley theorem and its implications, Shannon's limit, Rate Distortion Theory.				
Module 4	Linear Block Codes	Quiz	Surprise Test-2	10 Sessions
Topics: Introduction to Fields and Vector Spaces, Types of errors, Examples, Methods of controlling errors, Types of codes, Linear Block Codes- Matrix description, Encoding circuit, Syndrome and error detection, Syndrome circuit, hamming weight, hamming distance, Minimum distance of a block code error detection and correction capabilities of a linear block code, Single error-correcting Hamming codes, Table lookup decoding using standard array, General decoder for a linear block code. Binary cyclic codes: Algebraic structures of cyclic codes, Encoding using (n-k) bit shift register, Syndrome calculation.				
Targeted Application & Tools that can be used:				
Application areas such as Data compression, Error detection and correction, Cryptography and Security, IoT Professionally Used Software: MATLAB, Simulink, Python with libraries, R and Octave				
	Text Book T1. Fundamentals of Information Theory and Coding Design by Roberto Togneri and Christopher J.S. deSilva (2nd Edition, 2018) T2. Elements of Information Theory by Thomas M. Cover and Joy A. Thomas (2nd Edition, 2006) Dr.Giridhar			
	References R1. Muralidhar Kulkarni and K. S. Shivaprakasha, "Information Theory and Coding", Wiley (India), 2015. R2. Glover and Grant, "Digital Communications", Pearson 2nd Edition, 2008. Weblinks: https://onlinecourses.nptel.ac.in/noc20_eec96/preview https://www.cambridge.org/core/books/students-guide-to-coding-and-information-theory/1F15C9AB07345E9F5913B3E34BB680E4 https://home.ttic.edu/~madhurt/courses/infotheory2021/ https://www.amrita.edu/course/information-theory-and-coding/			

Course Code: CSE 260	Course Title: Introduction to Data Science Lab Type of Course: Program Core		L- T-P- C	0	0	0	2
Version No.		1.0					
Course Pre-requisites		Fundamentals of DS					
Anti-requisites		NIL					
Course Description		Objective of this course is to make students learn the basics of Machine Learning and data science are transforming engineering, healthcare and scientific discovery. In this class we are going to discuss how to use data to build models for prediction and inference. We put a special emphasis on engineering applications, signal prediction and modeling.					
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Introduction to Data Science Lab and attain Skill Development through Experiential Learning techniques.					
Course Out Comes	1.	2. To understand the python libraries for data science 2. To understand the basic Statistical and Probability measures for data science. 3. To learn descriptive analytics on the benchmark data sets. 4. To apply correlation and regression analytics on standard data sets. 5. To present and interpret data using visualization packages in Python.					
Course Content:		On successful completion of the course the students shall be able to: CO1: Make use of the python libraries for data science CO2: Make use of the basic Statistical and Probability measures for data science. Lab Manual CO3: Perform descriptive analytics on the benchmark data sets. CO4: Perform correlation and regression analytics on standard data sets CS3361 Data Science Laboratory CO5: Present and interpret data using visualization packages in Python.					
List of Experiments		Quiz	Knowledge based quiz on				No. of Classes: 30
1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages. 2. Working with Numpy arrays 3. Working with Pandas data frames 4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set. CS3361 Data Science Laboratory 5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b. Bivariate analysis: Linear and logistic regression modeling							

<ul style="list-style-type: none"> c. Multiple Regression analysis d. Also compare the results of the above analysis for the two data sets. 6. Apply and explore various plotting functions on UCI data sets. <ul style="list-style-type: none"> a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms CS3361 Data Science Laboratory Lab Manual e. Three dimensional plotting 7. Visualizing Geographic Data with Basemap
List of Laboratory Tasks: NA
Targeted Application & Tools that can be used: <ul style="list-style-type: none"> 1. AUTODESK SKETCHBOOK V8.4.3 2. AFFINITY PHOTO v 1.9 3. AFFINITY DESIGNER v 1.9 4. AFFINITY PUBLISHER v 1.9
Project work/Assignment:
Textbook(s): <ul style="list-style-type: none"> 1. Chris Solarski, “Drawing Basics and Video Game Art: Classic to Cutting-Edge Art Techniques for Winning Video Game Design”, Watson Guptill Publications. 2. Marc Taro Holmes, “Designing Creatures and Characters: How to Build an Artist's Portfolio for Video Games, Film, Animation and More”, Impact Books.
Web-Resources <ul style="list-style-type: none"> 1. NPTEL Course https://iitm.talentsprint.com/adsmi/mobile/?utm_source=googlesearch&utm_medium=tcpa&utm_campaign=ts-googlesearch-iitm-adsmi-tcpa-ds-training-certifications&utm_content=pg-in-applied-data-science&utm_term=Data%20science%20course&gclid=Cj0KCQiA2-2eBhCIARIsAGLQ2RmJTkyGvtgbA1Xx9NLGFHwRL3JQ3OdgDGXr7prF0hw4pMM8UWi3xkaAjzHEALw_wcB 2. Coursera course https://www.coursera.org/professional-certificates/ibm-data-science
References:
Topics relevant to "SKILL DEVELOPMENT": Data Visualization techniques for Skill development through Experiential Learning techniques . This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3039	Course Title: Social Media Analytics Type of Course: Integrated		L- T- P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites	•	• Python Programming					
Anti-requisites							
Course Description		This course will introduce concepts and approaches to mining social media data. It focuses on obtaining and exploring those data, mining networks, and mining text from social platforms. Students will learn how to apply previously learned data mining concepts to a domain that will likely be familiar to all of them: social media. Students will learn to explore, model, and predict with network and textual data from existing social platforms.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Social Media Analytics and attain Employability through Experiential Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Introduce the idea of social media analytics to the students and assist them in comprehending its importance.• Introduce the learners to the social media analytics tools.• Give the students the tools they need to learn how to analyse the efficiency of social media for business.					
Course Content:							
Module 1	Introduction to Social Media Analytics	Assignment		Data Collection/Interpretation		15 Sessions	
	Introduction to Social Media Analytics (SMA): Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas. Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization						
Module 2	Making connections: & Web analytics tools:	Case studies / Case let		Case studies / Case let		15 Sessions	

	<p>Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity.</p> <p>Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis</p>				
Module 3	Network Data Analytics:	Quiz		Case studies / Case let	15 Sessions
	<p>Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on Social Network. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis.</p> <p>(LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites)</p>				
Module 4	Processing and Visualizing Data	Quiz		Case studies / Case let	15 Sessions
	<p>Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics Introduction to Python Programming, Collecting and analyzing social media data; visualization and exploration.</p>				
	<p>Practical: Students should analyze the social media of any ongoing campaigns and present the findings.</p>				
	Project work/Assignment:				
	<p>Assignment on: Types of Data, Data Transfer, Fundamental Twitter Terminology</p>				
	<p>Text Book</p> <p>T1 Mathew A. Russell, “<i>Mining the Social Web</i>”, O’Reilly, 3rd Edition, 2019.</p> <p>T2 Marco Bonzanini, “<i>Mastering Social Media Mining with Python</i>”, PacktPub, 2016</p>				
	<p>References</p> <p>1 Michal Krystianczuk and Siddhartha Chatterjee, “Python Social Media Analytics”, Packt Publishing, 2017</p> <p>2 Sponder, M “<i>Social media analytics: Effective tools for building, interpreting, and using metrics</i>”. McGraw Hill Professional.</p> <p>ook link R1:</p> <p>E book link R2</p> <p>Web resources:</p> <ol style="list-style-type: none"> https://www.coursera.org/learn/social-media-data-analytics https://www.udemy.com/course/introduction-to-social-analytics/ https://onlinecourses.nptel.ac.in/noc21_cs28 https://research.facebook.com/publications/realtime-data-processing-at-facebook/ <p>Weblinks:</p> <ol style="list-style-type: none"> https://www.coursera.org/learn/social-media-analytics-introduction https://academy.quintly.com/courses/free-social-media-analytics https://presidencyuniversity.in/facility/library/ 				
	<p>Topics relevant to “EMPLOYABILITY SKILLS”:</p> <p>Handling Unstrucuted Data for Employability skills through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.</p>				

Course Code: CSE3035	Course Title: R Programming For Data Science Type of Course: Integrated			L- T-P- C	1	0	4	3
Version No.		1						
Course Pre-requisites		NIL						
Anti-requisites		NIL						
Course Description		This course is designed to provide the core concepts of data analytics in the R environment. Initially train them with basic R, then progressively increase the difficulty as they move along in the course, capping with advanced techniques through case studies. Mastering the core concepts and techniques of data analytics in R, will help the students to apply their knowledge to a wide range of Data Analytics. R is now considered one of the most popular analytics tools in the world.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of R Programming For Data Science and attain Skill Development through Experiential Learning techniques.						
Course Out Comes		On successful completion of this course the students shall be able to: <ul style="list-style-type: none">• Apply basic R functions pertaining to fundamental data analysis. [Application]• Interpret data using appropriate statistical methods [Application]• Demonstrate the decision trees concept with the given dataset. [Application]• Demonstrate the Mining concepts for both Data and Text. [Application]						
Course Content:								
Module 1	Introduction	Assignment		Data Collection/Interpretation	11 Sessions			
	Topics: Introduction to R, Overview of data analysis, Working with directory in R, Loading and handling data in R, Data Visualization with ggplot2, Data Transformation with dplyr.							
Module 2	Exploratory Data Analysis	Coding Assignment		Case Study	11 Sessions			
	Topics: Exploring a new dataset, Anomalies in numerical data, Visualizing relations between variables, Assumptions of Linear Regression, Validating Linear Assumption, Missing Values, Covariation, Patterns and Models, ggplot2 Calls.							
Module 3	Regression Analysis	Coding Assignment		Project	12 Sessions			
	Topics: Introduction, Types of Regression Analysis Models, Linear Regression, Simple Linear Regression, Non-Linear Regression, Regression Analysis with Multiple Variables, Cross Validation, Principal Component Analysis, Factor Analysis.							
Module 4	Classification	Quiz		Project	11 Sessions			

	Topics: Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Nearest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.
	List of Laboratory Tasks: 1. Using with and without R objects on console 2. Using mathematical functions on console 3. Write an R script, to create R objects for calculator 4. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars & cars datasets. 5. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R 6. Find the data distributions using box and scatter plot. 7. Find the outliers using plot. 8. Plot the histogram, bar chart and pie chart on sample data 9. Find the correlation matrix. 10. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data 11. Create a regression model for a given dataset 12. Install relevant package for classification. 13. Choose classifier for classification problem. c. Evaluate the performance of classifier. 14. Install relevant package for classification. 15. Choose classifier for classification problem. c. Evaluate the performance of classifier.
	Targeted Application & Tools that can be used Tools: RStudio / Google Colab
	Project work/Assignment:
	Assignment: During the course, students would need to do coding assignments to learn to train and use different models. Sample coding assignments include: Analysis of Sales Report of a Clothes Manufacturing Outlet. Comcast Telecom Consumer Complaints. Web Data Analysis
	Text Book T1 Hadley Wickham and Garrett Grolemund, “R for Data Science”, O’reilly, 2017.
	References R1 Dr. Bharati Motwani, “Data Analytics using R”, Wiley, 2019. Web resources: 1. https://www.geeksforgeeks.org/r-programming-for-data-science/ 2. https://r4ds.had.co.nz/
	Topics relevant to “SKILL DEVELOPMENT”: Regression model, classifier for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 2014	Course Title: Software Engineering Type of Course: School Core [Theory Only]	L-T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	<p>The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles.</p> <p>The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development.</p> <p>The course covers software quality, configuration management and maintenance.</p>					
Course Objectives	<p>The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Participative Learning techniques.</p>					
Course Out Comes	<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none"> 1] Describe the Software Engineering principles, ethics and process models(Knowledge) 2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension) 3] Understand the Agile Principles(Knowledge) 4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application) 					
Module 1	Introduction to Software Engineering and Process Models (Knowledge level)	Quiz				10 Hours
	<p>Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle</p> <p>Models: Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.</p>					
Module 2	Software Requirements, Analysis and Design (Comprehension level)	Assignment			Development of SRS documents for a given scenario	11 Hours
	<p>Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, Software Requirements Specification (SRS), Requirement Analysis and validation. Requirements modelling- Introduction to Use Cases, Activity diagram and Swim lane diagram. CASE support in Software Life Cycle, Characteristics of CASE Tools, Architecture of a CASE Environment.</p> <p>Design: Design concepts, Architectural design, Component based design, User interface design.</p>					
Module 3	Agile Principles & Devops (Knowledge level)	Quiz				12 Hours

	Agile: Scrum Roles and activities, Sprint Agile software development methods - Scaling, User Stories, Agile estimation techniques, Product backlogs, Stake holder roles, Dynamic System Development Method. Devops: Introduction, definition, history, tools.				
Module 4	Software Testing and Maintenance (Application Level)	Assignment		Apply the testing concepts using Programing	12 Hours
	Software Testing -verification and validation, Test Strategies - White Box Testing, Black box Testing. Automation Tools for Testing. Software Quality Assurance -Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management- SCM process, SCM Tools (GitHub). Maintenance - Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models.				
	Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
	Text Book 1] Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, VII Edition, Graw-Hill, 2017. 2] Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, VI Edition, Graw-Hill, 2018.				
	References Rajib Mall, “Fundamentals of Software Engineering”, VI Edition, PHI learning private ted, 2015. Ian Sommerville, “Software Engineering”, IX Edition, Pearson Education Asia, 2011. Agile Software Development Principles, Patterns and Practices.1 st Edition, Wiley, 2002				
	Topics Relevant to “Skill Development: Balck box Testing, White box Testing, Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout				

Course Code: CSE 3002	Course Title: Big Data Technologies Type of Course: Program Core Theory and Lab Integrated Course			L- T-P- C	2	0	2	3
Version No.	1.0							
Course Pre-requisites	CSE2012-Database Management System, CSE1001- Problem solving using Java.							
Anti-requisites	NIL							
Course Description	<p>The purpose of the course is to provide the fundamentals of Big data technology, to emphasize the importance of choosing suitable tools for processing and analyzing big data to gain insights.</p> <p>The student should have knowledge and skill to select and use most appropriate big data tools to solve business problems.</p> <p>The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.</p> <p>With a good knowledge in the fundamentals of Big data technology the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volume of data.</p>							
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Big Data Technologies and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.							
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <ul style="list-style-type: none"> • Apply Map-Reduce programming on the given datasets to extract required insights. (Application). • Employ appropriate Hadoop Ecosystem tools such as scoop, Hbase, Hive, to perform data analytics for a given problem. (Application). • Use Spark tool to analyze the given dataset for a given problem. (Application). 							
Course Content:								
Module 1	Introduction to Hadoop	Programming Assignment	Data Collection and Analysis					10 Classes
	<p>Introduction to Big Data and its importance: Basics of Distributed File System, Four Vs, Drivers for Big data, Big data applications, Structured, unstructured, semi-structured and quasi structured data. Big data Challenges-Traditional versus big data approach, The Big Data Technology Landscape: No-SQL.</p> <p>The Hadoop: History of Hadoop-Hadoop use cases, The Design of HDFS, Blocks and replication management, Rack awareness, HDFS architecture, HDFS Federation, Name node and data node, Anatomy of File write. Anatomy of File read, Hadoop Map Reduce paradigm, Map and reduce tasks, Job Tracker and task tracker, Map reduce execution pipeline, Key value pair, Shuffle and sort, Combiner and Partitioner, APIs used to Write/Read files into/from Hadoop, Need for Flume and Sqoop.</p> <p>Anatomy of a YARN: Hadoop 2.0 Features, Name Node High Availability, YARN Architecture, Introduction to Schedulers, YARN scheduler policies, FIFO, Fair And Capacity scheduler.</p>							

Module 2	Hadoop Ecosystem Tools	Programming Assignment	Data Collection and Analysis		12 Classes
<p>Introduction to SQOOP: SQOOP features, Sqoop Architecture, Sqoop Import All Tables, Sqoop Export All Tables, Sqoop Connectors, Sqoop Import from MySQL to HDFS, Sqoop vs flume.</p> <p>Hive: Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, and Hive sort by vs. order by, Hive Joining tables, Hive bucketing.</p> <p>Hbase: Introduction to HBase and its working architecture- Commands for creation and listing of tables- disabled and is disabled of table - enable and is enabled of table- describing and dropping of table-Put and Get command - delete and delete all command-commands for scan, count, truncate of tables.</p>					
Module 3	Spark	Programming Assignment	Data analysis		12 Classes
<p>Introduction to Apache Spark A unified Spark, Who uses Spark and for what?, A Brief History of Spark, Spark version and releases, Storage layers for Spark. Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. Spark SQL: Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-defined functions, Spark SQL Performance.</p> <p>Scala: The Basics, Control Structures and functions, Working with arrays, Maps and Tuples.</p>					
<p>List of Laboratory Tasks:</p> <ol style="list-style-type: none"> Level 1: To install the Hadoop in pseudo cluster mode. Level 1: HDFS Shell Commands – Files and Folders. Level 2: HDFS Shell Commands – Management. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. Level 1: Find the number of occurrence of each word appearing in the input file(s) Level 2: Performing a Map Reduce Job for word search count (look for specific keywords in a file). Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with Map Reduce, since it is record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all. Level 1: Find average, max and min temperature for each year in NCDC data set? Level 2: Programming assignment to analyze the social media data for business analytics. Level 1: Finding out Number of Products Sold in Each Country using map reduce with sample dataset Level 2: Find matrix multiplication using map reduce Level 1: Installation of Hive, working on basic hive commands. (Create, Alter and Drop tables) 					

	<p>Level 2: Apply Hive commands to student database/employee database.</p>
6.	<p>Level 1: Working on advance hive commands. (Static Partitioning & Dynamic partitioning)</p> <p>Level 2: Continue the previous experiment, select and apply suitable partitioning technique.</p>
7.	<p>Level 1: Working on advance hive commands-2. (Bucketing)</p> <p>Level 2: Continue the previous experiment, apply bucketing technique to bring out the difference between partitioning and bucketing.</p>
8.	<p>Level 1: Installing Ecosystem tools such as Scoop, Hbase.</p> <p>Level 2: Scoop – Move Data into Hadoop.</p>
9.	<p>Level 1: Working on basic Hbase commands (General commands, DDL Commands)</p> <p>Level 2: Apply Hbase commands on Insurance database/employee dataset.</p>
10.	<p>Level 1: Working on advanced Hbase commands. (DML).</p> <p>Level 2: Continue the previous experiment to demonstrate CRUD operations.</p>
11.	<p>Level 1: Install, Deploy & configure Apache Spark.</p> <p>Level 2: Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark</p>
12.	<p>Level 1: Write a program in Apache spark to count the occurrences words in a given text file and display only those words starting with 'a' in ascending order of count.</p> <p>Level 2: Apache access logs are responsible for recording data for all web page requests processed by the Apache server. An access log record written in the Common Log Format will look something like this: 127.0.0.1 - Scott [10/Dec/2019:13:55:36 0700] "GET /server-status HTTP/1.1" 200 2326 Where, HTTP 200 status response code indicates that the request has succeeded. Write a program to read the records of access log file log.txt and display the number of successful requests using Spark.</p>
13.	<p>Level 1: Chess king moves horizontally, vertically or diagonally to any adjacent cell. Given two different cells of the chessboard, determine whether a king can go from the first cell to the second in one move.</p>

the last from the	<p>Write a scala program that receives input of four numbers from 1 to 8, each specifying the column and row number, first two - for the first cell, and then two - for the second cell. The program should output YES if a king can go first cell to the second in one move, or NO otherwise.</p> <p>Level 2: Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.</p> <p>Write a single Spark application that:</p> <ul style="list-style-type: none"> • Transposes the original Amazon food dataset, obtaining a Pair RDD of the type: • Counts the frequencies of all the pairs of products reviewed together; • Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.
	<p>Targeted Application & Tools that can be used:</p> <ul style="list-style-type: none"> • Business Analytical Applications • Social media Data Analysis • Predictive Analytics <p>Tools: Hadoop Framework tools like map reduce, Hive, Hbase, Scoop, Spark.</p>
	<p>Text Book</p> <p>Seema Acharya, Subhashini Chellappan. 2015. <i>Big Data and Analytics</i>. Wiley Publication.</p> <p>Matei Zaharia, Bill Chambers. 2018. <i>SPARK: The Definitive Guide</i>. Oreilly.</p>
	<p>References</p> <p>Tom White. 2016. <i>Hadoop: The Definitive Guide</i>. O'Reilley.</p> <p>Cay S. Horstmann. 2017. <i>Scala for the Impatient</i>. Wesley.</p>
	<p>Topics relevant to development of “Skill Development”: Real time application development using Hadoop Ecosystem tools through Experiential Learning as mentioned in the course handout.</p>

Course Code: CSE3125/CSE265	Course Title: Service Oriented Architecture			L-T-P-C	3	0	0	3
	Type of Course: Program Core							
Version No.		2.0						
Course Pre-requisites		CSE207-Data Base Management System, CSE264 -Web Technology						
Anti-requisites		NIL						
Course Description		The study of the course is to enable the students to understand the different architectural styles and XML based web applications which is required to explore the basics of service-oriented Architecture(SOA) in two approaches i.e. Web Services (WS) and Representational State Transfer (REST) architecture.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Service Oriented Architecture and attain Skill Development through Participative Learning techniques.						
Course Out Comes		On successful completion of this course the students shall be able to: 1.Discuss the XML Fundamentals and to manipulate the data using XML. [Comprehension] 2.Define the key principles of SOA [Knowledge] 3.Discuss the web services technology elements for realizing SOA[Comprehension] 4. Illustrate the various Web Service Standards[Application]						
Course Content:								
Version No.		2.0						
Module 1	Introduction to XML	Assignment		Programming Task	12 Sessions			
	Topics: XML document structure ,Well formed and valid documents ,Namespaces – DTD – xml Schema – X-Files,Parsing XML – using DOM, SAX – XML Transformation and XSL Formatting – Modelling Databases in XML.							
Module 2	Service Oriented Architecture	Assignment		Architectural study	10 Sessions			
	Topics: Types of Architecture,Objectives of Software architecture,SOA Planning and analysis,Architecture patterns and styles ,Characteristics of SOA, Comparing SOA with Client-Server and Distributed architectures – Benefits of SOA ,Security and implementation ,Principles of Service orientation ,Service Layers, Application development process,SOA methodology for Enterprise.							
Module 3	Web Services	Quiz		Data patterns	11 Sessions			
	Topics: Service Descriptions – WSDL – Messaging with SOAP – Service Discovery – UDDI – Message Exchange Patterns – Orchestration – Choreography – WS Transactions.							
Module 4	Building SOA based Applications	Quiz		Security aspects	12 Sessions			

	Topics: Business Process Design, Business case for SOA, Stake holder objectives, Service Oriented Analysis and Design – Service Modeling – Design standards and guidelines – Composition – WS-BPEL – WS-Coordination – WS-Policy – WS-Security, Tools available for implementing SOA, SOA Security, approach for enterprise wide SOA implementation, Trends in SOA, Technologies in Relation to SOA, Advances in SOA, SOA Support in J2EE.
	Targeted Application & Tools that can be used: Basic HTML and XML
	Textbook(s): <ol style="list-style-type: none"> 1. Thomas Erl, “<i>Service Oriented Architecture: Concepts, Technology, and Design</i>”, Pearson Education, 2016. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6532 2. Ron Schmelzer et al. “<i>XML and Web Services</i>”, Pearson Education, 2013 http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6645
	References <ol style="list-style-type: none"> 1. Frank P.Coyle, “<i>XML, Web Services and the Data Revolution</i>”, Pearson Education, 2002 http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6647 2. Eric Newcomer, Greg Lomow, “<i>Understanding SOA with Web Services</i>”, Pearson Education, 2005 http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6619 3. Sandeep Chatterjee and James Webber, “<i>Developing Enterprise Web Services: An Architect’s Guide</i>”, Prentice Hall, 2004. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5906 4. James McGovern, Sameer Tyagi, Michael E.Stevens, Sunil Mathew, “<i>Java Web Services Architecture</i>”, Morgan Kaufmann Publishers, 2003. https://www.elsevier.com/books/java-web-services-architecture/mcgovern/978-1-55860-900-6 <p>Web Resources:</p> <ol style="list-style-type: none"> 1. https://presiuniv.knimbus.com/user#/home 2. https://www.coursera.org/learn/service-oriented-architecture 3. https://nptel.ac.in/courses/soa
	Topics relevant to “SKILL DEVELOPMENT”: Based on an understanding of architectural styles, understanding web applications based on XML, review architectures for web applications, Service-Oriented Architecture (SOA) in two approaches: Web Services (WS*) and Representational State Transfer (REST) architecture for Skill Development through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.

Course Code: CSE 3010	Course Title: Deep Learning Techniques		L-T-P-C	3	0	0	3
	Type of Course: Program Core Theory						
Version No.		2.0					
Course Pre-requisites	•	<ul style="list-style-type: none">• Data Mining and Machine Learning fundamentals• Basic working knowledge of Statistics and Probability• Familiarity with programming languages and hands on coding					
Anti-requisites		NIL					
Course Description		The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Deep Learning Techniques and attain Skill Development through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Apply basic concepts of Deep Learning to develop feed forward models(Knowledge) 2. Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks(Comprehension) 3. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. (Comprehension) 4. Analyze performance of implemented Deep Neural models(Application)					
Course Content:							
Module 1	Introduction to Deep Learning		Assignment		Programming		11 Sessions
	Topics: Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, , Perceptron, MLP Structures, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks, Building your Deep Neural Network: Step by Step.						
Module 2	Improving Deep Neural Networks		Assignment		Programming		12 Sessions
	Topics: Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization, Artificial Neural network.						

Module 3	Deep Supervised Learning Models	Assignment		Programming	11 Sessions
	Topics: Convolutional neural network, Deep learning in Sequential Data, RNN & LSTM, GRU, Deep Models in Pattern Recognition.				
Module 4	Deep Unsupervised Learning	Assignment		Programming	11 Sessions
	Topics: Basics of Deep unsupervised learning, Auto encoders, Boltzman Machine, Restricted Boltzmann Machine, Kohonen Networks, Deep Belief Network, Hopfield Network, Generative Adversarial Networks, Probabilistic Neural Network.				
	Targeted Application & Tools that can be used: Google collab Professionally used software : Anaconda, Spider.				
	Text Book T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017				
	References R 1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013 R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015 R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013 R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008. Weblinks: W1: pu.informatics.global, https://sm-nitk.vlabs.ac.in/				
	Topics relevant to “SKILL DEVELOPMENT”: Real time Data Analysis using Deep learning. Naming and coding convention for Data Science Project Development using ML/DL for Skill Development through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.				

Course Code: CSE 313	Course Title: Storage Area Networks Type of Course: Theory Only Course	L-T P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of information storage					
Anti-requisites						
Course Description	The course aims to equip students with basic introduction to Storage Area Networks, including storage architectures, logical and physical components of a storage infrastructure, managing and monitoring the data center and basic Disaster Recovery principles.					

Course Objective		The objective of the course is to familiarize the learners with the concepts of Storage Area Networks and attain Employability through Participative Learning techniques.			
Course Out Comes		On successful completion of the course the students shall be able to: CO1 Identify key challenges in managing information and analyze different storage networking technologies. [Understanding] CO2 Explain physical and logical components of a storage infrastructure of RAID, and intelligent storage systems. [Comprehension] CO3 Describe Object and Content addressed storage and storage virtualization. [Comprehension] CO4 Articulate business continuity solutions—backup and archive for managing fixed content. [Application]			
Course Content:					
Module 1	Storage System: Introduction to Information Storage	Assignment		Data Collection/Interpretation	12 Sessions
	Topics: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application Database Management System (DBMS), Host (Compute), Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Data Proliferation				
Module 2	Data Protection – RAID, Intelligent Storage Systems	Case studies / Case let		Case studies / Case let	12 Sessions
	Topics: RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID vs SSD, Types of RAID Storage for Databases in Public Cloud Intelligent Storage Systems: Components of an Intelligent Storage System, Types of Intelligent Storage Systems, Optimal architectures for intelligent storage systems				
Module 3	Object-Based and Unified Storage	Quiz		Case studies / Case let	11 Sessions
	Topics: Object-Based Storage Architecture: Components of OSD, Object Storage and Retrieval in OSD, Benefits of Object-Based Storage, Content-Addressed Storage. Virtualization in SAN: types of storage virtualization, Benefits of virtualization				
Module 4	Backup and Archive, Replication	Quiz		Case studies / Case let	10 Sessions

	Backup Purpose, Backup Considerations, Backup Granularity, Data Recovery Services, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments. Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies, Tracking Changes to Source and Replica, Restore and Restart Considerations, Creating Multiple Replicas. Remote Replication: Modes of Remote Replication, Remote Replication Technologies.				
	Targeted Application & Tools that can be used: Architecture based environment				
	Text Book T1. G. Somasundaram, Alok Shrivastava. “ <i>Information Storage and Management</i> ”, EMC Education Services, Wiley India. 2 nd Edition.2012.				
	References R1. Ulf Troppens, Rainer Erkens and Wolfgang Muller. “ <i>Storage Networks Explained</i> ”, Wiley India. 2 nd Edition.2015. R2. Rebert Spalding. “ <i>Storage Networks The Complete Reference</i> ”, Tata McGraw Hill, Indian Edition.2017. R3. Richard Barker and Paul Massiglia. “ <i>Storage Area Networks Essentials A Complete Guide to Understanding and Implementing SANs</i> ”, Wiley. 1 st Edition.2008. E-Resource: 1. https://presiuniv.knimbus.com/user#/home R3 Web resources: Students may find articles and significance of SAN at https://www.ibm.com/topics/storage-area-network and EMC ² and may refer an eBook on “Storage Area Network Essentials” A Complete Guide to Understanding and Implementing SANs by Richard Barker, Paul Massiglia https://presiuniv.knimbus.com/user#/searchresult				
	Topics relevant to “EMPLOYABILITY SKILLS”: Data Protection – RAID for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				
Course Code: CSE2051	Course Title: Information Retrieval			L-T-P- C	3 0 0 3
	Type of Course: Theory Only Course				
Version No.	1				
Course Pre-requisites	Basic Knowledge in Data Structures and algorithms and probability and statistics, background in machine learning				
Anti-requisites	NIL				
Course Description	The course studies the theory, design and implementation of Text- based information systems. The Information Retrieval core concepts of the course include statistical characteristics of text, representation of information needs and documents. Topics Include Several important retrieval models (Basic IR Models, Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model, Latent Semantic Indexing Model, Neural Network Model). Retrieval Evaluation, Retrieval Metrics, Text Classification and Clustering algorithms, Web Retrieval and Crawling. Recommender Systems: Basics of Content-				

		based Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models.			
Course Objective		The objective of the course is to familiarize the learners with the concepts Information Retrieval and attain Skill Development through Participative Learning techniques.			
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval. [Knowledge] CO2: Evaluate the effectiveness and efficiency of different information retrieval methods. [Application] CO3: Explain different indexing methodology requirements and the concept of web retrieval and crawling. [Comprehension] CO4: Classify different recommender system and its aspect. [Comprehension]			
Course Content:					
Module 1	Introduction to Information Retrieval	Assignment	Data collection		12 Sessions
	Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes				
Module 2	Modeling and Retrieval Evaluation	Assignment	Problem solving		11 Sessions
	Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.				
Module 3	Indexing & Web-Retrieval	Term paper/Assignment	Data analysis		11 Sessions
	Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing. The Web – Search Engine Architectures – Cluster based Architecture - Search Engine Ranking – Link based Ranking – Simple Ranking Functions, Evaluations — Search Engine Ranking – Applications of a Web Crawler.				
Module 4	Recommender System	Term paper/Assignment	Problem solving		11 Sessions
	Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models.				
	Targeted Application & Tools that can be used: Information Retrieval System, Collaborative Filtering System, Feedback System, Evaluation Metrics				
	Assignment:				
	Group assignment, Quiz				
	Text Book T1 Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —” Modern Information Retrieval: The Concepts and Technology behind Search”, Third Edition, ACM Press Books, 2018. Link: https://people.ischool.berkeley.edu/~hearst/irbook/				

	T2 Ricci, F, Rokach, L. Shapira, B.Kantor, —”Recommender Systems Handbook”, Fourth Edition, 2018.
	<p>References</p> <p>R1 Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —”<i>Information Retrieval: Implementing and Evaluating Search Engines</i>”, The MIT Press, 2017.</p> <p>R2 Jian-Yun Nie Morgan & Claypool –“ <i>Cross-Language Information Retrieval</i>”, Publisher series 2011.</p> <p>R3 Stefan M. Rüger Morgan & Claypool – “<i>Multimedia Information Retrieval</i>”, Publisher series 2014.</p> <p>R4 B. Liu, Springer, - “<i>Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data</i>”, Second Edition, 2013.</p> <p>R5 C. Manning, P. Raghavan, and H. Schütze, —”Introduction to Information Retrieval”, Cambridge University Press, 2015. Link: https://nlp.stanford.edu/IR-book/</p> <p>Web Based Resources and E-books: https://puniversity.informaticsglobal.com/login</p>
•	<ul style="list-style-type: none"> • Topics relevant to the development of SKILLS: Recommendation Techniques, Content-based Filtering for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE324	Course Title: Internet and Web Technologies Type of Course: Integrated			L-T-P- C	1	0	4	3
Version No.	1							
Course Pre-requisites	nil							
Anti-requisites	nil							
Course Description	The purpose of the course is to provide a comprehensive introduction to scripting languages that are used for creating web-based applications. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet and Web Technologies and attain Skill Development through Participative Learning techniques.							
Course Out Comes	On successful completion of the course the students shall be able to: <ul style="list-style-type: none">Implement web-based application using markup languages. [Application]Illustrate the use of various constructs to enhance the appearance of a website. [Application] Apply server-side scripting languages for web page design and link to a database. [Application]							
Course Content:	Module: 1: [25 Hrs - L[10] + T[15]] [Application] Module: 2: Advanced CSS [25 Hrs – L[10] + T[15]] [Application] XML: Basics, demonstration of applications using XML Module 3: PHP [25 Hrs – L[14] + T[11]] [Application] PHP: Introduction to server-side Development with PHP, Arrays, and Superglobals, Arrays, \$GET and \$ POST, Super global Arrays, \$_SERVER Array, \$_Files Array, Reading/Writing Files, PHP Classes and Objects, Object, Classes and Objects in PHP, Object Oriented Design, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP							
Module 1	Introduction to XHTML	Assignment		Data Collection/Interpretation	25 Sessions			
	Topics: Basics: Web, WWW, Web browsers, Web servers, Internet. XHTML: Origins and Evolution of HTML and XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic Differences between HTML and XHTML							
Module 2	Advanced CSS	Experiment		Case studies / Case let	25 Sessions			

Topics: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks					
Module 3	PHP	Quiz		Case studies / Case let	25 Sessions
Topics: Introduction to server-side Development with PHP, Arrays, and Superglobals, Arrays, \$GET and \$POST, Super global Arrays, \$_SERVER Array, \$_Files Array, Reading/Writing Files, PHP Classes and Objects, Object, Classes and Objects in PHP, Object Oriented Design, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP					
List of Laboratory Tasks: <ol style="list-style-type: none"> 1. HTML with tables 2. HTML with frames 3. Html with form 4. Web site with links 5. Website with advanced CSS 6. WAMP installation & introduction 7. PHP for website 8. Form validation 9. PHP and MySQL for website 					
Targeted Application & Tools that can be used <ol style="list-style-type: none"> 1. Notepad++ 2. WAMP 					
Project work/Assignment:					
Assignment: Mini Project on development of a Website					
Text Book <p>T1 Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 8th Edition, 2015.</p> <p>T2. CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)</p> <p>T3. Deitel, Deitel, Goldberg, "Internet & World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.</p>					
References <p>R1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st. Edition, 2016.</p> <p>R2. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition, 2016.</p> <p>R3 Web resources:</p> <p>W1. Journal resources</p> <ol style="list-style-type: none"> 1. Pallavi Yadav, Paras Nath Barwal, "Designing Responsive Websites Using HTML And CSS" INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 3, ISSUE 11, NOVEMBER 2014, ISSN 2277-8616 2. Thomas H. Park, Brian Dorn, Andrea Forte, " An Analysis of HTML and CSS Syntax Errors in a Web Development Course" ACM Transactions on Computing Education Volume 15 Issue 1 March 2015 Article No. 4pp 1–21, https://doi.org/10.1145/2700514 					

	<p>3. Thomas H. Park, Ankur Saxena, Swathi Jagannath, Susan Wiedenbeck, Andrea Forte, "Towards a taxonomy of errors in HTML and CSS" ACM Transactions on Computing Education, Pages 75–82 , https://doi.org/10.1145/2493394.2493405</p> <p>4. A. Veglis; M. Leclercq; V. Quema; J.-B. Stefani, "PHP and SQL made simple", Published in: IEEE Distributed Systems Online (Volume: 6, Issue: 8, August 2005) DOI: 10.1109/MDSO.2005.42</p> <p>W2. Course NPTEL / Swayam Link : https://nptel.ac.in/courses/106105084</p> <p>W3. Coursera Link : https://www.coursera.org/learn/html-css-javascript-for-web-developers</p> <p>W4. PU Library Link : https://puniversity.informaticsglobal.com/login</p> <p style="text-align: center;">Or</p> <p style="text-align: center;">: http://182.72.188.193/</p>
	<p>Topics relevant to development of “Skill Development”: Form Design and Validation for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE219	Course Title: Big Data Analytics		L- T-P- C	1	0	4	3
	Type of Course: Laboratory Integrated						
Version No.	2.0						
Course Pre-requisites	DDL, DML of SQL Queries and Creation of Class & object, interface, reading & writing a file, control statements in java programming.						
Anti-requisites	NIL						
Course Description	This course is designed to provide the fundamental knowledge to equip students being able to handle real world big data problems including the three key resources of Big Data: people, organizations, and sensor. With the advancement of IT storage, processing, computation and sensing technologies, big data has become a novel norm of life.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques						
Course Out Comes	On successful completion of the course the students shall be able to: 1: Describe the fundamental concepts of big data analytics (Knowledge) 2: Apply Map-Reduce programming on the given datasets to extract required insights. (Application). 3: Employ appropriate Hadoop Ecosystem tools such as Hive, Hbase to perform data analytics for a given problem (Application) 4: Use Spark and nosql tool to analyse the given dataset for a given problem. (Application).						
Course Content:							
Module 1	Introduction to Big data Analytics	Assignment	Case study on Real time applications	12 Sessions			
Introduction to Big Data: Basics of Distributed File System, Four Vs, Drivers for Big data, Big data applications, Structured, unstructured, semi-structured and quasi structured data. Big data Challenges-Traditional versus big data approach. The Hadoop: History of Hadoop-Hadoop use cases, The Design of HDFS, Blocks and replication management, Rack awareness, HDFS architecture, HDFS Federation, Name node and data node, Anatomy of File write, Anatomy of File read. Role of Data Scientist - Role of Data Analyst – Data Analytics in Product development - Business Intelligence vs Data analytics - Real time Business Analytical ProcessCase studies related to big data applications							
Module 2	Hadoop MapReduce Framework	Assignment	Installation of multimode cluster	12 Sessions			
MapReduce : Overview and Need of Distributed processing for big data- Introduction to hadoop framework and MapReduce programming - HDFS design and its goals - Master-Slave Architecture of hadoop – Working with hadoop daemons-Installation of hadoop single node cluster and multi node clusters - Working with MapReduce programming.							
Module 3	Hive and Hbase Analytical tools	Term paper/Assignment	Hive joins	12 Sessions			
Hive : Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, and Hive sort by vs. order by, Hive Joining tables, Hive bucketing. Hbase : Introduction to HBase and its working architecture- Commands for creation and listing of tables-disabled and is disabled of table - enable and is enabled of table- describing and dropping of table-Put and Get command - delete and delete all command-commands for scan, count, truncate of tables.							

Module 4	Data Analytics with Spark	Term paper/Assignment	Spark RDD	11 Sessions
Spark: Spark: Apache Spark's Philosophy, History of Spark, Running Spark, A Gentle Introduction to Spark, Spark's Basic Architecture, Spark Applications, DataFrames, Partitions, Transformations, Lazy Evaluation, Actions, Spark UI, An End-to-End Example, Integration of Hive and spark. Nosql: Mongo DB: Introduction ,Features ,Data types , Mongo DB Query language , CRUD operations ,Arrays , Functions: Count ,Sort , Limit , Skip , Aggregate , Cursors – Indexes , Mongo Import , Mongo Export.				
List of Laboratory Tasks <ol style="list-style-type: none"> 1. Introduction to Hadoop Ecosystem tools 2. Introduction to Hadoop distributed file System. 3. Installation of Hadoop single node cluster using Ubuntu operating system. 4. Working with Hadoop Commands 5. Introduction to Mapreduce framework 6. Word Count analysis using sample data set (MapReduce) 7. Stock analysis using sample data set (MapReduce) 8. Web log analysis using sample data set (MapReduce) 9. Temperature analysis using sample data set .(MapReduce) 10. Working on basic hive commands 11. Working on basic hbase commands 12. Install, Deploy & configure Apache Spark 13. Word count analysis using RDD and FlatMap 14. Working with MongoDB using restaurant data. 				
Targeted Application & Tools that can be used: Apache Hadoop- HDFS – for data storage Map reduce – Mapping and reducing. Hive – Structured data,HQL Hbase, MongoDB – No SQL Apache Spark – SCALA LANGUAGE				
Text Book <ol style="list-style-type: none"> 1. Big Data and Analytics- Seema Acharya, Subhashini Chellappan-2019, 2nd Edition, Wiley Publication. 2. Analytics in a Big data world- Bart Baesens- 2nd Edition, Wiley Publication. 2018 				
Reference <ol style="list-style-type: none"> 1. Big data Analytics, Radha Shankarmani and vijayalakshmi second edition wiley publication 2016 2. Big Data, Anil Maheshwari , McGraw Hill education 2019 3. Hadoop: The Definitive Guide, Tom White , 3rd Edition, O'reilly. 2016 				
E-Resources <ol style="list-style-type: none"> 1.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii 2.https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live 				
Topics relevant to SKILL DEVELOPMENT: Hadoop ecosystem tools, HDFS, Mapreduce, Hive, Hbase, MongoDB,NoSQL, Spark for Skill Development through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: CSE3123		Course Title: Search Engine Optimization Type of Course: Program Core & Theory Only		L- T- P- C	3	0	0	3
Version No.			1.0					
Course Pre-requisites			NIL					
Anti-requisites			NIL					
Course Description			Objective of this course is to make students learn the basics of Search Engine and develop ability to optimize the searching based on the key words so that the business can be improved. The search engine optimization is the skill of improving a website to upsurge its visibility when people search for products or services. The more visible a website has on search engines, the more likely it is that brand captures business. The students should have prior knowledge of WWW to pursue the Course. After successful completion of the Course, the students would acquire knowledge to comprehend the Search Engine Optimization algorithms, SEO tools and Reporting methods to analyze the web sites.					
Course Objective			The objective of the course is to familiarize the learners with the concepts of Search Engine Optimization and attain Skill Development through Participative Learning techniques.					
Course Out Comes			On successful completion of the course the students shall be able to: 1. Outline the basic concepts of SEO (Knowledge) 2. Discuss the content necessary for On-page & Off-Page SEO (Comprehension) 3. Illustrate Technical SEO (Application) 4. Analyse the Report of SEO to measure the performance (Analysis)					
Course Content:								
Module 1		Introduction to SEO						12 Sessions
	Topics: Search Engine – works- SEO vs SEM- need – history- works- Googlebot (Google Crawler)- Types of SEO technique- Search Engine Algorithm- Google Algorithm- Key word search- Types of key words- Competition analysis- Page ranking technology							
Module 2		On-Page and Off-Page SEO	Assignment					12 Sessions

	Topics: Introduction to On-Page SEO, Basics of website designing/development, HTML Basics for SEO, Meta Tag, Title Tag, Image Tag and H Tag Optimization- Link building- Optimizing SEO content- Key word search and Analysis. Introduction to Off-Page optimization- Local marketing of website as per the location- Page ranking- Building back links- Type of links – Natural Link, manually built link & Self-created link- White hat, grey hat and Black hat SEO- Social Media optimization technique.					
Module 3	Technical SEO					11 Sessions
	Basics of Technical SEO- Crawling and Indexing- HTML Sitemap vs. XML Sitemap, The robots.txt File protocol, Overcoming Error codes, Technical Analysis connected with Redirection, Broken Links - Redirects, Best Practices, Analysis of Crawl Errors					
Module 4	SEO Reporting	Assignment				10 Sessions
	Website position analysis in various search engine- Analyzing performance of the website using Google analytics- Goals and conversion- Tracking and report- Reports submission- Securing Ranks.					
	Targeted Application & Tools that can be used: Applications: Online Business models such as e-Commerce, Digital Marketing, Health Care Professionally used software – Google Analytics					
	Text Book T1 - “Search engine optimization all-in-one for dummies”, Clay, B ,3rd ed., John Wiley & Sons, Inc., 2015. T2 -”Google AdWords: A beginner's guide to Google. Use Analytics, SEO, and AdWords. Become an influencer on social media”, Wally Bax , Notion Press Media Pvt Ltd., 2022.					
	References R1 – “Introduction to search engine optimization: A guide for absolute beginners”, Kelsey, T, Apress. (2017). R2 - “Step By Step Guide to SEO”, Upendra Rana, Ocean Books Pvt Ltd.R-Tech Offset Printers, 2018. R3 - “Search Engine Optimization (SEO).Grow the Audience”, Clark, Hack Book Works, 2022. Weblinks: W1: https://puniversity.informaticsglobal.com/login W2: https://essentials.ebsco.com/search?query=Search+Engine+Optimization					
	Topics relevant to “SKILL DEVELOPMENT”: Development basic using HTML and Search engine optimization tools for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.					

Course Code: CSA3052/CSE3122	Course Title: PATTERN RECOGNITION		L-T-P- C	2	0	2	3
	Type of Course: Theory						
Version No.		1.0					
Course Pre-requisites		linear algebra, probability, random process, statistics, programming experience (MATLAB/C/C++) will be helpful.					

Anti-requisites		-			
Course Description		Pattern recognition techniques are used to design automated systems that improve their own performance through experience. This course covers the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives. Topics including Bayesian Decision Theory, Estimation Theory, Linear Discrimination Functions, Nonparametric Techniques, Support Vector Machines, Neural Networks, Decision Trees, and Clustering Algorithms etc. will be presented.			
Course Objective		The objective of the course is to familiarize the learners with the concepts of pattern recognition and attain Skill Development through Experiential Learning techniques.			
Course Out Comes		<p>On successful completion of the course the students shall be able to:</p> <p>CO1: Identify areas where Pattern Recognition and Machine Learning can offer a solution.[knowledge]</p> <p>CO2: Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems[Comprehensive]</p> <p>CO3: Describe genetic algorithms, validation methods and sampling techniques[Comprehensive]</p> <p>CO4: Describe and model data to solve problems in regression and classification[Comprehensive]</p> <p>CO5: Implement learning algorithms for supervised tasks. [Application]</p>			
Course Content:					
Module 1			quiz		Case studies / Case let 15 Sessions
	Importance of pattern recognition, Features, Feature Vectors, and Classifiers, Supervised, Unsupervised, and Semi-supervised learning, Introduction to Bayes Decision Theory, Discriminant Functions and Decision Surfaces, Gaussian PDF and Bayesian Classification for Normal Distributions. L1, L2				
Module 2			Assignment		Case studies / Case let 15 Sessions
	Introduction, Basis Vectors, The Karhunen Loeve (KL) Transformation, Singular Value Decomposition, Independent Component Analysis (Introduction only). Nonlinear Dimensionality Reduction, Kernel PCA. L1, L2				
Module 3			Quiz		Case studies / Case let 15 Sessions
	Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability estimation, Bayesian Interference, Maximum Entropy Estimation, Mixture Models, Naive-Bayes Classifier, The Nearest Neighbor Rule. L1, L2, L3				
Module 4					15 Sessions
	Introduction, Linear Discriminant Functions and Decision Hyperplanes, The Perceptron Algorithm, Mean Square Error Estimate, Stochastic Approximation of LMS Algorithm, Sum of Error Estimate. L1, L2, L3				

	<p>Text Book</p> <ol style="list-style-type: none"> 1. Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 4th edition. 2. Pattern Recognition and Image Analysis Earl Gose: Richard Johnsonbaugh, Steve Jost, ePub eBook.
	<p>References</p> <p>R1. The Elements of Statistical Learning: Trevor Hastie, Springer-Verlag New York, LLC (Paper Back), 2009.</p> <p>R2. Pattern Classification: Richard O. Duda, Peter E. Hart, David G. Stork. John Wiley & Sons, 2012.</p>
	<p>Topics relevant to SKILL DEVELOPMENT: Concepts of classification algorithms, regression models and linear models for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in the course handout.</p>

Course Code : CSE 2050	Course Title: System Software		L-T-P-C	3	0	0	3
Type of Course:	Theory Only						
Version No.	1.1						
Course Pre-requisites	Students are expected to be familiar with the basics of DataStructure, Programming Language Java Basics, J2EE and should have a knowledge on DBMS.						
Anti-requisites	NIL						
Course Description	This course is introduced to have an understanding of foundations of design of assemblers, loaders, linkers, and macro processors, The design and implementation of various types of system software and relationship between machine architecture and system software. Use and implementation of assemblers, macros, loaders, compilers, and operating systems. To Introduce formal systems and their application to programming languages, including topics such as Different System Software– Assembler, Assembler design options, macro processors, Device drivers.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of System Software and attain SKILL DEVELOPMENT through Participative Learning techniques.						
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1 : Distinguish different software into different categories.</p> <p>CO2 : Design, analyze and implement one pass, two pass or multi pass assembler</p> <p>CO3 : Design, analyze and implement loader and linker.</p> <p>CO4 : Design, analyze and implement macro processors</p> <p>CO5 : Critique the features of modern editing /debugging tools.</p>						
Course Content:							
Module 1	Introduction to System Software	Assignment		Analysis		10 Sessions	

Course Code: CSE2053	Course Title: Enterprise Network Design Type of Course: Theory Only Course		L-T- P- C		3	0	0	3
Version No.		1						
Course Pre-requisites		Computer Networks 1. OSI Reference Model and TCP/IP Protocol Suite 2. Routing IP Addresses 3. Internetworking Devices						
Anti-requisites								
Course Description		In Enterprise Network Design, students will investigate and design a variety of enterprise network configurations. They will enhance their consulting skills through the process of customer requirement analysis, network design, product specifications and price quotation. Methodologies for sourcing, wiring, hardware installations, software configurations and thorough testing and troubleshooting will complete the design to installation process. Modeling and simulating networks, using the most advanced computer tools, will be given special emphasis.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Enterprise Network Design and attain Skill Development through Participative Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: 1. Understand the customer requirements and Apply a Methodology to Network Design. Structure and Modularize the Network. 2. Design Basic Campus and Data Center Network, and Remote Connectivity. 3. Design IP Addressing and Select suitable Routing Protocols for the Network 4. Compare OpenFlow controllers and switches with other enterprise networks.						
Course Content:								
Module 1	Applying a Methodology to Network Design:	Assignment		Data Collection/Interpretation			12 Sessions	
	Topics: The Cisco Service Oriented Network Architecture, Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites, Using the Top-Down Approach to Network Design, The Design Implementation Process. Structuring and Modularizing the Network: Network Hierarchy, Using a Modular Approach to Network Design, Services Within Modular Networks, Network Management Protocols and Features							
Module 2	Designing Basic Campus and Data Center Networks	Case studies / Case let		Case studies / Case let			11 Sessions	
	Topics: Campus Design Considerations, Enterprise Campus Design, Enterprise Data Center Design Considerations. Designing Remote Connectivity							

Enterprise Edge WAN Technologies, WAN Design, Using WAN Technologies, Enterprise Edge WAN and MAN Architecture, Selecting Enterprise Edge Components, Enterprise Branch and Teleworker Design.					
Module 3	Designing IP Addressing in the Network & Selecting Routing Protocols	Quiz		Case studies / Case let	10 Sessions
Topics: Designing an IP Addressing Plan, Introduction to IPv6, Routing Protocol Features, Routing Protocols for the Enterprise, Routing Protocol Deployment, Route Redistribution, Route Filtering, Redistributing and Filtering with BGP, Route Summarization.					
Module 4	Software Defined Network	Assignment	Data Collection/Interpretation		12 Sessions
Understanding SDN and Open Flow: SDN – SDN Building Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers, POX and NOX, Open Flow in Cloud Computing, Case study: how SDN changed Traditional Enterprise network Design					
Targeted Application & Tools that can be used: Knowing and understanding an application as to how to design an enterprise network for given requirements.					
Project work/Assignment:					
Assignment: Students will have to do group assignments for Modules 1 & 4. As a part of their assignments, they will have to use some methodologies and approaches of network design for an enterprise network. Design an enterprise network for given user requirements in an application.					
Textbook T1 Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare. T 2. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D. T3. CCDA Cisco official Guide T 4. Software Defined Networking with Open Flow: PACKT Publishing Siamak Azodolmolky					
References R1 Top-Down Network Design (Networking Technology) 3rd Edition, Priscilla Oppenheimer, Cisco Press Book R2. Network Planning and Design Guide Paperback – 2000, Shaun Hummel E book link R1: http://www.teraits.com/pitagoras/marcio/gpi/b_POppenheimer_TopDownNetworkDesign_3rd_ed.pdf E book link R2: https://archive.org/details/networkplanningd0000humh/page/n1/mode/2up					

	Web resources: https://www.cisco.com/c/en/us/solutions/design-zone/networking-design-guides.html https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-an-enterprise-network.html
	Topics relevant to “SKILL DEVELOPMENT”: Development of various solutions by students in making the network design and followed by discussions and presentations for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3120	Course Title: Operating System with Linux Internals Type of Course: Discipline Elective in Information Science & Engineering Basket Theory & Integrated Laboratory	L-T- P-C	2	0	2	3
Version No.		1.0				
Course Pre-requisites		[1] C Programming [2] Unix shell programming [3] Data Structure				
Anti-requisites		NIL				
Course Description		<p>The purpose of this course is to enable the students to understand the need for Operating systems and to develop the basic concepts of process management, synchronization and memory management. The course will expose students to Linux OS internals, its design and features. The course is both conceptual and analytical in nature towards managing the process and memory and needs fair knowledge of programming fundamentals, C programming and data structures. The course develops the critical thinking and analytical skills on allocating and managing resources. The course also enhances the problem solving and systems programming abilities through assignments</p> <p>The associated laboratory provides an opportunity to validate the concepts taught as well as enhances the ability to approach designing new OS level features with confidence.</p>				
Course Objective		<p>The objective of the course is to familiarize the learners with the concepts of Operating System with Linux Internals and attain <u>SKILL DEVELOPMENT</u> through <u>EXPERIENTIAL LEARNING</u> techniques.</p>				
Course Outcomes		<p>On successful completion of this course the students shall be able to:</p> <p>(1) Explain the structure and functions of OS</p> <p>(2) Solve problems on various CPU Scheduling Algorithms</p> <p>(3) Apply different techniques to various synchronization problems</p> <p>(4) Discuss various memory management techniques</p> <p>(5) Apply appropriate Linux commands for memory management and directory management</p>				
Course Content:						

Module 1	Introduction	Quiz		Programming	11 Classes
	Topics: Introduction to OS – Computer System Architecture , Operating System Structure, Operations – Different management activities handled by the OS, Computing environments, Operating System Services, User and OS interface, System Calls and its types, System Programs[loaders, linkers...], Overview of OS design and implementation. Linux Operating System: Introduction to Linux OS, Basic Commands of Linux OS				
Module 2	Process Management	Quizzes and assignments		Pseudocode/Programming	10 Classes
	Topics: Process Concept, Operations on Processes, Inter Process Communication, Introduction to threads - Multithreading Models, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR, Priority, Multilevel Queue, Multilevel Feedback Queue. Linux Operating System: Process Management Commands and System Calls.				
Module 3	Process Synchronization and Deadlocks	Coding Assignment/Case Study		Pseudocode/Programming	11 Classes
	Topics: The Critical-Section Problem - Peterson’s Solution, Synchronization hardware, Mutex locks, Semaphores, Classic Problems of Synchronization, Monitors. Introduction to Deadlocks, Deadlock Characterization, Methods for handling deadlock: Deadlock Prevention- Deadlock Avoidance- Deadlock detection & Recovery from Deadlock Linux Operating System: Pipe, semaphore and message queue				
	List of Laboratory Tasks: Experiment No. 1: Basic UNIX Commands Level 1: Linux commands- PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, file handling utilities, security by file permissions, process utilities Level 2: Text Processing utilities and backup utilities , tail, head, sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio Experiment No. 2: Programs using system calls of UNIX operating system Level 1 Programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir Level 2 Simulate UNIX commands like cp, ls, grep. Experiment No. 3: Programs to demonstrate process creation and termination Level 1: Program to demonstrate creating new processes and waiting for a process Level 2: Program to demonstrate creation of zombie processes and orphan process Experiment No. 4: Programs to demonstrate inter process communication using Pipe Level 1: Programs to illustrate execution of two commands concurrently with a command pipe and communication between two unrelated processes Level 2: Program to demonstrate inter process communication using mkfifo, open, read, write and close APIs				

	<p>Experiment No. 5: Programs to demonstrate inter process communication using message queues</p> <p>Level 1: Program to create a message queue with read and write permissions and to write messages with different priority numbers</p> <p>Level 2: Program to receive messages of different priorities from the message queue and display them</p> <p>Experiment No. 6: Programs to demonstrate process synchronization using Semaphores</p> <p>Level 1: Program that illustrates suspending and resuming processes using signals</p> <p>Level 2: Program that illustrates access of shared memory using counting semaphore</p> <p>Experiment No. 7: Programs to demonstrate the event of a deadlock and its avoidance</p> <p>Level 1: Using POSIX Semaphores demonstrate the scenario where in deadlock happens due to incorrect use of semaphores</p> <p>Level 2: Program to implement a solution to the Dining Philosopher problem using Monitors</p>
	<p>Targeted Application & Tools that can be used:</p> <p>Targeted Application: Real time Applications such as traffic management system, banking system, health care and many more systems where there are entities that use and manage the resources.</p> <p>Software Tools: Linux Environment</p>
	Project work/Assignment:
	Each batch of students (self-selected batch mates) will identify projects and implement with the most suitable 2 or 3 antecedents.
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 9th edition Wiley, 2013 2. Sumitabha Das, “Unix concept and Programming”, McGraw Hill education, 4th Edition, 2015
	<p>References</p> <ol style="list-style-type: none"> 1. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, Linux in a Nutshell, O'Reilly Media, Inc, 2009 2. Operating Systems Internals and Design Principles Ninth Edition By Pearson Paperback – 1 March 2018. by William Stallings (Author)
	<p>Topics relevant to “ SKILL DEVELOPMENT ”: Linux OS commands and programming for SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques. This is attained through assessment component mentioned in the course handout.</p>

Course Code: CSE2056	Course Title: WEB 2.0		2	0	2	3
	Type of Course: Program Core Laboratory Integrated Course	L- T-P-C				
Version No.		1.0				
Course Pre-requisites		Programming fundamentals (any language), Knowledge of RDBMS, HTML, CSS, and JavaScript.				
Anti-requisites		NIL				
Course Description		The purpose of this course is to introduce the next level of web design using Web 2.0 technologies. Web 2.0 is the business revolution in the computer industry caused by the evolution of social networking. Students will be trained in planning and designing effective web pages by writing code using current leading trends in the web domain, enhancing web pages with the use of JavaScript frameworks. The major focus is on the key elements of web 2.0 like Rich internet applications, Service-oriented architecture, and social web.				
Course Outcomes		After the completion of the course students shall be able to: <ol style="list-style-type: none"> 1. Demonstrate database-driven web application with the server-side script using PHP. 2. Employ JavaScript frameworks to develop rich internet applications. 3. Demonstrate web application using Flex architecture deployed to flash player. 4. Describe the concept of web application terminologies and internet tools for developing the social web. 				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of WEB 2.0 and attain Skill Development through Experiential Learning techniques.				
Course Content:						
Module 1		Assignment				13 Hours
		Topics: Overview of internet and its evolution, Comparison of web 1.0 and web 2.0, characteristics of web 2.0, Introduction to server-side scripting-PHP, PHP and MySQL interaction, Web 2.0 technologies, Overview of JavaScript frameworks-AJAX. PHP example, AJAX example				
Module 2		Assignment				13 Hours
		Topics: Data interchange formats: XML, XML basics; XML Schema; Types, Sample program for XML, Overview of JQuery, JQuery example, Overview Angular JS				
Module 3		Assignment				13 Hours

		Topics: Overview of Flex architecture: Facebook, Angular JS example, Differences between HTML and Flex applications, Angular JS example, Flex example, Understanding ActionScript, Flex example, Differentiating between Flash player and Framework, Flex example, Understanding UI Components, Model View Controller			
Module 4		Assignment			13 Hours
		Topics: Introduction to Social Web, Building blog-part 1, Building blog-part 2, Social networking or social media sites Wikis, blog, Youtube, Building blog-part 3, Building blog-part 4, Collaborative consumption platforms, and mashup applications, Building blog-part 5			
		Targeted Application & Tools that can be used: 1. To creating a social web site List of Laboratory Task Experiment No. 1: Learn to use a web server (Apache) and server-side scripting using PHP along with a database. Experiment No. 2: Learn to create rich internet applications using JavaScript frameworks Experiment No. 3: Learn to create a web application using Flex architecture Experiment No. 4: Learn how web2.0 websites facilitate interaction among users, Eg: creating a social web site			
		Project work/Assignment:			
		Project Assignment: NIL			
		Text Books 1. P.J.Deitel and H.M. Deitel, "Internet and World Wide Web – How to Program", Pearson Education. 2. Programming Flex 2 – Chafic Kazoun, O'Reilly publications, 2007			
		References 1. Randy Connolly, "Fundamentals of Web Development", Pearson Education 2. Robert W Sebesta, "Programming the World Wide Web", Pearson Education 3. Gottfried Vossen, Stephan," Hagemann Unleashing Web 2.0: From Concepts to Creativity", Elsevier 4. Nicholas C Zakas," Professional AJAX", Wrox publications 5. Frank. P. Coyle, "XML, Web Services And The Data Revolution", Pearson Education. 6. James Snell, Doug Tidwell, Pavel Kulchenko, "Programming Web Services with SOAP", O'Reilly publishers. Web Resources:			

	<ol style="list-style-type: none"> 1. W3schools.com 2. Developer.mozilla.org/en-US/docs/Learn 3. docs.microsoft.com 4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking 5. https://presiuniv.knimbus.com/user#/home
	Topics relevant to “SKILL DEVELOPMENT”: Building blog, Social networking or social media sites for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE258	Course Title: Problem Solving Using Python	L-T-P-C	1	0	4	3
	Type of Course: Theory & Integrated Laboratory					
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	<p>This course provides the opportunity for the students of Computer Science engineering to develop Python scripts using its powerful programming features like lists, sets, tuples, dictionaries and sets. Students will also be introduced to object oriented programming concepts and packages for data visualization.</p> <p>Topics include: Basics of Python programming, operators and expressions, decision statements, loop control statements, functions, strings, lists, list processing : searching and sorting, nested list, list comprehension, tuples and dictionaries, sets, file handling, exception handling, object oriented programming concepts, modules and packages for data visualization</p>					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using Python and attain Employability Skills through Experiential Learning techniques.					
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate problem solving through understanding the basics of python (Application) 2. Manipulate functions and data structures. (Application) 3. Apply Tuple, Dictionaries, File and Exception Handling concepts to solve real time problems (Application) 4. Practice object-oriented programming (Application) 5. Produce data visualization using modules and packages (Application) 					
Course Content:						
Module 1	Problem Solving Techniques and Basics of Python Programming	assignments	Quizzes form basics of python		15Sessions	

Basics of problem solving techniques, Basics of Python programming, operators and expressions, decision statements, loop control statements.				
Module 2	Function, String and List	Quizzes and assignments	Comprehension based Quizzes and assignments	15 Sessions
Functions, strings, lists, list processing: searching and sorting, nested list, list comprehension				
Module 3	Data Structures, File and Exception handling	Term paper/Assignment	Quizzes form advanced python	15 Sessions
Tuples and dictionaries, sets, file handling, exception handling.				
Module 4	Object-Oriented Programming and Data Visualization	Term paper/Assignment	Application on data visualization	15 Sessions
Object oriented programming concepts, modules and packages for data visualization.				
List of Laboratory Tasks:				
Each Lab sheets experiments are prepared by level 0 and level 1 module wise. 30 hours				
Targeted Application & Tools that can be used:				
Any IDE – PyCharm, VS Code, Python IDE, Spyder, jupyter note book, Google Colab				
Text Book				
T1. Ashok Namdev Kamthane and Amit Ashok Kamthane, “Problem Solving and Python Programming”, Tata Mc Graw Hill Edition, 2018.				
T2. Charles Dierbach, “Introduction to Computer Science Using Python”, Wiley India Edition, 2015.				
T3. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press, 2017.				
References				
R1. Balagurusamy, “Introduction to Computing and Problem-Solving Using Python”, Tata McGraw-Hill, 2016 R2. Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2017				
E-Resources:				
W1. http://pythontutor.com/				
W2. https://www.udemy.com/topic/python/				
W3. https://in.coursera.org/courses?query=python				
W4: https://puniversity.informaticsglobal.com/login				
Topics relevant to the Employability SKILLS:				
problem solving techniques – Function - Object oriented programming - data visualization for Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE 2058	Course Title: Firewall and Internet security Type of Course: Integrated			L-T- P- C	2	0	2	3
Version No.		1						
Course Pre-requisites		Computer Networks						
Anti-requisites								
Course Description		This course provides an in-depth study of various network attacks techniques and methods to defend against them. A number of threats and vulnerabilities of the Internet will be covered, including various vulnerabilities of TCP/IP protocols, denial of service (DOS), attacks on routing, attacks on DNS servers, TCP session hijacking, and so on. This course will also cover defending mechanisms, including intrusion detection, firewalls, tracing the source of attacks, anonymous communication, IPsec, virtual private network, and PKI. To make it easy for students to understand these attacks, basics of the TCP/IP protocols will also be covered in the course.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Firewall and Internet security and attain Skill Development through Problem Solving Methodologies .						
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• To identify elements of firewall design, types of security threats and responses to security attacks.• Examine security incident postmortem reporting and ongoing network security activities.• Construct code for authentication algorithms.• Develop a signature scheme using Digital signature standard.• Demonstrate the network security system using open source tools						
Course Content:								
Module 1	Introduction to Firewall	Assignment		Data Collection/Interpretation	12 Sessions			
Introduction of Firewall in computer network,Categories of firewall,How firewall works,Types of firewall, Firewall location and Configuration,Firewall Policies,Firewall Biasing,Network Architecture,Net masks,Packet filters,Stateful firewalls,Resources								
Module 2	Computer security	Case studies / Case let		Case studies / Case let	12 Sessions			
Topics: Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)								
Module 3	Network Security	Quiz		Case studies / Case let	10 Sessions			
Topics: Overview of Network Security:Elements of Network Security , Classification of Network Attacks ,Security Methods ,Symmetric-Key Cryptography :Data Encryption Standard (DES),Advanced Encryption Standard (AES) , Public-Key Cryptography :RSA Algorithm ,Diffie-Hellman Key-Exchange Protocol , Authentication :Hash Function , Secure Hash Algorithm (SHA) , Digital Signatures.								

Module 4	Cyber laws and Compliance Standards	Quiz		Case studies / Case let	11 Sessions
Topics: Kerberos: Working ,ASS,TGS,SS-Internet security protocols-AH,ESP,Models-Transport and tunnel-Email security,Public key Infrastructure,Certificates,certificates authority.Cyber Crime: Introduction,Hacking,Digital forgery,Cyber Stalking,Identify theft and Fraud,Cyber terrorism,Cyber defamation,Crime against individual,Government,Property.					
List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Perform encryption, decryption using the following substitution techniques (i) Ceaser cipher, (ii) playfair cipher iii) Hill Cipher iv) Vigenere cipher 2. Perform encryption and decryption using following transposition techniques i) Rail fence ii) row & Column Transformation 3. Apply DES algorithm for practical applications. 4. Apply AES algorithm for practical applications. 5. Implement RSA Algorithm using HTML and JavaScript 6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem. 7. Calculate the message digest of a text using the SHA-1 algorithm. 8. Implement the SIGNATURE SCHEME – Digital Signature Standard. 9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other s/w. 10. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool 11. Defeating Malware i) Building Trojans ii) Rootkit Hunter 					
Targeted Application & Tools that can be used					
Text Book T1 : Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill, Indian Edition T2: James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017					
References R1: Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson Edition R2: Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014. Web resources: <ol style="list-style-type: none"> 1. https://networklessons.com/cisco/asa-firewall 2. https://www.udemy.com/course/cisco-asa-firewall-lab-guide 3. https://geekflare.com/learn-network-security 					
<ul style="list-style-type: none"> • Topics relevant to development of “Skill Development”: AES, Network Security for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout. 					

Course Code: CSE 2059	Course Title: MOBILE NETWORKING Type of Course: Integrated			L-T-P- C	2	0	2	3
Version No.		1.0						
Course Pre-requisites		NIL						
Anti-requisites		NIL						
Course Description		Objective of this course is to make students understand basics of various techniques in mobile Networks/Adhoc Networks and New technology of Wireless Broadband Networks						
Course Objective		The objective of the course is to familiarize the learners with the concepts of MOBILE NETWORKING and attain Skill Development through Experiential Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: 1] Understand basics of Routing and protocols in Adhoc and Sensor Networks. 2] Learn Wireless Broadband Networks Technology Overview, Platforms and Standards. 3] Learn management, testing and troubleshooting in Wireless Broadband Networks working principles of wireless LAN, its standards. 4] Learn latest wireless networks.						
Course Content:								
Module 1	AD HOC NETWORKS	Quiz		Case studies / Case let	8 Sessions			
	Topics: Characteristics and Applications of Ad hoc Networks, Routing – Need for routing and routing classifications, Table Driven Routing Protocols, Source Initiated On-Demand Routing Protocols,, Hybrid Protocols – Zone Routing, Fisheye Routing, LANMAR for MANET with group mobility, Location Added Routing, Distance Routing Effects, Microdiscovery and Power Aware Routing.							
Module 2	SENSOR NETWORKS	Quiz		Case studies / Case let	8 Sessions			
	Topics: Wireless Sensor Networks, DARPA Efforts, Classification, Fundamentals of MAC, Flat routing – Directed Diffusion, SPIN, COGUR, Hierarchical Routing, Cluster base routing, Scalable Coordination, LEACH, TEEN, APTEEN and Adapting to the dynamic nature of Wireless Sensor Networks.							
Module 3	WIRELESS BROADBAND NETWORKS TECHNOLOGY	Quiz		Case studies / Case let	8 Sessions			
	Topics: Overview, Platforms and Standards Wireless broadband fundamentals and Fixed Wireless Broadband Systems, Platforms- Enhanced Copper, Fibre Optic and HFC, 3G Cellular, Satellites, ATM and Relay Technologies, HiperLAN2 Standard, Global 3G CDMA Standard, CDMA Harmonization G3G Proposal for Protocol Layers.							
Module 4	MANAGING WIRELESS	Quiz		Case studies / Case let	8 Sessions			

	NETWORKS AND TESTING				
	Managing Wireless Broadband Operations Management of LMDS Systems and their Application, Principles of operations Management, LMDS Versus Other Access technologies, Applications, Testing Wireless Satellite Networks and Fixed Wireless Broadband Networks.				
Module 5	ADVANCED WIRELESS NETWORKS	Quiz	Case studies / Case let		8 Sessions
	Wireless. Broadband Network Applications: Teleservices Model and Adaptive QoS Parameters, Modeling of Wireless. Broadband Applications, Multicomponent Model, Residential High speed Internet Wireless Broadband Satellite Systems, Next Generation Wireless Broadband Networks – 3G, Harmonized 3G, 3G CDMA, Smart Phones and 3G Evolution.				
	List of Laboratory Tasks: 20 hours <ul style="list-style-type: none"> • Test the different sections of mobile phone. (such as ringer section, dialer section, receiver section and transmitter section). • Perform the process of call connection and call release of cellular Mobile system. • Transfer an image, audio and video file using Bluetooth protocol with varying distance between two devices and analyze the performance. • Configure Wi-Fi setting in mobile devices using mobile tethering to connect two devices such as mobile phone to mobile phone, mobile phone to laptop. • Apply RFID technology for real life applications using RFID kit. • Establish seamless wireless connectivity using multiple access point 				
	Targeted Application & Tools that can be used MATLAB and Simulink				
	Project work/Assignment:				
	Assignment:				
	Text Book T1. Joh R. Vacca, “Wireless Broadband Networks Handbook 3G, LMDS and Wireless Internet” Tata McGraw-Hill, 2001 (Unit III Chapter – 1, 2, 5; Unit IV Chapter 22, 23, 24, Unit V Chapter 25, 26 and 28) T2. D.P. Agrawal and Qing-An zeng, “Introduction to Wireless and Mobile Systems” Thomson Learning, 2003. [Unit I, Chapter 13.1 to 13.7.7, Unit 2 13.7.8 to 13.9]				
	References R1. Martyn Mallick, Mobile and Wireless Design Essentials, Wiley, 2003. R2. Kavesh Pahlavan and Prashant Krishnamurty - “Principles of Wireless Networks – A unified Approach, Pearson Education, 2002. E book link R1. https://www.youtube.com/watch?v=H7tGiGjL9bA E book link R2. https://nptel.ac.in/courses/106106167 https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live https://nptel.ac.in/courses/106102064				
	Topics relevant to “SKILL DEVELOPMENT”: Wireless and Cellular networks for Skill Development through Experiential Learning techniques . This is attained through assessment component mentioned in course handout.				

Course Code: CSE3132	Course Title: Network Management Systems Type of Course: Theory Only Course				L-T- P- C	3	0	0	3
Version No.		1.0							
Course Pre-requisites		NIL							
Anti-requisites		NIL							
Course Description		To understand the principles of network management, different standards and protocols used in managing complex networks and the Automation of network management operations and making use of readily available network management systems.							
Course Objective		The objective of the course is to familiarize the learners with the concepts of Network Management Systems and attain Skill Development through Participative Learning techniques.							
Course Out Comes		On successful completion of the course the students shall be able to: 1]Acquire the knowledge about network management standards (OSI and TCP/IP). 2]Acquire the knowledge about various network management tools and the skill to use them in monitoring a network. 3]Analyze the challenges faced by Network managers. 4]Evaluate various commercial network management systems and open network management systems. 5]Analyze and interpret the data provided by an NMS and take suitable actions.							
Course Content:									
Module 1	DATA COMMUNICATION AND NETWORK MANAGEMENT	Assignment		Data Collection/Interpretation	9 Sessions				
	Topics: OVERVIEW : Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.								
Module 2	Simple Network Management Protocol	Case studies / Case let		Case studies / Case let	9 Sessions				
	Topics: SNMPV1 NETWORK MANAGEMENT MANAGED NETWORK: Organization and Information Models MANAGED NETWORK: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The Information Model. SNMPV1 NETWORK MANAGEMENT: Communication and Functional Models The SNMP Communication Model, Functional model. SNMP MANAGEMENT: SNMPv2 Major Changes in SNMPv2, SNMPv2 System architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility with SNMPv1.								
Module 3	Remote Monitoring	Quiz		Case studies / Case let	9 Sessions				

	Topics: RMON : What is Remote Monitoring? ,RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, A Case Study of Internet Traffic Using RMON TELECOMMUNICATIONS MANAGEMENT NETWORK: Why TMN? , Operations Systems, TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN, Implementation Issues.				
Module 4	NETWORK MANAGEMENT TOOLS AND SYSTEMS	Quiz	Case studies / Case let		9 Sessions
	Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management, Enterprise Management Solutions.				
Module 5	WEB-BASED MANAGEMENT	Quiz	Case studies / Case let		9 Sessions
	NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network , Future Directions. Case Studies.				
	Targeted Application & Tools that can be used: Kiwi CatTools, SolarWinds Network Configuration Manager.				
	Project work/Assignment:				
	Assignment: Simulation of NMS using any of the tools mentioned above.				
	Text Book T1. Mani Subrahmanian, “Network Management Principles and Practice”, 2nd Edition, Pearson Education, 2010.				
	References R1. Morris, “Network management”, 1st Edition, Pearson Education, 2008. R2. Mark Burges, “Principles of Network System Administration”, 1st Edition, Wiley DreamTech, 2008. E book link R1. https://documentation.solarwinds.com/en/success_center/kct/content/kct_documentation.htm E book link R2. https://documentation.solarwinds.com/ E book link R3. https://www.youtube.com/watch?v=liBB_Q7Go5k NPTEL Course: https://onlinecourses.nptel.ac.in/noc22_cs98/course				
	Topics relevant to “SKILL DEVELOPMENT”: Telephony network management and SNMPV1 for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE220	Course Title: Internet of Things	L- T-P- C	1	0	4	3
	Type of Course: Integrated					
Version No.	2.0					
Course Pre-requisites	1. Students should know basic python programming. 2. Students have basic knowledge basic electronic components such as sensors – temperature, motion, pressure, and actuators etc. 3. Students should have basic idea about Cloud and its uses.					
Anti-requisites	NIL					
Course Description	The Internet of Things (IoT) is an emerging paradigm combining heterogeneous devices at an unprecedented scale, thereby enabling individuals and organizations to gain greater value from networked connections among people, processes, data, and things. The Internet of Things (IoT) is a course of objects interacting with people, with information systems, and with other objects. The course will focus on creative thinking, IoT concepts & IoT technologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet of Things and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Identify the application areas of IoT 2. Understand building blocks of Internet of Things and characteristics 3. Describe IoT Protocols 4. Demonstrate use of IoT devices for simple application					
Course Content:						
Module 1	INTRODUCTION TO INTERNET OF THINGS	Assignment	Simulation/Data Analysis		20 Sessions	
Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless sensor networks, Cloud computing, Big data Analytics						
Module 2	IOT COMMUNICATION MODEL AND PROTOCOLS	Assignment	Numerical from E-Resources		20 Sessions	
Connectivity Protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100,NFC, RFID. Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol						
Module 3	IOT COMMUNICATION MODEL AND PROTOCOLS	Term paper/Assignment	Simulation/Data Analysis		20 Sessions	
Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol. RFID: Introduction, Principle of RFID, Components of an RFID system.						

List of Laboratory Tasks

- 1 Installation of arduino IDE & Arduino program to implement scrolling LED, to glow even/odd LED
- 2 Arduino program to demonstrate usage of push button to control the LED
- 3 Arduino program to demonstrates traffic control system
- 4 Arduino program to demonstrates usage of servo motor with potentiometer.
5. Arduino program to Control an LED using Bluetooth.
6. Arduino program to implement RFID reader for security access.
7. Arduino Program to detect obstacle using IR sensor.
8. Arduino Program to detect motion using PIR sensor.
9. Installation of Raspberry pi software
10. Working basic commands on Raspberry pi & to demonstrate remote logging in raspberry pi
11. Raspberry pi program to implement blinking LED
12. Raspberry pi program to implement camera module for video
13. Raspberry pi program to obtain the temperature using DHT sensors
14. Using a Raspberry Pi with distance sensor (ultrasonic sensor HCSR04)
15. Raspberry pi program to implement Garage spot light

Targeted Application & Tools that can be used:

Interfacing of ARDUINO and Raspberry pi for developing smart CITIES

Tools:

Tinker cad
Cooja simulator
Contiki
Thingspeak

Text Book

- T1 Arshdeep Bagha, Vijay Madiseti, Internet of Things A hands on approach, First Edition, Universities Press, 2018
- T2 Hakima Chaouchi, The internet of Things Connecting Objects to web Wiley 2017

References

- R1 Vinit Kumar Gunjan, MohdDilshad Ansari, Mohammed Usman, ThiDieuLinh Nguyen Internet of Things Technology, Communications and Computing Springer January 2023
- R2 Dr. Hassan Internet of Things A to Z: Technologies and Applications IEEE Press 2018

E-Resources

NPTEL course –

- a) https://onlinecourses.nptel.ac.in/noc22_cs53/preview
- b) <https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/>
- c) <https://puniversity.informaticsglobal.com:2229/login.aspx>

Topics relevant to “SKILL DEVELOPMENT”: Case studies of water supply projects – Design criteria through group discussion. Interpolation of sensors through group presentation for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2057	Course Title: Could computing and Virtualization Type of Course : Theory	L-T-P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		Basics of Distributed Computing, Service Oriented Architecture				
Anti-requisites		nil				
Course Description		This Course is designed to introduce the concepts of Cloud Computing as a new computing paradigm. Cloud Computing has emerged in recent years as a new paradigm for hosting and delivering services over the Internet. The students can explore various Cloud Computing terminology, principles and applications. Understanding different views of the Cloud Computing such as theoretical, technical and commercial aspects. Topics include: Evolution of cloud computing and its services available today, Introduction, Architecture of cloud computing, Infrastructure, platform, software, Types of cloud, Business models, cloud services, Collaborating using cloud services, Virtualization for cloud, Security, Standards and Applications.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Could computing and Virtualization and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Describe fundamentals of cloud computing, virtualization and cloud computing services.• Discuss high-throughput and data-intensive computing.• Explain security and standards in cloud computing.• Demonstrate the installation and configuration of virtual machine.				
Course Content:						
Module 1				12 Sessions		
	Introduction to Cloud and Virtualization Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Virtualization, Characteristics of Virtualized Environments Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Technology Examples, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Economics of Cloud					
Module 2				12 Sessions		
	High Throughput and Data Intensive Computing: Task computing, MPI applications, Task based programming, Introduction to DIC, Technologies for DIC, Aneka Map Reduce Programming					

Module 3	11 Sessions
Cloud Security and Standards : Cloud Security Challenges, Software-as-a-Service Security, Application standards, Client standards, Infrastructure and Service standards.	
Module 4	10 Sessions
Cloud Platforms, Advances in cloud: introduction to Amazon Web Services: Introduction to Google App Engine , Introduction to Microsoft Azure . Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Cloud	
Text Book	<ol style="list-style-type: none"> 1. John Rittinghouse and James Ransome, “Cloud Computing, Implementation, Management and Security”, CRC Press. 2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education.
References	<ol style="list-style-type: none"> 1. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press. 2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill. <p>Web resources: https://presiuniv.knimbus.com/user#/home</p>
Topics relevant to “EMPLOYABILITY SKILLS”:	Aws, Azure, APIs, Aneka Cloud Platform, EC2, Installation of VM Workstation, Infrastructure Security Challenges for developing Employability Skills through Participative Learning techniques . This is attained through assessment component mentioned in course handout..

Course Code: CSE3143	Course Title: Infrastructure Management Type of Course : Theory	L-T- P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		Basic Knowledge on Linux and Information Management				
Anti-requisites		NIL				
Course Description		The course will employ a research, reporting and presentation approach using the latest ICT tools to examine and critically analyze a combination of the technical and management issues in contemporary infrastructure management, with a focus on business alignment. IT infrastructure Management evaluates new ICTs and case studies in the context of enterprise architecture. It is suitable for combinations of students in information technology, business administration and electronic commerce.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Infrastructure Management and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Describe the business value and processes of ICT services in an organization and apply that knowledge and skill with initiative to a workplace scenario.• Investigate, critically analyze and evaluate the impact of new and current ICT services to an organization.• Describe how effective IT Infrastructure Management requires strategic planning with alignment from both the IT and business perspectives in an organization.• Demonstrate the technical and communications skills that contribute to the operation of ICT services in an organization.				
Course Content:						
Module 1				12 Sessions		
	Introduction to Infrastructure management Definitions, Infrastructure, management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-New age systems) and their management, growth of internet, current business demands and IT systems issues, complexity of today’s computing environment, Total cost of complexity issues, Value of Systems management for business.					
Module 2				11 Sessions		
	Managing Infrastructure Factors to consider in designing IT organizations and IT infrastructure, determining customer’s Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL).					
Module 3				11 Sessions		
	Security Concerns					

	Introduction Security, Identity management, Single sign-on, Access Management, Basics of network security, LDAP fundamentals, Intrusion detection, firewall, security information management. Introduction to Storage, Backup & Restore, Archive & Retrieve, Space Management, SAN & NAS, Disaster Recovery, Hierarchical space management, Database & Application protection, Bare machine recovery, Data retention. Service-level management, financial management and costing, IT services continuity management, Capacity management, Availability management.
Module 4	11 Sessions
	Configuration Management Configuration Management, Service desk, Incident management, Problem management, Change management, Release management.
	Text Book 1. Rich Schiesser, IT Systems Management.
	References 1. E Turban, E Mclean and James Wetherbe, —Information Technology for Management 2. Kenneth C Laudon, Jane P Laudon, —Management Information Systems 3. Roger S Pressman, —Software Engineering: A Practitioner ‘s Approach 4. James A O ‘Brien, —Management Information Systems 5. Walker Royce, — Software Project Management: A Unified Framework Web resources: 1 . http://pu.informatics.global 2. https://presiuniv.knimbus.com/user#/home
	Topics relevant to “EMPLOYABILITY SKILLS”: Identity management, Single sign-on, Access Management, Basics of network security, LDAP fundamentals, Intrusion detection, firewall, security information management for developing Employability Skills through Participative Learning techniques . This is attained through assessment component mentioned in course handout..

Course Code: CSE384	Course Title: Data Warehousing and Mining Type of Course: Theory	L-T-P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		Data Mining				
Anti-requisites		NIL				
Course Description		The course is an intermediary course and aims to provide students with an in-depth understanding of the design and implementation of data warehousing and data mining. The course will help students to enhance their understanding of various classification, clustering, and outlier analysis methods. An interest to understand the concepts of data warehousing, and data mining and a desire to be a successful data scientist are key to enabling students to complete the course successfully. Topics include: Data Models for Data Warehouses, data extraction, cleansing, transformation and loading, data cube computation, materialized view selection, and OLAP query processing. Data mining-Fundamentals. Mining Techniques and Application: Classification, Clustering, Outlier Analysis.				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Data Warehousing and Mining and attain Skill Development through Participative Learning techniques.				
Course Out Comes		On successful completion of this course the students shall be able to: 1. Describe data warehousing architecture and considerations to build data warehouse. [Knowledge] 2. Discuss different multidimensional data models for data warehouse. [Comprehension] 3. Apply various classification and clustering methods for mining information from data. [Application] 4. Apply different techniques to find outliers in data. [Application]				
COURSE CONTENT (SYLLABUS):		Module 1: Introduction to Data Warehousing [10 Hrs] [Knowledge] The need for data warehousing, paradigm shift, data warehouse definition and characteristics, Data warehouse architecture, sourcing, acquisition, cleanup and transformation, metadata, access tools, data marts, data warehouse administration and management, building a data warehouse: business consideration, technical consideration, design consideration, implementation consideration, integrated solutions, benefits of data warehousing. Module 2: Data Warehouse modelling [12 Hrs] [Comprehension] Data cube: A multidimensional data model, stars, snowflakes, and fact constellations: schemas for multidimensional data models, dimensions: the role of concept hierarchies, measures: their categorization and computation, typical OLAP operations, efficient data cube computation, the compute cube operator and the curse of dimensionality, partial materialization: selected computation of cuboids, indexing olap data: bitmap index and join index. Module 3: Classification & Clustering methods [14 Hrs] [Application] Bayesian Belief Networks, Support Vector Machines, Classification by Back propagation, Fuzzy clusters, Probabilistic Model-Based Clusters, Expectation-Maximization Algorithm.				

	<p>Module 4: Outlier detection [09 Hrs]</p> <p>[Application]</p> <ol style="list-style-type: none"> 1. Outliers and Outlier Analysis, Types of Outliers, 2. Outlier Detection Methods: Detection of univariate Outliers Based on Normal Distribution, 3. Statistical Approaches, 4. Proximity-Based Approaches. <p>Report and PPT for 2 topics That means 2 PPTs and 2 reports. 1st topic should be from Module 4 2nd topics can be from module 4 or module 3.</p> <p>DELIVERY PROCEDURE (PEDAGOGY): Classroom Lecture, PPT Self-learning: Article review of journals on Data mining. Participative Learning: Implementation of discussed algorithm with graphical visualization using any suitable language/platform.</p> <p>REFERENCE MATERIALS: Text Books: T1. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, McGraw Hill, 2016 T2. Jiawei Han, Micheline Kamber, Jian Pei, “Data-Mining.-Concepts-and-Techniques “, The-Morgan-Kaufmann, 3rd-Edition-Morgan-Kaufmann, 2012</p> <p>Reference Books: R1. Sam Anahory, Dennis Murray, “Data Warehousing in the Real World”, Pearson, 2016 R2. Tan P. N, Steinbach M and Kumar V, “Introduction to Data Mining”, Pearson Education, 2016</p> <p>Web Based Resources and E-books: W1. NPTEL Course on “Business Analytics & Data Mining Modeling Using R”, Prof. Gaurav Dixit. https://onlinecourses.nptel.ac.in/noc22_mg67/preview W2. NPTEL Course on “Data Mining”, Mr. L. Abraham David https://onlinecourses.swayam2.ac.in/cec22_cs06/preview W3. Coursera course on “Data Warehousing for Business Intelligence Specialization”, Michael Mannino, Jahangir Karimi https://www.coursera.org/specializations/data-warehousing W4. Journal on “Data Mining and Knowledge Discovery” https://www.springer.com/journal/10618/</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Bayesian Belief Networks, Support Vector Machines, Classification by Back propagation, Fuzzy clusters for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in the course handout.</p>

Course Code: CSE2034		Course Title: Edge Computing			L-T-P-C	3	0	0	3
		Type of Course: Theory Only Course Discipline Elective							
Version No.			1.0						
Course Pre-requisites			Distributed Systems and Algorithms						
Anti-requisites			Nil						
Course Description			In this course, we will study significant tools and applications that comprise today's cloud computing platform, with a special focus on using the cloud for big data applications. The course covers various topics such as the evolution of computing industry, cloud computing basics and edge computing. The course provides information on the different types of edge compute deployments, different types of edge compute services (such as CDN Edge, IOT Edge, and Multi-access Edge (MEC)). The course also educates the students on the different vendor platforms, software services, standard bodies and open source communities available for edge computing. Students will also create a research project of their choosing.						
Course Objective			The objective of the course is to familiarize the learners with the concepts of Edge Computing and attain Employability through Problem Solving Methodologies.						
Course Out Comes			On successful completion of the course the students shall be able to: CO1 Understand the principles, architectures of edge computing (Knowledge) CO2 Describe IoT Architecture and Core IoT Modules (Comprehension) CO3 Summarize edge to Cloud Protocols (Comprehension) CO4 Describe Edge computing with RaspberryPi (Comprehension)						
Course Content:									
Module 1		IoT and Edge Computing Definition and Use Cases	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity				9 Sessions	
	Topics: Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.								
Module 2		IoT Architecture and Core	Term paper/Assignment/Cas e Study	Programming/Simulation/Data Collection/any other such associated activity				9 Sessions	

	IoT Modules			
	Topics: A connected ecosystem, IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.			
Module 3	RaspberryPi	Term paper/Assignment/Case Study	Programming/Simulation/Data a Collection/any other such associated activity	10 Sessions
	Topics: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.			
Module 4	Edge to Cloud Protocols	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	9 Sessions
	Topics: Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols- Protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.			
Module 5	Edge computing with RaspberryPi	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	8 Sessions
	Topics: Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.			
	Targeted Application & Tools that can be used: <ul style="list-style-type: none"> Application : Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking. Tools :Eclipse ioFog : An integrated development environment built by the Eclipse Foundation, backed by IBM. Eclipse ioFog is the organization's open-source edge computing platform. 			
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
	Exploring topics such as developing scalable architectures, moving from closed systems to open systems, and ethical issues rising from data sensing, addresses both the challenges and opportunities of Edge computing presents. Students can harness federating Edge resources, middleware design issues, data management and predictive analysis, smart transportation and surveillance applications, and more. A coordinated and integrated solutions can be			

	provided by thorough knowledge of the foundations, applications, and issues that are central to Edge computing.
	Text Book 1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806 2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.
	Topics relevant to "EMPLOYABILITY SKILLS": Implementation of Microcomputer RaspberryPi and device Interfacing for developing Employability Skills through Problem Solving methodologies . This is attained through assessment component mentioned in course handout.

Course Code: CSE 3090	Course Title: 5G Networking Type of Course: Theory Only Course			L- T-P- C	3	0	0	3
Version No.		1						
Course Pre-requisites		Digital communications, Mobile Communication Systems, Wireless Networks						
Anti-requisites		Nil						
Course Description		The aim of this course is to let the students understand that air Interface is one of the most important elements that differentiate between 2G, 3G, 4G and 5G. While 3G was CDMA based, 4G was OFDMA based; this course reveals the contents of air interface for 5G. While 4G brought in a deluge of infotainment services, 5G aims to provide extremely low delay services, great service in crowd, enhanced mobile broadband (virtual reality being made real), ultra-reliable and secure connectivity, ubiquitous QoS, and highly energy efficient networks.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of 5G Networking and attain Employability through Participative Learning techniques						
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Explain the channel models of 5G and the use cases for 5G.• Analyze use of MIMO in 5G and its techniques.• Understand device to device (D2D) communication and standardization.• Illustrate the in-depth functioning of 5G radio access technologies and security issues in 5G.						
Course Content:								
Module 1	5G channel modelling and use cases	Assignment		Data Collection/Interpretation			13 Sessions	

Topics: 5G channel modelling and use cases, Modeling requirements and scenarios, Channel model requirements, Propagation scenarios, Relaying multi-hop and cooperative communications: Principles of relaying, fundamentals of relaying, Cognitive radio: Architecture, spectrum sensing, Software Defined Radio (SDR), Multiple-input multiple-output (MIMO) systems, Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems. Diversity, exploiting multipath diversity, Transmit diversity, Space-time codes.					
Module 2	The 5G architecture	Case studies / Case let		Case studies / Case let	12 Sessions
Topics: Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.					
Module 3	Device-to-device (D2D) communications	Quiz		Case studies / Case let	10 Sessions
Topics: D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, Multi-hop D2D communications for proximity and emergency, services, National security and public safety requirements in 3GPP and METIS, Device discovery without and with network assistance.					
Module 4	The 5G radio-access technologies	Quiz		Case studies / Case let	10 Sessions
Topics: Access design principles for multi-user communications, Orthogonal multiple-access systems, Spread spectrum multiple access systems, Capacity limits of multiple-access methods, Sparse code multiple access (SCMA), Interleave division multiple access (IDMA), Radio access for dense deployments, OFDM numerology for small-cell deployments, Small-cell sub-frame structure, Radio access for V2X communication, Medium access control for nodes on the move, Radio access for massive machine type communication.					
Targeted Application & Tools that can be used:					
Project work/Assignment:					
Assignment: Quiz					
Text Book T1 : Afif Osseiran, Jose F. Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press Second Edition, 2015. T2 : Erik Dahlman, Stefan Parkvall, Johan Skold, 5G NR: The Next Generation Wireless Access Technology, Elsevier First Edition, 2016.					

References R1 : Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, Wiley First Edition 2015 E book link R1: https://www.wiley.com/en-in/Fundamentals+of+5G+Mobile+Networks-p-9781118867525 Web resources: https://nptel.ac.in/courses/108/105/108105134/ https://www.udemy.com/course/5g-mobile-networksmorden-wireless-communication-technology/ https://presiuniv.knimbus.com/user#/home
Topics relevant to “EMPLOYABILITY SKILLS”: D2D: from 4G to 5G, D2D standardization: 4G LTE D2D for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE316/3083	Course Title: Advanced Computer Architecture Type of Course: Program Core & Theory Only	L-T-P-C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		The course aims at familiarizing students with advanced computer architectures suitable for high-performance computing. The advanced concepts in uniprocessor and the issues in designing & using high performance parallel computers will also be covered. System resources such as memory technology and I/O subsystems needed to achieve proportional increase in performance will be discussed along with the software support required for these systems.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Advanced Computer Architecture and attain Employability through Participative Learning techniques .				
Course Out Comes		On successful completion of the course the students shall be able to: 1] Explain the concepts of parallel computing and hardware technologies 2] Compare and contrast the parallel architectures 3] Illustrate parallel programming concepts 4] Understand the organization and operation of current generation parallel computer systems, including multiprocessor and multicore systems.				

Course Content:					
Module 1	Theory of Parallelism	Assignment			10 Sessions
	Topics: Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.				

Course Code: CSE3068	Course Title: Advance Database Management System Type of Course: Integrated			L-T- P- C	2	0	2	3
Version No.		1.0						
Course Pre-requisites	1.	2. Basics about DBMS 2. MYSQL software tool usage						
Anti-requisites		Nil						
Course Description		This course covers advanced aspects of database management including normalization and renormalizations, query optimization, distributed databases, data warehousing, and big data. There is extensive coverage and hands on work with SQL, and database instance tuning. Course covers various modern database architectures including relational, key value, object relational and document store models as well as various approaches to scale out, integrate and implement database systems through replication and cloud based instances. Students learn about unstructured "big data" architectures and databases, and gain hands-on experience with Spark and MongoDB.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Advance Database Management System and attain Employability through Experiential Learning techniques						
Course Out Comes		On successful completion of the course the students shall be able to: 1.Select the appropriate high-performance database like parallel and distributed database 2.Infer and represent the real-world data using object-oriented database 3.Interpret rule set in the database to implement data warehousing of mining						
Course Content:								
Module 1	Review of Relational Data Model and Relational Database Constraints:	Assignment		Data Collection/Interpretation			15 Sessions	
Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Object and Object-Relational Databases: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.								
Module 2	Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures:	Assignment		Case studies / Case let			20 Sessions	

<p>Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.</p> <p>Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalogue Management</p>				
Module 3	NOSQL Databases and Big Data Storage Systems	Assignment	Case studies / Case let	20 Sessions
<p>Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. Big Data Technologies Based on MapReduce and Hadoop: What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion</p>				
<p>List of Laboratory Tasks: Lab sheet -1 [2 Practical Sessions] Experiment No 1: Level 1 – Study and Configure Hadoop for Big Data</p> <p>Lab sheet – 2 [2Practical Sessions] Experiment No. 2: Level 1– Study of NoSQL Databases such as Hive/Hbase/Cassandra/DynamoD Level 2 - Design Data Model using NoSQL Databases such as Hive/Hbase/Cassandra/DynamoDB</p> <p>Lab sheet – 3 [2 Practical Sessions] Experiment No. 1: Level 1 - Implement any one Partitioning technique in Parallel Databases Level 2 – Implement Two Phase commit protocol in Distributed Databases</p> <p>Lab sheet – 4 [2 Practical Sessions] Experiment No. 1: Level 1 - Design Persistent Objects using JDO and implement min 10 queries on objects using JDOQL in ObjectDB NOSQL DATABASE Level 2 - Design database schemas and implement min 10 queries using Hive/ Hbase/ Cassandra column based databases</p> <p>Lab sheet -5 [2 Practical Sessions] Experiment No. 1: Level 1 - Design database schemas and implement min 10 queries using DynamoDBkeyValue based databases Level 2 – Design and Implement social web mining application using NoSQL databases, machine learning algorithm, Hadoop and Java/.Net</p>				
<p>Targeted Application & Tools that can be used MangoDB</p>				
Project work/Assignment:				

Assignment: CASE STUDY OF TRADITIONAL RDBMS AND NOSQL DATABASE SYSTEM and submit the report	
Text Book 1. Elmasri R and Navathe S B, “Fundamentals of Database System”, 7th Edition, Pearson Publication, 2017.	
References 1. Hector Garcia Molina, Jeffery D Ullman, Jenniffer Widom, “Database systems: The Complete Book”, 2nd edition, Pearson Publication, 2013. 2. Avi Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 7th Edition, McGraw-Hill, 2019. a. https://www.classcentral.com/course/youtube-sql-tutorial-for-beginners-in-hindi-dbms-tutorial-sql-full-course-in-hindi-great-learning-99143/classroom b. https://www.udemy.com/course/sql-for-beginners-course/ c. https://onlinecourses.nptel.ac.in/noc22_cs51/preview d. https://www.coursera.org/learn/database-management e. https://www.youtube.com/watch?v=HXV3zeQKqGY PU Library Link : https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=none&topresult=false&content=*cloud*	
Topics relevant to “EMPLOYABILITY SKILLS”: Distributed Database for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	

Course Code: CSE 3015	Course Title: ADVANCED NATURAL LANGUAGE PROCESSING Type of Course: Integrated	L-T-P- C	2	0	2	3
Version No.		1.0				
Course Pre-requisites		CSE 3014 – Fundamentals of Natural Language Processing				
Anti-requisites						
Course Description		This course is an advanced course for Natural Language Processing. As a part of the course, students will be introduced to solving multiple problems in natural language processing, such as sentiment analysis, machine translation, cognitive natural language processing, etc. Topics include: Machine translation, Text summarization, Sentiment analysis, Cognitive NLP, Gaze behaviour, Evaluation Metrics, etc.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Advanced Natural Language Processing and attain Employability through Experiential Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand how to solve different problems in natural language processing. [Comprehension]• Solve natural language generation problems such as machine translation and text summarization. [Application]				

		<ul style="list-style-type: none"> • Perform sentiment analysis on reviews to discern the stance of the writer. [Application] • Use public gaze behaviour data to improve the performance of different NLP systems. [Application] 			
Course Content:					
Module 1	Pre-trained Language Models				9 Sessions
	Topics: Introduction to Pre-Trained Language Models. BERT. Multi-lingual variants of BERT. Introduction to NLTK and Huggingface Transformers.				
Module 2	Machine Translation and Text Summarization				10 Sessions
	Topics: Introduction to machine translation – source and target languages. Pivot-based machine translation. Using Transformers for machine translation. Monolingual machine translation examples. Machine translation evaluation metrics – BLEU. Implementation of BLEU score calculation using NLTK in Python. Other MT metrics – METEOR, TER, etc. Text summarization – definition. Types of summarizations – Extractive and Abstractive Summarization. Summarization evaluation metrics – ROUGE score.				
Module 3	Sentiment Analysis				9 Sessions
	Topics: Introduction to Sentiment Analysis. Solving sentiment analysis using text classification. Classification of sentiment analysis based on different levels – polarity-based and intensity-based. Challenges in sentiment analysis – sarcasm, thwarting, negations. Case studies in sentiment analysis – Reviewer rating prediction, short-text classifications, etc.				
Module 4	Cognitive NLP Using Gaze Behaviour				10 Sessions
	Topics: Eye-Mind Hypothesis and gaze behaviour terminology. Using gaze behaviour for prediction of translation complexity, sentiment analysis complexity, sarcasm understandability, text complexity, text quality prediction, etc. Challenges with recording gaze behaviour at run time. Comparison of gaze behaviour across different people – normalization and binning. Gaze behaviour datasets. Mitigation of recording gaze behaviour at run time using type aggregation.				
	List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Familiarization with Python. Using Python to read text files, basic tokenization and other preprocessing. 2. Introduction to NLTK and Huggingface Transformers in Python. 3. Using Huggingface Transformers to create a simple MT application. 4. Implementation of pivot-based machine translation using Huggingface Transformers. 5. Calculation of BLEU using NLTK – difference between sentence_bleu and corpus_bleu methods. 6. Implementation of extractive summarization. 7. Polarity classification of text using VADER. 8. Intensity prediction of text using Weighted Normalized Polarity Intensity. 9. Estimating gaze behaviour for a user using normalization and binning 10. Calculating gaze behaviour for a text based on type aggregation in multiple languages. 11. Complex word identification using gaze behaviour. 				
	Targeted Application & Tools that can be used:				

	<ol style="list-style-type: none"> 1. Google Colab 2. Python IDE (Eg. PyCharm) 3. Huggingface Transformers 4. NLTK
	Project work/Assignment:
	Assignment: Students will have to do a course group assignment over the course of the semester. The assignment topics can be taken from Modules 2 or 3 as per the instructor-in-charge.
	Text Books T1 Daniel Jurafsky, and James Martin. “ <i>Speech and Language Processing</i> ” (3rd edition draft, 2022). T2 Abhijit Mishra, and Pushpak Bhattacharyya. “ <i>Cognitively Inspired Natural Language Processing: An Investigation Based on Eye Tracking</i> ”. Springer, Singapore. 2018.
	References R1 Steven Bird, Ewan Klein, and Edward Loper. “ <i>Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit</i> ”. O’Reilly Publishers. 2009. R2 Chris Manning, and Heinrich Schutze. “ <i>Foundations of Statistical Natural Language Processing</i> ”. MIT Press. 1999. E book link R1: https://www.nltk.org/book/ E book link R2: https://nlp.stanford.edu/fsnlp/ Web resources: http://pu.informatics.global
	Topics relevant to “EMPLOYABILITY SKILLS”: Calculation of BLEU and ROUGE scores using NLTK , Estimating gaze behaviour through type aggregation, Using Hugging face Transformers for machine translation for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3038	Course Title: Applied Data Science with Python Type of Course: Program Core	L-T-P-C	2	0	2	3
Version No.		1.0				
Course Pre-requisites		Fundamentals of Python concepts				
Anti-requisites		NIL				
Course Description		The aim of the course is to give complete overview of Python’s data analytics tools and techniques. Learning python is a crucial skill for many data science roles, and this course helps to understand and develop feature engineering. With a blended learning approach, Python for data science along with concepts like data wrangling, mathematical computing, and more can be learnt.				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Applied Data Science and attain Employability through Experiential Learning techniques.				
Course Out Comes		On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Understand Numpy and Matrix Operations [Knowledge] 2. Analyze the need for data preprocessing and visualization techniques. [Comprehensive] 				

		3. Demonstrate the performance of different supervised learning algorithms like decision Tree, Random Forest, Linear Regression, Logistic Regression etc. [Application] 4. Apply unsupervised learning algorithms like K-Means, K-Medoids etc for grouping the given data. [Applicaion]			
Course Content:					
Module 1	Introduction to Data Science, Python Data Structures, Python Numpy Package	Quiz		Knowledge based quiz	No. of sessions:10
	Data Science - Need, Applications, Difference between data analysis and data analytics. Python- Variables, data types, control structures, Operators, Simple operations, Array and its operations, Numpy operations, Matrix and its operations				
Module 2	Data preparation and preprocessing using Pandas dataframe, Exploratory Data Analysis, Data Visualization	Assignment		Data Visualization	No. of sessions:10
	Dealing missing values, Normalization, statistical description about the data, Accessing the data, Summary of the data, Relationship between the data, Data Visualization using matplotlib				
Module 3	Supervised Learning Algorithms	Design an algorithm using Example		Random Forest	No. of sessions:10
	Decision Tree Algorithm, ID3 Classifier, Random Forest, Classifier Accuracy, Linear Prediction, Logistic Regression – Case study				
Module 4	Unsupervised Learning Algorithms	Case Study		Conduct a case study on how data sets can be gathered and implemented in real time application.	No. of sessions:10
	Various distance Function, Dissimilarity between the mixed types of data, K-Means Algorithm, K- Medoids Algorithm -Case Study				
	List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Introduction to R tool for data analytics science 2. Basic Statistics and Visualization in R 3. K-means Clustering 4. Association Rules 5. Linear Regression 6. Logistic Regression 7. Naive Bayesian Classifier 8. Decision Trees 9. Simulate Principal component analysis 10. Simulate Singular Value Decomposition 				

	Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • IBM SPSS • Julia and Jupyter Notebook • Matplotlib
	Project work/Assignment:
	<ol style="list-style-type: none"> 1. Design forest fire and wildfire prediction system. 2. Driver Drowsiness Detection System with OpenCV & Keras 3. Credit Card Fraud Detection using Python.
	Textbook(s): <ol style="list-style-type: none"> 1. Applied Data Science with Python and Jupyter-Alex Galea, Packt Publishing, October 2018 2. Data Visualization in Python with Pandas and Matplotlib Paperback –David Landup, June 16, 2021
	References: <ol style="list-style-type: none"> 1. Data Science with Python and Dask- Jesse Daniel, 1st Edition, July 30, 2019 Weblinks: <ul style="list-style-type: none"> • Udemy: https://www.udemy.com/course/applied-data-science-with-python-specialization-mhm/ • NPTEL online course : https://nptel.ac.in/courses/106106179 • https://presiuniv.knimbus.com/user#/home
	Topics relevant to “EMPLOYABILITY SKILLS”: Data Science, Decision Tree Algorithm for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3017	Course Title: Autonomous Navigation and Vehicles Type of Course: Theory	L- T-P- C	3	0	0	3
Version No.	1					
Course Pre-requisites	<ul style="list-style-type: none"> • Real-time embedded programming • Optimal estimation and control • Linear algebra 					
Anti-requisites	NIL					
Course Description	<p>Overview of technologies vehicles including sensors, sensing algorithms, machine learning, localization, mapping, object detection, tracking, communication and security. Hands-on implementation of robotic sensing and navigation algorithms on both simulated and physical mobile platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for vision-based navigation of autonomous vehicles (e.g., mobile robots, self-driving cars, drones). It culminates in a critical review of recent advances in the field and a team project aimed at advancing the state-of-the-art.</p> <p>Topics include: Autonomous driving technologies overview, Object Recognition and Tracking, Localization with GNSS, Visual Odometry, Perceptions In Autonomous driving, Deep learning in Autonomous</p>					

		Driving Perception, Prediction and Routing, Decision planning and control
Course Objective		The objective of the course is to familiarize the learners with the concepts of Autonomous Navigation and Vehicles and attain Employability through Participative Learning techniques.
Course Out Comes		<p>On successful completion of the course the students shall be able to:</p> <p>CO1. Understand the Autonomous system's and its requirements. Explain algorithm, sensing, object recognition and tracking of an Autonomous system [Understand]</p> <p>CO2. Do the error analysis of Localization systems and use the tools and techniques [Application]</p> <p>CO3. Explain, plan and control the traffic behavior, and shall be able to do lane level routing and create simple algorithms [Understand]</p> <p>CO4. Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform. [Understand]</p>
Course Content:		
Module 1		12 Sessions
	Introduction to autonomous driving: Autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception. Object Recognition and Tracking: Autonomous driving client system, driving cloud platform, Robot Operating System, HD Map Production, Deep learning Model Training, Localization with GNSS: GNSS overview, GNSS error analysis, satellite based augmentation systems, real time kinematic and differential GPS, precise point positioning, Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry.	
Module 2		12 Sessions
	Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Stereo, Optical flow and Scene flow. Deep learning in Autonomous Driving Perception: Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow.	
Module 3		10 Sessions
	Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost.	
Module 4		11 Sessions
	Decision planning and control: Behavioral decisions, Motion planning, Feedback control Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating systems and computing platform Cloud platform for Autonomous driving: Introduction, infrastructure, simulation.	
	Text Book	

	<p>T1: Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 1st Edition, 2018</p> <p>T2: Ronald K. Jurgen Autonomous Vehicles for Safer Driving SAE International Edition, 2013</p>
	<p>References</p> <p>R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 1st Edition, 2016</p> <p>R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 1st Edition, 2016</p> <p>R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 1st Edition, 2018</p> <p>Web resources: http://pu.informatics.global</p>
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Autonomous driving for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 395	Course Title: Image Processing			L- T-P- C	3	0	0	3
	Type of Course: Theory Only							
Version No.	2.0							
Course Pre-requisites	In order to pursue this course student should have prior knowledge on Engineering Mathematics concepts and Digital Signal processing.							
Anti-requisites	NIL							
Course Description	<p>This Course is an introduction to image processing and image analysis techniques and concepts. Image processing has found much wider applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, law enforcement, defense, intelligence. With the progress made in multimedia these days, digital image processing has become an indispensable part of our digital age.</p> <p>Topics include: Fundamentals, Applications, Human Visual Perception, Image Formation, Sampling and Quantization, Binary Image, Three-Dimensional Imaging, Image file formats. Color and Color Imagery: Perception of Colors, Image Transformation: Fourier Transforms, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods , Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering, Image Enhancement and Restoration, Image Restoration, Image Reconstruction, Image Segmentation, Recognition of Image Patterns.</p>							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Image Processing and attain Entrepreneurship Skill through Participative Learning techniques.							
Course Out Comes	COURSE OUTCOMES: On successful completion of the course the students shall be able to: 1. Describe the Fundamentals and Applications of Image Processing. 2. Discuss the major Image Transformation Techniques 3. Explain the various models for the image restoration and degradation process. 4. Classify the Image Segmentation and Color Processing Models.							
Course Content:								
Module 1	Introduction	Quiz	Image file	10 Sessions				
Topics: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Classification of images, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.								
Module 2	Image Transformation	Quiz	Spatial filters	11 Sessions				
Topics: Some basic gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters. 1D FFT, 2D FFT, Smoothing and Sharpening frequency domain filters.								
Module 3	Image Restoration	Assignment	Exponential	12 Sessions				
Topics: A model of the image restoration and degradation process, Noise models – spatial and frequency properties of noise, some important probability density functions- Gaussian noise, Rayleigh noise, Gamma noise, exponential, uniform, impulse noise, Periodic noise Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering.								
Module 4	Image Segmentation	Assignment	Morphological	12 Sessions				

Topics: Point, Line, and Edge Detection, Thresholding, Region growing, split and merge algorithms, Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing.

Targeted Application & Tools that can be used:

Professionally used software – Matlab permits quick prototyping leading to its usage in research. This tool is used in making the application of Image Processing.

Text Book

T1. Tinku Acharya and Ajoy K. Ray, “*Image Processing Principles and Applications*”, John Wiley and Sons publishers.

References

R1. Maria Petrou and Costas Petrou, “*Image Processing the Fundamentals*”, John-Wiley and Sons Publishers.

R2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “*Digital Image Processing Using MATLAB*”, Gatesmark Publishing

Weblinks:

[Computer Vision and Image Processing - Fundamentals and Applications - Course \(nptel.ac.in\)](https://www.nptel.ac.in/courses/106/01/2019-2020/106012019001/)
[Image Processing for Engineering and Science | Coursera](https://www.coursera.org/learn/image-processing-for-engineering-and-science)

Topics relevant to “ENTREPRENEURIAL SKILLS”: Region-Based Segmentation, Morphological Image Processing, Biomedical Imaging for developing **Entrepreneurship Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSE3021	Course Title: BLOCKCHAIN FOR PUBLIC SECTOR	L-T-P-C	3	0	0	3
	Type of Course: Theory					
Version No.		1.0				
Course Pre-requisites		Foundations of Blockchain Technology				
Anti-requisites		NIL				
Course Description		Blockchain Technology is being increasingly employed in the public sector, specifically where trustworthiness and security are of importance. This course discusses about the blockchain technology and its potential applications, emerging technologies and their role in the implementation of blockchain technologies in the digital government and the public sector particularly in Smart City, Electronic Health Care monitoring and Digital Certificates. It also analyses effects, impacts, and outcomes from the implementation of blockchain technologies in the public sector in the selected case studies.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Blockchain For Public Sector and attain Employability through Participative Learning techniques..				
Course Out Comes		On successful completion of the course the students shall be able to: 1] Understand the Standards and Protocols of Blockchain and data management in the public sector [COMPREHENSION] 2] Apply Artificial intelligence and machine learning approaches for implementation of Smart cities using blockchain architecture [APPLICATION] 3] Discuss about Electronic Healthcare Records Monitoring using Blockchain Technology [COMPREHENSION] 4] Describe the Blockchain Technology use cases in Indian and Foreign Countries [KNOWLEDGE]				
Course Content:						
Module 1	Blockchain in Government and the Public Sector	Quiz	Data Collection		11 Sessions	
Blockchain in Government and the Public Sector use cases – Benefits – Standards and Protocols of Blockchain - data management in the public sector - Building networked public services - Understanding and addressing risks and challenges. Blockchain Applications to Public Sector Governance. Case Study – Keyless Signature Infrastructure (KSI)						

Module 2	Blockchain in Smart City Applications	Assignment	Data Collection		11 Sessions
The Application of Blockchain Technology to Smart City Infrastructure - Artificial intelligence and machine learning approaches for smart transportation in smart cities using blockchain architecture - Blockchain architecture for intelligent water management system in smart cities - Blockchain-based energy-efficient smart green city in IoT environments - Citizen e-governance using blockchain - Cloud/edge computing for smart cities.					
Module 3	Blockchain in Healthcare	Case Study	Data Collection		12 Sessions
Blockchain in Healthcare Applications – Use cases - Blockchain and Data Security – Blockchain Medical Records - Healthcare Blockchain Use Case: Supply Chain Transparency – Electronic Health Records, A novel Blockchain-based Access Control Manager to Electronic Health Records. Case Study – Avaneer Health, MEDICALCHAIN, BurstIQ, Guardtime					
Module 4	Implementation of Blockchain in Indian System and Foreign Countries	Case Study	Data Collection		11 Sessions
Implementation of Blockchain in India - land registration - Blockchain Fit Assessment: Digital certificates, SuperCert: Anti certificates fraud identity intelligence blockchain solution for educational certificates. Case study- Implementation of Blockchain in Foreign Countries - Vehicle Wallet – BenBen – Project Ubin					
Targeted Application & Tools that can be used: Remix IDE - Solidity Programming					
Project Work / Assignment / Case Study					
Assignment 1: Blockchain architecture for intelligent water management system in smart cities. Case Study: Blockchain-based health care monitoring for privacy preservation of COVID-19 medical records. Case Study: Implementation of Blockchain in Government of Estonia - Digital Certification by DNV GL.					
Text Books 1. Saravanan Krishnan, Valentina Emilia Balas, Raghvendra Kumar, “ <i>Blockchain for Smart Cities</i> ”, Elsevier, 2021. https://doi.org/10.1016/C2020-0-01958-4 2. Christopher G. Reddick, Manuel Pedro Rodríguez-Bolívar, Hans Jochen Scholl, “ <i>Blockchain and the Public Sector Theories, Reforms, and Case Studies</i> “, Stanford University Press, 2021.					

	<p><u>Blockchain and the Public Sector: Theories, Reforms, and Case Studies (Public Administration and Information Technology Book 36) eBook : Reddick, Christopher G., Rodríguez-Bolívar, Manuel Pedro, Scholl, Hans Jochen: Amazon.in: Kindle Store</u></p>
	<p>References</p> <ol style="list-style-type: none"> 1. Sheikh Mohammad Idrees, Parul Agarwal, M. Afshar Alam, “<i>Blockchain for Healthcare Systems: Challenges, Privacy, and Securing of Data</i>”, CRC Press, 2021 . https://books.google.co.in/books/about/Blockchain_for_Healthcare_Systems.html?id=hiU7EAAAQBAJ&redir_esc=y
	<p>Web Resources:</p> <ol style="list-style-type: none"> 1. https://link.springer.com/book/10.1007/978-3-030-55746-1 2. https://consensus.net/blockchain-use-cases/government-and-the-public-sector/ 3. https://www.oecd.org/gov/innovative-government/oecd-guide-to-blockchain-technology-and-its-use-in-the-public-sector.htm 4. https://www2.deloitte.com/in/en/pages/public-sector/articles/blockchain-in-public-sector.html 5. https://www.ibm.com/in-en/blockchain/industries/government 6. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/using-blockchain-to-improve-data-management-in-the-public-sector 7. https://www.frontiersin.org/articles/10.3389/fbloc.2022.869665/full 8. https://www.settlemint.com/government-blockchain-use-cases/ 9. https://stlparkers.com/articles/digital-health/5-blockchain-healthcare-use-cases/ 10. https://www.oecd.org/finance/Opportunities-and-Challenges-of-Blockchain-Technologies-in-Health-Care.pdf 11. https://builtin.com/blockchain/blockchain-healthcare-applications-companies 12. https://www.hhs.gov/sites/default/files/blockchain-for-healthcare-tlpwhite.pdf 13. https://healthitanalytics.com/features/3-use-cases-for-blockchain-in-healthcare 14. https://www2.deloitte.com/us/en/pages/public-sector/articles/blockchain-opportunities-for-health-care.html 15. https://www.niti.gov.in/sites/default/files/2020-01/Blockchain_The_India_Strategy_Part_I.pdf 16. https://www.bigchaindb.com/usecases/government/benben/
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Keyless Signature Infrastructure for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 3044	Course Title: BUILD AND RELEASE MANAGEMENT Type of Course: Theory Only Course	L- T-P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE 2014 – Software Engineering				
Anti-requisites		-				
Course Description		Build and Release management course guides the software development efforts from planning to deployment, resulting in better customer satisfaction with the end product. The benefits of Build and release is essential to high-performing software development and delivery. Build and release enhanced by safely testing features in production environments, gathering valuable feedback and releasing new and improved features continuously. In this course, Students will learn about the benefits of using a release management process to manage and improve the development of a software build. This course covers the key concepts and principles that apply to release management, as well as common considerations and potential challenges to be aware of.				
Course Objective		The objective of the course is to familiarize the learners with the concepts Of Build And Release Management and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> • Learn about the common Infrastructure build servers, scalability and availability • Understand the Continuous Integration and Deployment (CI/CD) • Implement Automated, build, Installations and deployments and release 				
Course Content:						
Module 1	UNDERSTANDING COMMON AGILE PRACTICES IN DEVOPS	Assignment		Data Collection/Interpretation		15 Sessions
	Topics: Introduction to Product Management, Product Design and Requirement gathering, Product Design Challenges, UX Design, Product Development Methodologies, Product Marketing and Presentation, Traditional Software Development Methodologies, Problem/issues with traditional approach, Agile Development, Agile Manifesto, Scrum Model, Agile Estimations and Planning, Soft skills in agile Kanban - What is Kanban, Understanding the Principle of Kanban, Value System of Kanban, WIP Limits, Classes of Service in Kanban, Sample Kanban Boards (Proto Kanban) , How to read a Kanban Board, Meetings in Kanban System, Extreme Programming.					
Module 2	CODE DESIGN	Case studies / Case let		Case studies / Case let		15 Sessions

Topics: Good design is good design regardless of paradigm, Fundamental characteristics of good design: modular, loosely coupled, etc., Using design to simplify code structure, how programming languages are designed to support good code design, best practices of design in OO program development, First Fundamental OO principle: Interface and implementation design, Second Fundamental OO Principle: Recursive design, Design Patterns: reusing best practices., SOLID Design Principles				
Module 3	TESTING AND DEBUGGING	AND Quiz	Case studies / Case let	15 Sessions
Topics: TESTING AND DEBUGGING Planning for errors and exceptions, Basic test-driven development: writing tests first, How TDD improves the quality of the resulting code, automating testing: using Junit, etc, Avoiding creeping errors. REFACTORING: IMPROVING STRUCTURE Code smells: symptoms of poorly designed code, Refactoring: changing code structure without changing functionality, Using TDD for controlled code changes, the refactoring process, using refactoring to make better code faster, Collective Code Ownership				
Targeted Application & Tools that can be used: Common frameworks and code architectures: Spring, Hibernate, Microservices, Spring Boot. IDEs: Eclipse, Visual Studio, IntelliJ				
Project work/Assignment:				
Assignment: Each student have to submit assignment as 4 to 5 pages report on Agile Frameworks and tools				
Text Book T1. Eric Breachner, "Agile Project Management with Kanban", 1st Edition, 2019, MSPress Publishers. T2. Peter Measey and Radtac, "Agile Foundations: Principles, Practices and Frameworks", Whitshire publishers, 2015.				
References R1. Dave Howard, "IT Release Management: Hands on Guide", CRC Press, 2016. R2. Lyssa Adkins, "Coaching Agile teams", Addison-wesley publications, 2012. E book link R1: https://download.manageengine.com/academy/it-release-management-e-book.pdf E book link R2: https://www.smartsheet.com/release-management-process R3 Web resources: https://presiuniv.knimbus.com/user#/home <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=dvFQrsY_tKg • https://www.youtube.com/watch?v=vlsLxaY4P7M 				
Topics relevant to "EMPLOYABILITY SKILLS": Build and release management Process, Frameworks and tools for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE2025	Course Title: Business Continuity and Risk Analysis Type of Course: Theory		L-T- P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		NIL					
Anti-requisites		NIL					
Course Description		Through the study of incident response and contingency planning, including incident response plans, disaster recovery plans, and business continuity plans, this course aims to help students comprehend the principles of risk management.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Business Continuity and Risk Analysis and attain Employability through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Describe concepts of risk management [Knowledge] 2. Define and be able to discuss incident response options [Comprehension] 3. Design an incident response plan for sustained organizational operations [Comprehension] 4. Discuss and recommend contingency strategies, including data backup and recovery and alternate site selection for business resumption planning. [Knowledge]					
Course Content:							
Module 1 Sources of disaster and types of disasters					12 Sessions		
	Disaster Recovery Operational cycle of disaster recovery, disaster recovery cost, incidents that requires disaster recovery plans, evaluating disaster recovery - methods, team, phases, objectives, checklist. Best practices for disaster recovery - Business continuity - Business continuity vs. disaster recovery						
Module 2 Business continuity management:					11 Sessions		
	Introduction - Elements of business continuity management. Business continuity plan – Business continuity planning and strategies - BCP standards and guidelines - BCP Project Organization - Crisis communication plan - Emergency response plan - Contingency planning						
Module 3 Managing, assessing and evaluating risks:					10 Sessions		
	Importance of risk management - Risk management methodology - Attack methods and Countermeasures - Cost benefits analysis of risk management - Risk assessment responsibilities - Responsibilities of security professional - Information system auditing and monitoring – Verification tools and techniques.						
Module 4 Risk control policies and Counter measures					12 Sessions		

	Introduction - Counter measures - Risk control policy development factors-Development of information assurance principles and practices - Laws and procedures in information assurance policy implementation, Security test and evaluation, Automated security tools, Cost benefit analysis, Developing a risk assessment methodology, Security requirements, Information categorization, Risk management methodologies to develop life cycle management policies and procedures, Education, training and awareness. Policy development Information security policy, change control policies, system acquisition policies and procedures, Risk analysis policies and General risk control policies.
	<p>Text Book</p> <ol style="list-style-type: none"> 1. John W. Rittinghouse and James F. Ransome, Business Continuity and Disaster Recovery for Info Sec Managers. Elsevier: Elsevier Digital Press, 2005. (ISBN: 978-0-52-119019-0) 2. EC Council Press. Disaster Recovery, 1st Ed. Course Technology, 2011. (ISBN: 978-1-55558-339-2)
	<p>References</p> <ol style="list-style-type: none"> 1. ISO 27001:2013 A specification for an information security management system 2. David Alexander, Amanda Finch, David Sutton, Andy Taylor. Information Security Management Principles, 2nd Ed. BCS Shop, 2013. (ISBN: 9781780171753) 3. Mark Talabis, Jason Martin. Information Security Risk Assessment Toolkit Practical Assessments through Data Collection and Data Analysis. Syngress Imprint, 2013. (ISBN: 978-1-59-749735-0). <p>Web resources: http://pu.informatics.global</p>
	Topics relevant to “EMPLOYABILITY SKILLS”: Business continuity vs. disaster recovery , risk management, Storage disaster recovery services tools, Verification tools and techniques for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3088		Course Title: Business Intelligence and Analytics Type of Course: Theory			L-T-P-C	3	0	0	3
Version No.			1.1						
Course Pre-requisites			NIL						
Anti-requisites			NIL						
Course Description			Business Intelligence (BI) refers to technologies, applications, and practices for the collection, integration, analysis, and presentation of business information. The purpose of business intelligence is to support better business decision making. This course provides an overview of the technology of BI and the application of BI to an organization’s strategies and goals.						
Course Objective			The objective of the course is to familiarize the learners with the concepts of Business Intelligence and Analytics and attain Employability through Problem Solving Methodologies.						
Course Out Comes			On successful completion of the course the students shall be able to: 1. Introduce the concepts and components of Business Intelligence (BI) [Knowledge] 2. Evaluate the technologies that make up BI (data warehousing, OLAP) [COMPREHENSION] 3. Define how BI will help an organization and whether it will helpful [COMPREHENSION] 4. Identify the technological architecture that makes up BI systems [COMPREHENSION]						
Course Content:									
Module 1		Basics of Insights	Assignment		Programming Task			10 Sessions	
	Topics: The importance of data in the information age – the data value chain – tools for generating insights – job roles available in the data insights market								

Module 2	Basics Statistics: Foundation of Quantitative Insights	Assignment		12 Sessions
Topics: Basic statistics – Variables - Measures of central tendency - Measures of dispersion - Normal distribution and histograms - The empirical rule - Covariance and correlation				
Module 3	Data Visualization	Assignment		10 Sessions

Topics: Data visualisation and Anscombe's Quartet - Data cleaning using SAS Data Studio - Bar and Pie Charts				
Module 4	Advanced charts and dashboards			13 Sessions
Topics: Multi variation correlation matrix and bar and line chart - SAS Visual Analytics filtering and controls - KPIs and targeted bar charts - Dashboard theory – Demand forecasting - Linear regression analysis – Forecasting - Forecasting and smoothing methods				
Targeted Application & Tools that can be used: Professionally used software				
Project work/Assignment:				
Text Book <ol style="list-style-type: none"> 1. Business Intelligence Guidebook: From Data Integration to Analytics 1st Edition, Kindle Edition. 2. Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications (Addison-Wesley Information Technology Series) 1st Edition, Kindle Edition 				
References <ol style="list-style-type: none"> 1. Successful Business Intelligence, Second Edition: Unlock the Value of BI & Big Data 2nd Edition, Kindle Edition Weblinks: <p>W1: https://www.coursera.org/learn/business-intelligence-data-analytics#</p> <p>W2: https://onlinecourses.nptel.ac.in/noc20_mg11/preview</p>				
Topics relevant to “EMPLOYABILITY SKILLS”: information age , data value chain for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				

Course Code: CSE 3127	Course Title: Cloud Application Development			L-T-P-C	3	0	0	3
Type of Course: Theory Only								
Version No.		1.0						
Course Pre-requisites		Cloud Computing Basics						
Anti-requisites		NIL						
Course Description		The Cloud Application Development Foundations Specialization program will teach students the tools and technologies that successful software developers use to build, deploy, test, run, and manage Cloud Native applications – putting them in an advantageous position to begin a new career in a highly in-demand area. The course will provide the students’ knowledge on cloud computing and related concepts, cloud services, applications developments of Amazon web services, Cloud architecture and programming model, map reducing in cloud, virtualization, applying virtualization, Cloud Resource Management and Scheduling, Cloud Security issues.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Cloud Application Development and attain Employability through Participative Learning techniques.						
Course Out Comes		On successful completion of this course the students shall be able to: 1. Understand the Define cloud computing and related concepts and Memorize the Cloud architecture and programming model. [Comprehension] 2. Identify compute intensive model and date intensive model and Understand the Cloud Resource Management and Scheduling. [Comprehension] 3. Understand the Cloud Security issues and Identify the how standards deal with cloud services and virtualization. [Application] 4. Understand the cloud resource virtualization and Identify the application virtualization, applying virtualization. [Application] 5. Understand compliance for the cloud provider vs compliance for the customer. [Comprehension]						
Course Content:								
Module 1	INTRODUCTION AND CLOUD APPLICATION DEVELOPMENT	Assignment		Knowledge, Quizzes	No. of Classes:8			
	Topics: Introduction: Definition, Characteristics, Benefits, challenges of cloud computing, cloud models: service IaaS(infrastructure as service),PaaS(platform as a service),SaaS(software as a service), deployment models-public, private, hybrid, community; Types of cloud computing: Grid computing utility computing, cluster; computing Cloud services:							

	Amazon, Google, Azure, online services, open source private clouds, SLA; Applications of cloud computing: Healthcare, energy systems, transportation, manufacturing, education, government, mobile communication, application development. Assignment: Types of cloud and their comparisons.				
Module 2	CLOUD ARCHITECTURE, PROGRAMMING MODEL	Assignment		Knowledge, Quizzes	No. of Classes:9
	Topics: Cloud Architecture, programming model: NIST reference architecture, architectural styles of cloud applications, single, multi, hybrid cloud site, redundant, non-redundant, 3 tier, multi-tier architectures; Programming model: Compute and data intensive. Assignment: Cloud Architecture, architectural styles of cloud applications.				
Module 3	CLOUD RESOURCE VIRTUALIZATION	Case Study		Application, Quizzes	No. of Classes:8
	Topics: Cloud resource virtualization: Basics of virtualization, types of virtualization techniques, merits and demerits of virtualization, Full vs Para - virtualization, virtual machine monitor/hypervisor. Virtual machine basics, taxonomy of virtual machines, process vs system virtual machines. Case Study: Cloud resource virtualization: Basics of virtualization, types of virtualization techniques.				
Module 4	CLOUD RESOURCE MANAGEMENT AND SCHEDULING	Case study		Application, Quizzes	No. of Classes:10
	Topics: Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, resource bundling, combinatorial, fair queuing, start time fair queuing, borrowed virtual time, cloud scheduling subject to deadlines, scheduling map reduce applications subject to deadlines, resource management and application scaling. Case Study: Cloud Resource Management and Scheduling.				
Module 5	CLOUD RESOURCE MANAGEMENT AND SCHEDULING	Case study		Application, Quizzes	No. of Classes:10
	Topics:				

	<p>Cloud Security: Risks, privacy and privacy impacts assessments; Multi-tenancy issues, security in VM, OS, virtualization system security issues and vulnerabilities; Virtualization system-specific attacks: Technologies for virtualization-based security enhancement, legal.</p> <p>Case Study: Cloud Security: Risks, privacy and privacy impacts assessments.</p>
	<p>Targeted Application & Tools that can be used: Public cloud platforms like AWS, GCP and Azure.</p>
	<p>Project work/Assignment:</p>
1.	<p>2. Create an Amazon EC2 Instance (Linux) or use equivalent other cloud platform such as Google Cloud or Azure to create a virtual machine service.</p> <p>2. Create an Amazon S3 Bucket or use equivalent other cloud platform such as Google Cloud or Azure to create a storage service.</p> <p>3. Create a static website in AWS using S3 and cloud front.</p>
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Dan Marinescu, “Cloud Computing: Theory and Practicel”, M K Publishers, 1st Edition, 2013, 2. Kai Hwang, Jack Dongarra, Geoffrey Fox,” Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, M K Publishers, 1st Edition, 2011.
	<p>References</p> <ol style="list-style-type: none"> 1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGraw Hill, 1st Edition, 2009. 2. Arshdeep Bahga, “Cloud Computing: A Hands on Approach”, Vijay Madisetti Universities Publications, 1 st Edition, 2013.
	<p>Web Resources and Research Articles:</p> <ol style="list-style-type: none"> 1. https://www.oracle.com/in/cloud/application-development 2. http://computingcareers.acm.org/?page_id=12 3. http://en.wikibooks.org/wiki/cloud_application 4. http://www.acadmix.com/eBooks_Download 5. http://www.ibm.com 6. pu.informatics.global, https://sm-nitk.vlabs.ac.in/
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: EC2 for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3095	Course Title: Cloud Security Type of Course: Theory	L- T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Cloud Computing and Services (CSE322)					
Anti-requisites	NIL					
Course Description	This course provides ground-up coverage on the high-level concepts of cloud landscape, architectural principles, and techniques. It describes the Cloud security architecture and explores the guiding security for Infrastructure and Softwares.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Cloud Security and attain Employability through Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe fundamentals of cloud computing [Knowledge]. 2. Explain cloud computing security architecture and associated challenges [Comprehension]. 3. Discuss cloud computing software security essentials [Comprehension]. 4. Apply infrastructure security and data security in cloud computing environment. [Application].					
Course Content:						
Module 1:	Fundamentals of Cloud Computing	Quiz		Knowledge based Quiz	12 Sessions	
	Topics: Cloud Computing at a Glance, Building Cloud Computing Environments, Computing Platforms and Technologies, Cloud Computing Architecture: Cloud Delivery Models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud Deployment Models, Expected Benefits.					
Module 2:	Cloud Security Challenges and Cloud Security Architecture	Quiz		Comprehension based Quiz	11 Sessions	
	Topics: Security Policy Implementation, Computer Security Incident Response Team, Virtualization Security Management. Architectural Considerations, Identity Management and Access Control, Autonomic Security.					
Module 3	Cloud Computing Software Security Essentials	Assignment		Batch-wise Assignments	11 Sessions	
	Topics: Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Secure Cloud Software Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery.					
Module 4:	Infrastructure Security and Data Security	Assignment and Presentation		Batch-wise Assignment and Presentations	10 Sessions	
	Topics: Infrastructure Security: The Network Level, The Host Level, The Application Level.					

	Data Security : Aspects of Data Security, Data Security Mitigation, Provider Data and its Security.
	Targeted Application & Tools that can be used: Use of CloudSim simulator.
	Project work/Assignment: Survey on Cloud Service Providers
	Text Book <ol style="list-style-type: none"> 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “<i>Mastering Cloud Computing</i>”, McGraw Hill Education, July 2017. 2. Roland L Krutz and Russell Dean Vines, “<i>Cloud Security - A Comprehensive Guide to Secure Cloud Computing</i>”, Wiley Publishing, Inc. 2010.
	References <ol style="list-style-type: none"> 1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, “<i>Secure Cloud Computing</i>”, Springer, ISBN 978-1-4614-9278-8 (eBook). 2. John Rittinghouse and James Ransome, “<i>Cloud Computing, Implementation, Management and Security</i>”, CRC Press, 2010. 3. Tim Mather, Subra Kumaraswamy and Shahed Latif”, “Cloud Security and Privacy – An Enterprise Perspective on Risks and Compliance”, Oreily Publication, 2009. WEB RESOURCES: https://presiuniv.knimbus.com/user#/home
	Topics relevant to “EMPLOYABILITY SKILLS”: Cloud computing architecture, Security policy implementation, Infrastructure security and Data security for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3103		Course Title: Cognitive Science & Analytics Type of Course:		L-T-P-C	3	0	0	3
Version No.			1.1					
Course Pre-requisites			NIL					
Anti-requisites			NIL					
Course Description			This course is an introduction to computational theories of human cognition. Drawing on formal models from classic and contemporary artificial intelligence, it will explore fundamental issues in human knowledge representation, inductive learning and reasoning. What are the forms that our knowledge of the world takes? What are the inductive principles that allow us to acquire new knowledge from the interaction of prior knowledge with observed data? What kinds of data must be available to human learners, and what kinds of innate knowledge (if any) must they have?					
Course Objective			The objective of the course is to familiarize the learners with the concepts of Cognitive Science & Analytics and attain Employability through Participative Learning techniques.					
Course Out Comes			On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Introduce the concepts and components of Cognitive Science• Evaluate the technologies that make up Cognitive Science .• Define how CS will help an organization and whether it will helpful• Identify the technological architecture that makes up this systems					
Course Content:								
Module 1		Introduction	Assignment		Programming Task	12 Sessions		
	Topics: Cognition Process, Cognitive Psychology, Cognitive Science; Foundations of Cognitive Science, Cognitive Science and Multi-disciplinary; Machines and Minds; Laws thoughts to binary logic; Classical Cognitive Science; Connectionist Cognitive Science; Mind body Problem; Turing Response to Mind Body Problem; Pinker, Penerose and Searle’s Responses to Mind Body Problem; Representational Theory of Mind; Theories of Mental Representation: Minimal Analysis of mental representation, Resemblance theories of mental representation, Casual covariation theories of mental representation, internal roles theories of mental representation							

Module 2	Precursors of Cognitive Science	Assignment			10 Sessions
	Topics: Behaviorism; Theory of Computation and Algorithms; Algorithms and Turing Machines; Marr's Three Level of Computation; Linguistics and Formal Language; Information Processing Models in Psychology				
Module 3	Psychological Perspective of Cognition	Assignment			10 Sessions
	Topics: Cognitive Models of Memory, Atkinson-Shiffrin's Model, Tulving's Model, Mental Imagery, Kosslyn's View, Moyer's View, Peterson's View, Cognitive Maps, Problem Understanding, States of Cognition, Cognition in AI				
Module 4	Cognitive System and analytics				13 Sessions
	Topics: Cognitive System; Architecture for intelligent agents; Modularity of Mind; Modularity Hypothesis; The ACT-R/PM architecture Data Analytics overview, Importance of DA, Types of DA, Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Benefits of DA, Data Visualization for Decision Making, Data types, Measure of central tendency, Measures of Dispersion				
	Targeted Application & Tools that can be used: Professionally used software				
	Project work/Assignment:				
	Text Book 1. José Luis Bermúdez, Cognitive Science: An Introduction to the Science of the Mind, Cambridge University Press 2. Michael R. W. Dawson , Mind, Body, World: Foundations of Cognitive Science, UBC Press				
	References 1. Daniel Kolak, William Hirstein, Peter Mandik, Jonathan Waskan, Cognitive Science, An Introduction to Mind and Brain, Routledge Taylor and Francis Group 2. Amit Konar – Artificial Intelligence and Soft computing: Behavioral and Cognitive Modeling of the Human Brain, CRC Press Weblinks: W1: Top Cognitive Science Courses - Learn Cognitive Science Online Coursera W2: Introduction to Cognitive Psychology - Course (nptel.ac.in)				
	Topics relevant to “EMPLOYABILITY SKILLS”: Cognitive System for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE3022	Course Title: Cryptocurrency Technology Type of Course: Theory Only Course		L-T- P- C	3	0	0	3
Version No.		1					
Course Pre-requisites	<ul style="list-style-type: none">	<ul style="list-style-type: none">Basics of cryptography and Blockchain					
Anti-requisites							
Course Description		The course is designed to provide an introductory understanding of decentralized digital currencies (cryptocurrencies) such as bitcoin, a basic understanding of its underlying technology ‘Blockchain’ and why this new and innovative technology is so important, since it has the potential to disrupt a number of industries in the immediate near future. In particular, the course will survey the theory and principles by which cryptocurrencies operate, practical examples of basic cryptocurrency transactions, the likely interaction of cryptocurrencies with the banking, financial, legal and regulatory systems, and how cryptocurrencies could be viewed within a framework of innovation and development.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Cryptocurrency Technology and attain Employability through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Understand the technology components of blockchain-based digital currencies. [Comprehensive] 2. Explain the transactions from a digital currency wallet. [Comprehensive] 3. Understand alternatives to bitcoin, such as alt-coins, Ethereum and Bitcoin Cash. [Comprehensive] 4. Use cryptocurrencies in the context of disruptive innovations [Application]					
Course Content:							
Module 1	Introduction to Cryptography	Assignment		Data Interpretation	11 Sessions		
	Topics: Cryptography, Digital Signatures, Cryptographic Hash Functions. Cryptographic Data Structures: Hash Pointers, Append-Only Ledgers (BlockChains), Merkle Trees.						
Module 2	Bitcoin’s Protocol	Assignment		Data Interpretation	11 Sessions		
	Topics: Bitcoin’s Protocol Keys as Identities, Simple Cryptocurrencies, Decentralization through Distributed Consensus, Incentives, Proof of Work (Mining), Application-Specific Integrated Circuit (ASIC) Mining and ASIC-resistant Mining, Virtual Mining (Peer coin).						
Module 3	Bitcoin Engineering	Quiz		Questions Set	11 Sessions		
	Topics: Engineering Details, Bitcoin Blocks, Hot and Cold Storage, Splitting and Sharing Keys, Proof of Reserve Proof of Liabilities. Anonymity, Pseudonymity, Unlinkability: Statistical Attacks (Transaction Graph Analysis), Network-layer De-anonymization, Chaum’s Blind Signatures, Single Mix and Mix Chains, Decentralized Mixing, Zero-Knowledge Proof Cryptocurrencies.						
Module 4	Cryptocurrency Technologies	Quiz		Questions Set	12 Sessions		

	<p>Topics: Cryptocurrency Technologies, Smart Property, Efficient micro-payments, Coupling Transactions and Payment (Interdependent Transactions,) Public Randomness Source, Prediction Markets, Escrow transactions, Green addresses, Auctions and Markets, Multi-party Lotteries.</p>
	<p>Targeted Application & Tools that can be used: A cryptocurrency is a digital or virtual currency, it is secured by cryptography which makes it impossible to simulate or double-spend. Many cryptocurrencies are decentralized networks based on blockchain technology. Cryptocurrency caters to the promise of making the easier transaction of funds directly between two groups or parties without the need for any third party like bank or credit card company. Applications are Money transfer, Smart contracts, Internet of Things (IoT), Personal identity security, Healthcare, Logistics. Tools: Messari, Glass node, Lunar Crush, Coin Metrics, Coin Market Cal.</p>
	<p style="text-align: center;">Project work/Assignment:</p>
	<p>Assignment:</p> <ol style="list-style-type: none"> 1. Beyond a method for payment, what are other functions of cryptocurrencies? 2. How are cryptocurrency transactions recorded? 3. What are the top cryptocurrencies? 4. What is the market capitalization of all cryptocurrencies and which ones make up largest % of that capitalization? 5. Explain briefly efficient micro-payments
	<p>Text Books: T1. Narayanan, Arvind, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016. T2. Schar, Fabian, and Aleksander Berentsen. Bitcoin, Blockchain, and Cryptoassets: A Comprehensive Introduction. MIT press, 2020. T3. Karame, Ghassan O., and Elli Androulaki. Bitcoin and blockchain security. Artech House, 2016.</p>
	<p>References: R1. Antonopoulos, Andreas M., and Gavin Wood. Mastering ethereum: building smart contracts and dapps. O'reilly Media, 2018. R2. Antonopoulos, Andreas M. Mastering Bitcoin: unlocking digital cryptocurrencies. " O'Reilly Media, Inc.", 2014. R3. Day, Mark Stuart. Bits to bitcoin: how our digital stuff works. MIT Press, 2018.</p> <p>E book link R1: http://fincen.gov/statutes_regs/guidance/html/FIN-2013-G001.html</p> <p>E book link R2: http://www.scribd.com/doc/212058352/Bit-Coin</p> <p>Web resources: W1. http://www.usv.com/posts/bitcoin-as-protocol W2. http://startupboy.com/2013/11/07/bitcoin-the-internet-of-money/ W3. http://startupboy.com/2014/03/09/the-bitcoin-model-for-crowdfunding/ W3. http://www.hmrc.gov.uk/briefs/vat/brief0914.html</p>
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Cryptography, Digital Signatures, Hash Pointers, BlockChains, ASIC-resistant Mining, Hot and Cold Storage, Transaction Graph Analysis, Zero-Knowledge Proof Cryptocurrencies, Escrow transactions, Multi-party Lotteries. for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3096	Course Title: Cyber Digital Twin Type of Course: Theory Only Course		L-T- P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		CSE2013					
Anti-requisites		NIL					
Course Description		This course is designed to improve the learners ‘Skill Development’ by using modeling, optimizing, and risk management approach. The course objective is to get familiar with the Cyber digital twin-working principal, Development considerations, Data-Modelling Environment, Digital Twin Optimization, Risk Management and Applications.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Cyber Digital Twin and attain Employability through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Understand the basic concepts of Cyber Digital twin, and its working principle. [KNOWLEDGE] 2. Explain Data modeling and development consideration in digital twin model for cloud and IoT technology. [COMPREHENSION] 3. Observe digital twin-human behavior modeling in digital twin-optimization [COMPREHENSION] 4. Show Risk Assessment-Digital twin reference model-Implementation. [APPLICATION] 5. Apply Digital twin in various area like Manufacturing, Automotive and Healthcare. [APPLICATION]					
Course Content:							
Module 1	Introduction	Assignment	Theory		No. of Classes:12		
Introduction- Cyber Digital twin-definition-uses and benefits-need for digital twin-working principal Technology Digital thread-digital shadow-building blocks of digital twin-digital twin technology drivers and enablers.							
Module 2	Data Modelling Environment	Assignment	Theory		No. of Classes:10		
Types of digital twin-Based on Product and Process-Based on Functionality-Based on Maturity. Development considerations-Overview of Data-Modelling Environment. Modelling-model and data management-Managing data-implementing the model- Cloud and IOT technologies.							
Module 3	Digital Twin Optimization	Assignment	Theory		No. of Classes:11		
Cyber range vs digital twin-human behavior modeling in digital twin-optimization using digital twin-digital twin and cyber security-Techniques. Technologies-Industrial IOT and Digital Twin-simulation and digital twin-Machine learning and digital twin-virtual reality and digital twin-cloud technology and digital twin.							

Module 4	Risk Management and Applications	Assignment	Case Study		No. of Classes:12
Digital twin and Risk Assessment-Digital twin reference model-Implementation-Development of risk assessment plan-Development of communication and control system-Development of digital twin tools-Integration-platform validation-Difficulties-Practical implications. Applications: Digital Twin in Manufacturing-Digital Twin in Automotive-Digital Twin in Healthcare-Digital Twin in Utilities-Digital Twin in Construction					
Targeted Application & Tools that can be used: Ansys Twin Builder is a powerful solution for building, validation and deploying simulation-based systems and digital twins: Build, validate, and deploy digital twins. Digital twin models integrate real-world data. Increase efficiency with digital twins.					
Project work/Assignment:					
Project Assignment:					
Text Book 1. Clint Bodungen, Bryan Singer, Aaron Shbeeb, Kyle Wilhoit, and Stephen Hilt,” Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions”,1st Edition, ISBN: 978-1259589713. 2. Eric D. Knapp and Raj Samani,” Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure “,1st Edition. Kevin Mitnick,” The Art of Invisibility”,2017.					
References 1. Michael E. AuerKalyan Ram B. Digital,” Cyber-physical System and Digital Twins - Part of the Lecture Notes in Networks and Systems book series”. 2. Nassim Khaed, Bibin Pattel and Affan Siddiqui,” Development and Deployment on the Cloud”, Elsevier, 2020.					
Weblinks: 3. https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-live%26ebv%3dEB%26ppid%3dpp_xiii 4. https://www.udemy.com/course/digital-twin-a-comprehensive-overview/					
Topics relevant to “EMPLOYABILITY SKILLS”: Digital thread-digital shadow-building blocks of digital twin, Digital Twin in Manufacturing-Digital Twin in Automotive, Cyber range vs digital twin-human behavior modeling in digital twin-optimization for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.					

Course Code: CSE3094	Course Title: Cyber Security		L- T-P- C		3	0	0	3
	Type of Course: 1] Discipline Elective 2] Theory Only							
Version No.		1.1						
Course Pre-requisites		Fundamental knowledge in Information Security and Networks						
Anti-requisites		NIL						
Course Description		This is a foundation program geared towards generating and enhancing awareness about cyber security challenges and the concept of Cyber Security and Cyber Ethics among the stakeholders to help them become responsible Cyber Citizens and participate safely and securely in the rapidly evolving information-age society. The important topics include: Network Security model, attacks, malware, firewall, IT act and Cyber forensics						
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Cyber Security and attain Employability through Participative Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: 1) Describe the basic concept of Cyber Security [Knowledge] 2)Classify different types of attacks for a scenario [Comprehension] 3) Prepare a mitigation policy for security threat [Comprehension] 4) Demonstrate Cyber Security tools [Application]						
Course Content:								
Module 1	Introduction to Cyber Security	Quiz	Knowledge		11 Sessions			
	Topics History of Internet, Cyber Crime, Information Security, Computer Ethics and Security Policies, Guidelines to choose web browsers, Securing web browser, Antivirus, Email security, Guidelines for setting up a Secure password , Cyber Security Threat Landscape, Emerging Cyber Security Threats, Cyber Security Techniques							
	Module 2	Security in Networks	Assignment	Comprehension	10 Sessions			
	Topics: Security in Networks – Concepts, threats in Network, website vulnerabilities, man in the middle attack, denial of Service attack, distributed denial of service attack, Firewalls – introduction and design, types of firewalls, personal firewalls, Program Security – non malicious program errors, malicious program flaws, virus and other malicious code, prevention of virus infection. Assignment: Program Security – non malicious program errors.							

	Module 3	Smartphone Security	Assignment	Comprehension	12 Sessions
	Topics: Introduction to mobile phones, Smartphone Security, Android Security, IOS Security, Cyber Security Exercise, Cyber Security Incident Handling, Cyber Security Assurance, Guidelines for social media security, Tips and best practices for safer Social Networking, Basic Security for Windows, User Account Password Assignment: Social Media Security				
	Module 4	Ethical Issues in Cyber Security	Assignment	Programming/Data analysis task	12 Sessions
	Legal and ethical issues in Cyber Security – protecting program and data, copyright, patents and trade secrets, IT Act, EDP audit, Overview of CISA, Privacy in computing, Cyber Forensic Tools – types and categories, Cyber forensic suite. Forensic tools: types, categories, open source proprietary Assignment: Cyber Forensic Tools				
	Textbooks T1. Charles P. Pfleeger and Shari Lawrence Pfleeger, “Security in Computing”, Pearson Education, 5 th Edition, 2012 T2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018 . T3. Dejeu and Murugan, “Cyber Forensics”, Oxford University Press, 2018.				
	References R1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5 th Ed, Pearson Education, 2015. R2. Behrouz A Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3 rd Edition, Mc Graw Hill Publication, ISBN 13: 978-93-392-2094-5.2008. Web links: W1. https://www.youtube.com/watch?v=RYB4cG8G2xo W2. https://www.coursera.org/lecture/detecting-cyber-attacks/Cyber Security-UeDqJ , https://presiuniv.knimbus.com/user#/home				
	Topics relevant to “EMPLOYABILITY SKILLS”: Mobile Security for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE319	Course Title: Machine Learning	L- T-P- C	3	0	0	3
	Type of Course: Theory Only					
Version No.	2.0					
Course Pre-requisites	Mathematical Logic, Algebra, probability and Statistics, Vectors, Matrices.					

Anti-requisites	NIL			
Course Description	<p>This Course aims to introduce student's concepts and techniques on Machine Learning and to study various probability based learning techniques, graphical models of Machine Learning algorithms.</p> <p>This course encompasses various theoretical spectrum of Machine Learning concepts behind several Machine Learning algorithms without going deep into the mathematics, gaining practical experience by applying them. Covering Correlations, Regressions and to have a thorough understanding of the Supervised and Unsupervised learning techniques, and limitations on Predictive Models.</p>			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Machine Learning and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques			
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <p>CO 1: Explain the basic concepts on Machine Learning. [Comprehension]</p> <p>CO 2: Apply Supervised Machine Learning algorithms on real time Applications. [Application]</p> <p>CO 3: Apply Un-Supervised Machine Learning algorithm for real time problems. [Application]</p> <p>CO 4: Illustrate advanced concepts in machine learning [Application]</p>			
Course Content:				
Module 1	Introduction	Assignment	Simulation/Data Analysis	10 Sessions
Introduction to Machine learning- What Why and How?, Types of Machine Learning, Applications, Models selection, Machine learning concept work flow, Issues, types of variables/features used in ML algorithms, One-hot encoding				
Module 2	Supervised learning	Assignment	Numerical from E-Resources	13 Sessions
Types of supervised learning: linear regression, Simple Linear Regression, Multiple Linear Regression, Model Evaluation, Validation and Accuracy measures for Regression models. Classification: logistic-KNN-Decision tree-SVM-Naïve Bayes, Metrics for supervised learning.				
Module 3	Unsupervised learning	Term paper/Assignment	Simulation/Data Analysis	11 Sessions
Types of Unsupervised Learning: K-means clustering, Hierarchical clustering, Association Rule Mining, Collaborative Filtering – User based and item based similarity--Applications of unsupervised learning, cluster validity measures, Components of Time Series data				
Module 4	Introduction to Neural Network	Term paper/Assignment	Simulation/Data Analysis	11 Sessions
Overview of neural networks- What and Why? , Real and artificial neurons, Threshold logic unit algorithm, Linear separability and vectors, Introduction to Learning Rules in Neural Network.				
Targeted Application & Tools that can be used: Jupyter notebook Colab notebook				
Text Book 1. Ethem Alpaydin, “ <i>Introduction to Machine Learning</i> ”, Third Edition.				

2. Stephen Marsland, “*Machine Learning: An Algorithmic Perspective*”, Springer, 2014, Second Edition.

References

1. Tom M. Mitchell, “*Machine Learning*”, McGraw Hill Education, 2013.
2. Sebastian Raschka and Vahid Mirjalili, “*Python Machine Learning*”, PACKT Publishing, Third Edition.
3. Wes McKinney, “*Python for Data Analysis*”, O’Reilly Media, Inc., Second Edition.
4. Simon Haykin, “*Neural Networks: A Comprehensive Foundation*”, Prentice Hall, Second Edition, 1998.

Web Based Resources and E-books:

W1. pu.informatics.global, <https://sm-nitk.vlabs.ac.in/>

W2. Udemy course on “**Machine learning A-Z: Hands-on Python and R in Data Science**”, <https://www.udemy.com/course/machinelearning/>

W3. Coursera course on “**Machine learning specialization**”, Andrew Ng
<https://www.coursera.org/specializations/machine-learning-introduction>

Topics relevant to “EMPLOYABILITY SKILLS: linear regression, Classification: logistic-KNN-Decision tree-SVM-Naïve Bayes ,K-means clustering, Hierarchical clustering, Association Rule Mining for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout

Course Code: CSE2023	Course Title: Data Warehousing and its Applications Type of Course: Theory			L-T- P- C	3	0	0	3
Version No.		1.0						
Course Pre-requisites		NIL						
Anti-requisites		Basics of data mining & Python						
Course Description		The Objective of this course is to create a trove of historical data that can be retrieved and analyzed to provide useful insight into the organization's operations. A data warehouse is a vital component of business intelligence. This course will introduce basic concepts of data warehousing, architecture, design principles, building data warehouse, data mining techniques and major application areas of data warehouse.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Data Warehousing and its Applications and attain Employability through Participative Learning techniques.						
Course Outcomes		On completion of this course, the students will be able to <ul style="list-style-type: none"> Describe data warehousing architecture and considerations to build data warehouse. [Knowledge] Discuss different multidimensional data models for data warehouse. [Comprehension] Apply various techniques to build data warehouse [Application] Apply different data mining techniques to mine insights [Application] 						
Course Content:								
Module 1	Introduction To Data Warehousing	Assignment/Quiz	Benefits of data warehousing					11 Session
	Topics: The need for data warehousing, paradigm shift, data warehouse definition and characteristics, Data warehouse architecture, sourcing, acquisition, cleanup and transformation, metadata, access tools, data marts, data warehouse administration and management, building a data warehouse: business consideration, technical consideration, design consideration, implementation consideration, integrated solutions, benefits of data warehousing. Data Warehouse Architecture: Two and Three tier Data Warehouse architecture. Assignment: Benefits of data warehousing							
Module 2	Data Warehouse modelling	Assignment/Quiz	Data cube					12 Session
	Topics: Data cube: A multidimensional data model, stars, snowflakes, and fact constellations: schemas for multidimensional data models, dimensions: the role of concept hierarchies, measures: their categorization and computation, typical OLAP operations, efficient data cube computation, the compute cube operator and the curse of dimensionality, partial materialization: selected computation of cuboids, indexing olap data: bitmap index and join index. Assignment: Data cube							
Module 3	8	Case Study	Data Warehouse design principles					12 Session
	Topics: Building a data warehouse: Introduction, Critical Success Factors, Requirement Analysis, Planning for the data Warehouse-The data Warehouse design stage, Building and implementing data marts. Building data warehouses, Backup and Recovery, Establish the data quality framework, Operating the Warehouse, Recipe for a successful warehouse, Data warehouse pitfalls. Assignment: Data Warehouse design principles							

Module 4	Introduction to Data Mining	Case Study	Data Mining Techniques	10 Session
Topics: Introduction to Data mining, KDD versus data mining, data mining techniques, tools and applications. Mining complex data objects, Spatial databases, Multimedia databases, Time series and Sequence data; mining Text Databases and mining Word Wide Web. Applications of data warehousing across different industries- Retail industry, Manufacturing and distribution, Bank, insurance company, Government agencies etc Assignment: Data Mining Techniques				
Targeted Application & Tools that can be used: Application Area includes Ecommerce, retail, manufacturing industry, government agencies, Finance, banking etc Professionally Used Software: Microsoft Azure Synapse SQL, IBM DB2 warehouse, Terradata vantage, SAP data warehouse cloud, Google Bigtable, google sheets, BigQuery, MongoDB, MarkLogic, Talend, Informatica, Arm Treasure data, Micro focus vertica, Cloudera Enterprise data platform.				
Assignment:				
1. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link . 2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				
Text Book(s): T1. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, McGraw Hill, 2016 T2. Jiawei Han, Micheline Kamber, Jian Pei, “Data-Mining.-Concepts-and-Techniques “, The-Morgan-Kaufmann, 3rd-Edition-Morgan-Kaufmann, 2015				
Reference(s): R1. Sam Anahory, Dennis Murray, “Data Warehousing in the Real World”, Pearson, 2016 R2. Tan P. N, Steinbach M and Kumar V, “Introduction to Data Mining”, Pearson Education, 2016 Web Based Resources and E-books: W1. NPTEL Course on “Business Analytics & Data Mining Modeling Using R”, Prof. Gaurav Dixit. https://onlinecourses.nptel.ac.in/noc22_mg67/preview W2. NPTEL Course on “Data Mining”, Mr. L. Abraham David https://onlinecourses.swayam2.ac.in/cec22_cs06/preview W3. Coursera course on “Data Warehousing for Business Intelligence Specialization”, Michael Mannino, Jahangir Karimi https://www.coursera.org/specializations/data-warehousing W4. Journal on “Data Mining and Knowledge Discovery” https://www.springer.com/journal/10618/ https://presiuniv.knimbus.com/user#/home				
Topics relevant to “EMPLOYABILITY SKILLS”: Building a data warehouse, data mining tools, for developing Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.				

Course Code: CSE3018	Course Title: Digital Health and Imaging Type of Course: Program Core& Theory Only	L-T- P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE3008: Machine Learning Techniques				
Anti-requisites		-				
Course Description		This course will give an overview of digital health and its impact on healthcare, Image enhancement techniques, filtering, and restoration. Medical Imaging, health informatics, Health data analytics and predictive modeling.				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of : Digital Health and Imaging and attain Employability through Problem Solving Methodologies .				
Course Out Comes		On successful completion of the course the students shall be able to: 1.Understand the role of digital health’s impact in ethical and legal considerations. [Understand] 2. Apply Machine learning techniques for medical image analysis. [Application] 3. Apply Computer-aided detection and diagnosis in medical imaging. [Application] 4. Apply Health data analytics and predictive modeling. [Application]				
Course Content:						
Module 1	Introduction to Digital Health and Digital Image	Assignment		Theory		L : 12
	Introduction to Digital Health Overview of digital health and its impact on healthcare, Introduction to telemedicine, wearables, and health monitoring devices, Ethical and legal considerations in digital health. Digital Image Processing Fundamentals: Digital image representation and properties, Image enhancement techniques, Image filtering and restoration, Image segmentation and feature extraction					
Module 2	Medical Imaging Modalities	Assignment		Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions		L: 10
	Medical Imaging Modalities: Principles and applications of various medical imaging modalities. X-ray imaging, computed tomography (CT), and magnetic resonance imaging (MRI) , Ultrasound imaging and nuclear medicine imaging, Imaging modalities for specific healthcare domains (e.g., radiology, cardiology)					
Module 3	Image Analysis in Healthcare	Assignment /Quiz		Researching and reviewing academic papers or industry publications on specific AI applications		L:12

Image registration and fusion techniques, Quantitative image analysis for disease diagnosis and treatment planning, Computer-aided detection and diagnosis in medical imaging, Machine learning in medical image analysis. Health Informatics and Electronic Health Records, Introduction to health informatics and electronic health records (EHR), EHR systems and interoperability, Data privacy, security, and regulatory considerations in health informatics.					
Module 4	Digital Health Applications and Innovations	Assignment		Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.	L: 11
Mobile health (mHealth) applications and remote patient monitoring, Health data analytics and predictive modeling. Artificial intelligence and machine learning in digital health. Emerging technologies and trends in digital health.					
Targeted Application & Tools that can be used: Applications: Quantitative image analysis for disease diagnosis, Mobile health (mHealth) Tools: TensorFlow, PyTorch, Computer-aided detection					
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
Assignments can involve researching and reviewing academic papers or industry publications on specific AI applications in engineering / Students may be given programming assignments to implement AI algorithms / Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions / Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.					
Text Book <ol style="list-style-type: none"> 1. "Digital Health: Scaling Healthcare to the World" by Paul Sonnier-2020 2. Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods 3. "Biomedical Signal and Image Processing" by Kayvan Najarian and Robert Splinter 					
References <ol style="list-style-type: none"> 1. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley , 2021.. 2. "Introduction to Health Informatics" by Mark S. Braunstein 3. https://talentsprint.com/course/ai-digital-health 4. https://www.udemy.com/topic/medical-imaging/ 					
Topics relevant to “EMPLOYABILITY SKILLS”: Health data analytics and predictive modeling. Artificial intelligence and machine learning in digital health for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.					

Course Code: CSE 3101	Course Title: Digital Watermarking and Steganography Type of Course: Theory Only	L-T-P-C	3	0	0	3
Version No.		1.1				
Course Pre-requisites		Fundamental knowledge in Operating Systems, Cryptography & Network Security and Computer Networks				
Anti-requisites		NIL				
Course Description		The purpose of this course is to enable the students to Comprehend the need for Digital Watermarking and Steganography and to develop the basic abilities of design and use Digital Watermarking and Steganography- information hiding technique. The course is both conceptual in nature and needs fair knowledge of Mathematical and computing. The course develops critical thinking and analytical skills. The course also enhances the abilities through assignments.				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Digital Watermarking and Steganography and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Discuss the Introduction of Digital Watermarking• Classify the various Digital Watermarking techniques.• Explain the Fundamentals of Steganography.• Summarize the Steganographic Techniques.				
Course Content:						
Module 1	Introduction to digital watermarking	Assignment	Programming Task		10 Sessions	
	Topics Introduction to Digital Watermarking, Digital Steganography differences, brief History, Watermarking Applications, Classification in Digital Water Marking- Classification based on Characteristics, Classification based on Applications.					
	Module 2	Types and tools of digital watermarking	Assignment	Programming Task	14 Sessions	
	Topics: Digital Watermarking Fundamentals, Least Significant bit substitution, Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform, Random Sequence Generation, Chaotic Map, Error Detection Code. Spatial domain watermarking, frequency Domain watermarking,					

	Fragile Watermark, Robust Water Mark, Watermarking attacks and Tools, Image processing techniques, Water Mark (software Analysis).				
	Module 3	Introduction to Steganography	Assignment	Programming/Data analysis task	10 Sessions
	Topics: Steganography, Watermarking vs Steganography, Need for Steganography, Application of Steganography, Methods of Hiding, properties of Steganography, Performance measure of Steganography Approaches, Mathematical Notation and Terminology, Steganography Software (S-tools, StegoDos, EzStezo, JSteg,Jpeg,).				
	Module 4	Techniques of Steganography	Assignment	Programming/Data analysis task	11 Sessions
	Substitution Systems and Bit-plane Tools- Least Significant Bit Substitution, Pseudorandom Permutations, Image Downgrading and Covert Channels, Practical Approach towards Steganography, Embedding of a secret Message.				
	Textbooks T1. Frank Y Shih. Digital Water marking and Steganography Fundamentals and Techniques, 2017, CRC Press, second edition. T2. Jsjit. S. Suri Shivendra Shivani, Suneeth Agarwal, Handbook on Image based Security Techniques, CRC Press, 2018.				
	References R1. Abid Yahya, Steganography Techniques for Digital Images, Springer, 2019. Weblinks: W1. Digital Watermarking ScienceDirect (informaticsglobal.com) W2. Digital Watermarking and Steganography ScienceDirect (informaticsglobal.com)				
	Topics relevant to “EMPLOYABILITY SKILLS”: Building a data warehouse, data mining tools, for developing Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.				

Course Code: CSE3136		Course Title: E – Business and Marketing Analytics		L-T- P- C	3	0	0	3
		Type of Course: Discipline Theory						
Version No.			1.0					
Course Pre-requisites		•	<ul style="list-style-type: none">• Basic Communication skills• General Knowledge in information technology• Basic knowledge about online business					
Anti-requisites			Nil					
Course Description			The course intends to provide the basis of electronic business applications. This course will help the students understand the dynamics of E – Business and demonstrate the ability to identify, describe and apply the essential current practices in the contemporary scenario and provides a conceptual understanding of how marketing decisions are aided by analytics.					
Course Out Comes			At the end of the course, the student shall be able to: CO 1: Describe the fundamentals of E – Business(Knowledge) CO 2: Discuss the various E – Business models (Comprehension) CO 3: Identify how to manage E – Business (Comprehension) CO4: Describe the basics of marketing analytics for decision making (Knowledge)					
Course Objective:			The objective of the course is to familiarize the learners with the concepts of E – Business and Marketing Analytics and attain Employability through Participative Learning techniques.					
Module 1		Introduction to Electronic Business		Case study		Case study on Types of Networking for E-Business		12 Sessions
	Electronic Business: Overview, Definitions, Advantages & Disadvantages of E - Business, History of Electronic Business, Threats of E – Business, Types of E – Business and related Industries, E – Business Technology: Different Types of Networking for E-Business, Internet, Intranet, EDI Systems, Development of the Internet, Advantages of Internet, E-Business Infrastructure: An Overview, Hardware, Server Operating System, Software, Network Website, Roadmap of E – Business in India							
Module 2		E-business Markets and Models		Case study		Case study on One-to-One Marketing and E – Governance		11 Sessions
	E-business Markets and Models: Introduction, E-business Environment, E – Marketplaces, E – Business Markets, Types of E – Business Models: Model based on Transaction Type, Model based on Transaction Party – B2B, B2C, C2B, C2C, E-commerce Sales Life Cycle (ESLC) Model, E – Marketing: Key Issues, Introduction, The Scope of E – Marketing, Internet Marketing Techniques, E – Marketing Plan, The Marketing Mix, Branding, Online Advertising, Targeting Online Customers, One-to-One Marketing, E – Governance							

Module 3	The Management of E – Business:	Group Discussion		Group Discussion on E – Payment Mechanism	10 Sessions
	Managing Knowledge, Managing Applications Systems for E – Business, Management Skills for E – Business, Comparison between Conventional Design and E – Organisation, Supply Chain Management (SCM), Customer Relationship Management, E – Payment Mechanism: Payment through Card System, E – Cheque, E – Cash, E – Payment Threats & Protections.				
Module 4	Introduction to Marketing Analytics	Assignment		E-resource Review	12 Sessions
	Marketing analytics-data for marketing analytics-Exploratory data analysis-descriptive analysis-predictiveanalytics-prescriptive analytics-Customer analytics-benefits-Segmentation analytics-applications of cluster analysis				
	DELIVERY PROCEDURE (PEDAGOGY): Self-learning: An Overview, Hardware, Server Operating System, Software, Network Website, Roadmap of E – Business in India Experiential Learning: Case Studies on E-business Participative learning: Group discussion on E-Payment Mechanism				
	Textbook T1- Colin Combe, Introduction to E-business Management and Strategy, Elsevier Ltd,1 st edition,2006 T2- Gupta, Seema. Marketing Analytics,1st Edition,Wiley,1 st October 2021.				
	References R1: Tokuro Matsuo and Ricardo Colomo-Palacios , Electronic Business and Marketing: NewTrends on its Process and Applications, Springer,2015. R2: Joseph, P.T, E-COMMERCE AN INDIAN PERSPECTIVE (2e), New Delhi Prentice-Hall of India,2019 R3: Chaffey, E-Business and E-Commerce Management: Strategy, Implementation and Practice, 5e, Pearson Education India,2013 R4: Kenneth C. Laudon and Carol Guercio Traver, E-Commerce, Pearson Education,2017 R5. Winston, Wayne, Marketing Analytics: Data –driven techniques with Microsoft Excel,Wiley,2014. R6. Grigsby, Mike,Marketing analytics: A practical guide to improving consumer insights using data techniques. Kogan Page,2022.				
	Project /Assignment : Case study on Legal and Regulatory Environment for E - Business				
	PU E-Resource Links: 1. Ng, E. (2005), "An empirical framework developed for selecting B2B e-business models: the case of Australian agribusiness firms", <i>Journal of Business & Industrial Marketing</i> , Vol. 20 No. 4/5, pp. 218-225. Link: https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/08858620510603891/full/html PU1: https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/17505930710734125/full/html PU2: https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/JCM-02-2019-				

	3080/full/pdf?title=the-internet-of-everything-implications-of-marketing-analytics-from-a-consumer-policy-perspective
	NPTEL Videos: <ol style="list-style-type: none"> 1. https://www.digitat.in/nptel/courses/video/110105083/L01.html 2. https://www.digitat.in/nptel/courses/video/110105083/L60.html 3. http://www.digitat.in/nptel/courses/video/110105083/L22.html 4. https://onlinecourses.nptel.ac.in/noc20_mg30/preview (Sessions on Marketing Analytics)
	Web Based Resources: <p>W1. https://hbr.org/2018/05/why-marketing-analytics-hasnt-lived-up-to-its-promise</p> <p>W2. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Deloitte-Analytics/dttl-analytics-us-da-pricinganalytics3minguide.pdf</p> <p>W3. https://hbr.org/2010/11/using-customer-journey-maps-to improve customer satisfaction</p> <p>W4. https://www.zoho.com/subscriptions/guides/what-is-customer-lifetime-val</p> <p>W5. https://www.mediassociates.com/wp-content/uploads/2018/12/Mediassociates-whitepaper-Predictive-Analytics_2018.pdf</p>
	Topics relevant to “EMPLOYABILITY SKILLS”: Managing Knowledge, Managing Applications Systems for E – Business, Management Skills for E – Business, Comparison between Conventional Design and E – Organisation, for developing Employability Skills through Participative learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3024	Course Title: Emerging Areas in Blockchain Type of Course: Theory Only Course		L- T-P- C	3	0	0	3
Version No.		1					
Course Pre-requisites	<ul style="list-style-type: none">•	<ul style="list-style-type: none">• Basic concepts in networking.• Cryptography Techniques• Data Structures and Algorithms• Introduction to Programming					
Anti-requisites							
Course Description		This course will be on the fundamentals of Blockchain and Blockchain Technology. The most well-known example of Blockchain Technology in wide use today is as the storage and transaction mechanism for the cryptocurrency Bitcoin. We will use historical examples, key concepts, key challenges, and their proposed (and implemented) solutions to help explain Blockchain Fundamentals. A key focus for the class will be on the decisions between challenge and implementation. This ‘design’ process can take a very long time, and the design and research process that ultimately led to a ‘successful’ implementation for a cryptocurrency took decades. Bitcoin represents an elegant technical solution to a series of long posed problems and partial solutions.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Emerging Areas in Blockchain and attain Employability through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: CO1: To understand the mechanism of Blockchain and Cryptocurrency. CO2: To understand the functionality of current implementation of blockchain technology. CO3: To explore the applications of Blockchain to cryptocurrencies and understanding limitations of current Blockchain.					
Course Content:							
Module 1	Blockchain: A new perspective in cyber technology	Assignment		Data Interpretation	12 Sessions		
Topics: 1. Introduction, Blockchain architecture, Blockchain concepts ,Consensus algorithms, Blockchain validity, Blockchain attacks, Merkle trees							
Module 2	Blockchain-enabled cyber-physical systems	Assignment		Data Interpretation	10 Sessions		
Topics: Background of CPS, Background of blockchain, Blockchain-enabled cyber-physical systems, Characteristics of blockchain-enabled CPS systems, Challenges in blockchain-enabled CPS systems							

Module 3	Blockchain for intrusion detection systems	Quiz		Questions Set	11 Sessions
Topics: . Intrusion detection system, About blockchain, Host-based intrusion detection system, Blockchain-based intrusion detection, Collaborative intrusion detection system, Applications of IDS: Snort, Limitations Comparison with firewalls					
Module 4	Blockchain for digital rights management	Quiz		Questions Set	12 Sessions
Topics: Introduction, Illustrations, DRM requirement, Parts of a traditional DRM, Compatibility of blockchain for DRM, Various cryptographic hash functions in blockchain, Methodologies and technology in use, Effects and applications of using blockchain in DRM, Methodologies for coupling DRM with blockchain, Advantages of integrating blockchain with digital content, Limitation of blockchain in DRM,					
Targeted Application & Tools that can be used: Blockchain has so many applications in every sector you can imagine such as healthcare, finance, government, identity, etc. And that's not including its most popular application which is Bitcoin. Tools: Geth, Solc, Remix IDE, Truffle					
Project work/Assignment:					
Assignment: 1.					
T1. Blockchain Technology for Emerging Applications, A Comprehensive Approach 1st Edition - May 21, 2022, SK Hafizul Islam, Arup Kumar Pal, Debabrata Samanta, Siddhartha Bhattacharyya					
References R1. Applications of Blockchain Technology in Business Challenges and Opportunities , Mohsen Attaran, Angappa Gunasekaran · Springer International Publishing 2019 E book link R1: https://www.blockchain-council.org/e-books/ E book link R2: https://101blockchains.com/ebooks/blockchain-for-enterprise/ Web resources: W1. https://www.coursera.org/specializations/blockchain . W2. https://nptel.ac.in/courses/106105184/ W3. https://swayam.gov.in/nd1_noc20_cs01/preview					
Topics relevant to development of “EMPLOYABILITY SKILLS”: Byzantine Generals, Public-Key Cryptography, Bitcoin Blockchain, Incentive Model, Ethereum Structure, Ethereum Blockchain, for developing Employability Skills through Participative learning techniques. This is attained through assessment components mentioned in course handout.					

Course Code: CSE 3108	Course Title: Expert Systems Course type : Theory Only		L- T-P- C	3	0	0	3
Version No.	1.0						
Course Pre-requisites	“CSE 3108 – Expert systems” course						
Anti-requisites	NIL						
Course Description	The purpose of this course is to present the concepts of intelligent agents, searching, knowledge and reasoning, planning, learning and expert systems, to study the idea of intelligent agents and search methods, to study about representing knowledge, to study the reasoning and decision making in uncertain world, to construct plans and methods for generating knowledge, to study the concepts of expert systems.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Expert Systems and attain Employability through Participative Learning techniques .						
Course Out Comes	On successful completion of this course the students shall be able to: 1. CO1: Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions. 2. CO2: Demonstrate awareness of informed search and exploration methods. 3. CO3: Explain about AI techniques for knowledge representation, planning and uncertainty Management. 4. CO4: Develop knowledge of decision making and learning methods.						
Course Content:							
Module 1	Introduction	Assignment	Theory				9 Hours
	Topics: Introduction to AI: Intelligent agents – Perception – Natural language processing – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.						
Module 2	Knowledge and Reasoning	Assignment	Theory				9 Hours
	Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.						
Module 3	Uncertain knowledge and Reasoning	Assignment	Theory				8 Hours

	Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye’s rule – Probabilistic reasoning – Making simple decisions.				
Module 4	Planning and Learning	Assignment	Theory		9 Hours
	Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.				
Module 5	Systems 10hrs	Assignment	Theory		Expert
	Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.				
	Targeted Application & Tools that can be used:				
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
	Text Book 1. Stuart Russel and Peter Norvig, ‘Artificial Intelligence A Modern Approach’, Second Edition, Pearson Education, 2003 / PHI. 2. Donald A. Waterman, ‘A Guide to Expert Systems’, Pearson Education.				
	References 1. George F. Luger, ‘Artificial Intelligence – Structures and Strategies for Complex Problem Solving’, Fourth Edition, Pearson Education, 2002. 2. Elain Rich and Kevin Knight, ‘Artificial Intelligence’, Second Edition Tata McGraw Hill, 1995. 3. Janakiraman, K. Sarukesi, ‘Foundations of Artificial Intelligence and Expert Systems’, Macmillan Series in Computer Science. 4. W. Patterson, ‘Introduction to Artificial Intelligence and Expert Systems’, Prentice Hall of India, 2003.				
	Links : <u>pu.informatics.global</u> , <u>https://sm-nitk.vlabs.ac.in/</u>				
	Topics relevant to “EMPLOYABILITY SKILLS”: Optimal and imperfect decisions, Logical agents, for developing Employability Skills through Participative Learning Techniques. This is attained through Review of digital/e resource as mentioned in course handout.				

Course Code: CSA3073	Course Title: Game design and Development		L-T-P-C	2	0	2	3
Type of Course: Program Core							
Version No.		1.0					
Course Pre-requisites		Nil					
Anti-requisites		NIL					
Course Description		The Game Design and development course is a hands-on learning experience that focuses on teaching students how to design, develop, and test game prototypes. Students will learn game design concepts such as player engagement, game mechanics, and game balance, as well as the basics of game art, sound, and programming. Throughout the course, students will work in teams to develop and refine their game prototypes, receiving feedback and guidance from the instructor and their peers. Topics covered include prototyping tools, sample game engines, and the creation of simple 2D and 3D game prototypes. The course will culminate in a final project where students will present and demonstrate their completed game prototypes to the class.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Game design and Development and attain Employability through Participative Learning techniques.					
Course Out Comes		At the end of the course the student should be able to: CO1 Recognize the elements of Game Mechanics. [Knowledge] CO2 Distinguish between various types of prototypes. [Comprehension] CO3 Apply concepts to create prototypes of games. [Application]					
Course Content:		Game mechanics, emergence and progression, resource mechanics, feedback structures. Uses and importance of prototyping, different types of prototypes, stages of prototyping, identifying key features, create functioning prototypes.					
Version No.		1.0					
Module 1		Game Mechanics	Assignment		Evolution of prototyping		No. of Classes:20
	Topics: Introduction to Game Mechanics, different types of game mechanics and applications, concepts of emergence and progression, Resource mechanics and economies, level design and progression in levels, feedback structures and semiotics.						
Module 2		Designing	Case Study		Importance of prototyping		No. of Classes:20
	Topics: Introduction to prototyping, uses and importance of prototyping. Different types of prototypes such as paper, physical, playable, art and sound prototypes, interface, low fidelity and high fidelity code, core game and complete game prototypes.						

Module 3	Creating and Testing Prototypes	Assignment		Prepare physical prototype of a popular game	No. of Classes:20
	<p>Topics: Documentation, identifying key features, stages of prototyping, testing and feedback, application of different prototyping techniques such as paper, physical, playable, art and sound prototypes, interface, code, low fidelity and high fidelity prototyping techniques to create functioning prototypes.</p>				
	<p>Targeted Application & Tools that can be used: Algodoo</p>				
	<p>Project work/Assignment:</p>				
1.	<p>2. 2D Platformer Design 2. Game Development 3. UI/UX Design</p>				
	<p>Textbook(s):</p> <p>1. Jeremy G. Bond, “Introduction to Game Design, Prototyping, and Development”, 2nd Edition, Addison-Wesley Professional, 2017.</p>				
	<p>References</p> <p>1. Ennio De Nucci, Adam Kramarzewski, “Practical Game Design : Learn the Art of Game Design Through Applicable Skills and Cutting-edge Insights”, Packt Publishing, 2018. 2. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012.</p> <p>Weblinks:</p> <p>https://learn.unity.com/ https://starloopstudios.com/rapid-game-prototyping-why-is-it-important-in-game-development/</p>				
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Progression, prototyping, for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>				

Course Code: CSE 3025	Course Title: Industry Use Cases using Blockchain Type of Course: Theory Only	L-T-P-C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		Data structures, Distributed Systems, Cryptography				
Anti-requisites		NIL				
Course Description		The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way. The concept and applications of Blockchain have now spread from cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on. This course is a joint venture from academia and industry, where the target is to cover both the conceptual as well as application aspects of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of : Industry Use Cases using Blockchain and attain Employability through Participative Learning techniques.				
Course Out Comes		<ul style="list-style-type: none">• Describe what the Blockchain does• Evaluate if Blockchains are useful for a particular application• Demonstrate the application of hashing and public key cryptography in protecting the blockchain• Explain the elements of trust in a Blockchain: validation, verification, and consensus.• Develop smart contracts in Ethereum framework.				
Course Content:						
Version No.		1.0				
Module 1	Introduction to Blockchain	Assignment	Knowledge, Quizzes		No. of Classes:12	
	Topics: Basic ideas behind blockchain, how it is changing the landscape of digitalization, Bitcoin eco system -,peer - to - peer permission less network addresses in bitcoin. Transactions : syntax , structures, and validation , Blocks - structure, Merkle tree and validation, Cryptographic Hash Functions, Hash Pointers and Data Structures, Mining : target/difficulty, hash rates, consensus, forking. Assignment: Blockchain Architecture and Components in the blockchain.					

Module 2	Tiers of Blockchain Technology	Assignment	Application, Quizzes		No. of Classes:10
	<p>Topics:</p> <p>Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Types of Blockchain: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Sidechains. Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Introduction to Bitcoin Blockchain, task of Bitcoin miners, Mining Hardware, Bitcoin network, Limitations and improvements.</p> <p>Assignment: Bitcoin Blockchain and use cases.</p>				
Module 3	Cryptographic Applications in Blockchain	Case Study	Application, Quizzes		No. of Classes:12
	<p>Topics:</p> <p>Wallets - hash functions - public key cryptography - elliptic curve cryptography - digital signatures Introduction to Aneka, Framework overview, Anatomy of the Aneka container, Building Aneka clouds, Cloud programming, and management.</p> <p>Case Study: Use of Cryptography in Blockchain.</p>				
Module 4	Types of Consensus Algorithms	Case study	Application, Quizzes		No. of Classes:11
	<p>Topics:</p> <p>Proof of Stake, Proof of Work, Delegated Proof of Stake, Proof Elapsed Time, Deposite-Based Consensus, Proof of Importance, Federated Consensus or Federated Byzantine Consensus, Practical Byzantine Fault Tolerance. Smart Contracts- Objectives and principles for the design of Blockchain systems, Understanding Ethereum, Ethereum Basics , Writing smart contracts using Ethereum, issues and Needs of Blockchain, Benefits and Challenges of Blockchain Implementation</p> <p>Case Study: Blockchain Use Case: Supply Chain Management, Smart Health Care, Transportation</p>				
	<p>Targeted Application & Tools that can be used:</p> <p>Private Blockchain, Health sector, Finance, Supply Chain Management</p> <p>Ethereum, Hyper ledger</p>				
	Project work/Assignment:				
1	<p>2. Defend your blockchain analysis of real world systems and present relevant findings and arguments in a structured logical and compelling manner.</p> <p>2. 9. Determine real world challenges that blockchain technologies may assist (or explain why not) in solving.</p>				
	<p>Textbook(s):</p> <p>1. Blockchain and Distributed Ledger Technology Use Cases: Applications and Lessons Learned Treiblmaier, Horst, and Trevor Clohessy ,1st ed. 2020 Edition, Kindle Edition</p> <p>2. Ritesh Modi, Solidity Programming Essentials : A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing Limited, 2018.</p>				

	<p>References:</p> <p>R1. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016 .</p> <p>R2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017.</p> <p>R3: Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014</p>
	<p>Web Resources and Research Articles:</p> <ol style="list-style-type: none"> 1. https://www.coursera.org/specializations/blockchain. 2. https://nptel.ac.in/courses/106105184/ 3. Introduction to Blockchain Technology and Applications: https://swayam.gov.in/nd1_noc20_cs01/preview 4. https://www.edx.org/course/blockchain-and-fintech-basics-applications-andlimitations
	<p>Topics relevant to “EMPLOYABILITY SKILLS”: Hashing , public key cryptography, public and private blockchain, for development of Employability Skills through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE2060	Course Title: Information Security and Management Type of Course: Theory Only Course	L- T-P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		Data Communication and Computer Networks, Information Security, Database Management Systems and Concepts of cryptography.				
Anti-requisites						
Course Description		The course explores information security through some introductory material and helps gain an appreciation of the scope and context of information security. It includes a brief introduction to cryptography, security management, network and computer security. It allows a student to begin a fascinating journey into the study of information security and develop an appreciation of some key security concepts. The course concludes with a discussion of a simple model of the information security in industry and explores skills, knowledge and roles required for employability. A student will be able to determine and analyze potential career opportunities in this profession.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Information Security and Management and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> • Describe the basic concept of information security. (Knowledge) • Explain the concepts and methods of cryptography. (Comprehension) • Demonstrate the aspects of risk management. (Application) 				
Course Content:						
Module 1	Information Security Management:	Assignment		Data Collection/Interpretation		15 Sessions
	Topics: Information Security Overview, Threat and Attack Vectors, Types of Attacks, Common Vulnerabilities and Exposure (CVE), Security Attacks, Fundamentals of Information Security, Computer Security Concerns, Information Security Measures.					
Module 2	Fundamentals of Information Security and Data Leakage	Case studies / Case let		Case studies / Case let		15 Sessions
	Topics: Key Elements of Networks, Logical Elements of Networks, Critical Information Characteristics, Information States. What is Data Leakage and Statistics, Data Leakage Threats, Reducing the Risk of Data Loss, Key Performance Indicators (KPI), Database Security.					
Module 3	Information Security Policies and Management	Case studies / Case let		Case studies / Case let		15 Sessions

	<p>Topics: Information Security Policies-Necessity-Key Elements and Characteristics, Security Policy Implementation, Configuration, Security Standards-Guidelines and Frameworks, Security Roles and Responsibilities, Accountability, Roles and Responsibilities of Information Security Management, Team Responding to Emergency Situation- Risk Analysis Process.</p>
	<p>Targeted Application & Tools that can be used:</p> <p>An ISMS is a systematic approach to managing sensitive company information so that it remains secure. It includes people, processes and IT systems by applying a risk management process.</p> <p>It can help small, medium and large businesses in any sector keep information assets secure. The ISO 27000 family of standards helps organizations keep information assets secure.</p> <p>Using this family of standards will help your organization manage the security of assets such as financial information, intellectual property, employee details or information entrusted to you by third parties.</p> <p>ISO/IEC 27001 is the best-known standard in the family providing requirements for an information security management system (ISMS).</p>
	<p>Project work/Assignment:</p>
	<p>Assignment:</p>
	<p>Text Book</p> <p>T1 Management of Information Security by Michael E. Whilman and Herbert J. Mattord</p> <p>T2 Information Security: The Complete Reference, Second Edition, 2nd Edition. by Mark Rhodes-Ousley. Released April 2013. Publisher(s): McGraw-Hill.</p>
	<p>References</p> <p>R1 Title, Cryptography & Network Security (Sie) 2E. Author, Forouzan. Publisher, McGraw-Hill Education (India) Pvt Limited.</p> <p>R2 Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices. Nina Godbole.</p> <p>E book link R1: http://www.iso.org/iso/home/standards/management-standards/iso27001.html</p> <p>E book link R2: http://csrc.nist.gov/publications/nistpubs/800-55-Rev1/SP800-55-rev1.pdf</p> <p>BLINKS: pu.informatics.global , https://sm-nitk.vlabs.ac.in.</p>
	<p>Topics relevant to development of “SKILL DEVELOPMENT”: Security Policy Implementation, Security Roles, for development of Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3086	Course Title: Information Theory and Coding Type of Course: Theory Only	L-T-P-C	3	0	0	3
Version No.		1.1				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		<p>Information Theory is the science for measuring, preserving, transmitting, and estimating <i>information</i> in random data. It was initially proposed by Shannon as a mathematical theory of communication more than five decades ago. It provides the fundamental limits of performance for transmission of messages generated by a random source over a noisy communication channel. On the one hand, Information Theory has been the driving force behind the revolution in digital communication and has led to various practical data compression and error correcting codes that meet the fundamental theoretical limits of performance. On the other hand, over the years, techniques and concepts from Information Theory have found applications well beyond communication theory. In this course, we will introduce the basic notions and results of Information Theory, keeping in mind both its fundamental role in communication theory and its varied applications beyond communication theory. This course, and the follow-up advanced courses to be offered in the future, will be of interest to students from various backgrounds.</p>				
Course Objective		<p>The objective of the course is to familiarize the learners with the concepts of Information Theory and Coding and attain Employability through Problem Solving Methodologies.</p>				
Course Out Comes		<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Calculate the entropy of Zero memory; Analyze Markov sources and Apply the properties of Entropy for a given source statistic. 2. For the given source message, Determine the code words and Calculate coding efficiency using Shannon, Shannon-Fano, Huffman and Arithmetic coding algorithm for memoryless sources given the source statistics and LZ algorithm for sources with memory. 3. Determine and Analyze the channel entropies, mutual information and the channel capacities for Discrete Memoryless Channels for the given channel diagram or channel matrix and to Discuss Shannon Hartley Law and Shannon's limit. 4. For the given (n, k) Linear Block Codes and Binary Cyclic Codes Determine the code words, syndrome, error detecting & correcting capability of the code and the corrected received vector; Design a single error correcting Linear Block Code for the given message length. 5. Evaluate the code words for a given (n, k, m) convolution encoder and Use Sequential search and Viterbi algorithm to decode the information from the given received vector and Discuss BCH, RS, Golay, shortened cyclic, burst error 				

		correcting, Burst and Random error correcting codes and Turbo codes.	
Course Content:			
Module 1		Information Theory	12 Sessions
	Topics: Introduction, Measure of information, Average information content (entropy) of symbols in long independent sequences, Information rate, Properties of entropy, Extension of discrete memory less (zero-memory) sources, Average information content (entropy) of symbols in long dependent sequences, Mark off statistical model for information source, Entropy and information rate of Mark off sources.		
Module 2		Source Coding	11 Sessions
	Topics: Properties of codes- Block codes, on-singular codes, Uniquely decodable codes. Instantaneous codes and Optimal codes, Prefix of a code, Test for instantaneous property, Construction of Instantaneous code, Decision tree, Kraft's inequality, Source coding theorem (Shannon's Noiseless coding theorem), Shannon's encoding algorithm, Shannon Fano Algorithm, Huffman minimum redundancy code (binary, ternary and quaternary), Code efficiency and redundancy, Extended Huffman Coding, Arithmetic Codes, Lempel – Ziv Algorithm.		
Module 3		Channels and Mutual Information	11 Sessions
	Topics: Introduction, Discrete communication channels, Representation of a channel, Probability relations- Apriori, Posteriori entropy, Equivocation, Mutual information, Properties, Rate of information transmission over a discrete channel, Capacity of a discrete memoryless channel, Shannon's theorem on channel capacity (Shannon's second theorem), Special channels- Symmetric, Binary symmetric, Binary erasure, Noiseless, Deterministic and cascaded channels, Estimation of channel capacity by Muroga's method, Continuous channels, Shannon-Hartley theorem and its implications, Shannon's limit, Rate Distortion Theory.		
Module 4		Linear Block Codes	11 Sessions
	Topics: Introduction to Fields and Vector Spaces, Types of errors, Examples, Methods of controlling errors, Types of codes, Linear Block Codes- Matrix description, Encoding circuit, Syndrome and error detection, Syndrome circuit, hamming weight, hamming distance, Minimum distance of a block code error detection and correction capabilities of a linear block code, Single error-correcting Hamming codes, Table lookup decoding using standard array, General decoder for a linear block code. Binary cyclic codes: Algebraic structures of cyclic codes, Encoding using (n-k) bit shift register, Syndrome calculation.		
	Text Book T1- K. Sam Shanmugham, "Digital and Analog Communication Systems", John Wiley Publications, 1996. T2- Simon Haykin, "Digital Communications", John Wiley Publications, 2003. T3- Shu Lin, Daniel J. Costello, "Error Control Coding", Pearson / Prentice Hall, 2nd Edition, 2004.		

	References R1-Muralidhar Kulkarni and K. S. Shivaprakasha, “Information Theory and Coding”, Wiley (India), 2015. R2-Glover and Grant, “Digital Communications”, Pearson 2nd Edition, 2008. R3-Abramson, “Information Theory & Coding”, McGraw-Hill, 1963. Weblinks: pu.informatics.global .
	Topics relevant to development of “EMPLOYABILITY SKILL”: Algebraic structures of cyclic codes, Encoding using (n-k) bit shift register, Syndrome calculation, for developing Employability Skills through Problem Solving Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE305	Course Title: Parallel Computing		L-T-P- C	3	0	0	3
Version No.	2.0						
Course Pre-requisites	Computer Organization and Architecture, Algorithms and Operating Systems, Some Networking concepts						
Anti-requisites	NIL						
Course Description	This is an introductory course to Parallel Computing. The purpose of this Course is to understand the motivation for Parallel Computing and the concept of Parallel Computing. It also exposes the various Models of Parallel Computers and their interconnections and how computations can be performed using Parallel Algorithms and Parallel Programming Models like OpenMP and MPI.						
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Parallel Computing and attain Employability through Problem Solving techniques						
Course Out Comes	On successful completion of this course the students shall be able to: 1. Classify Parallel Systems 2. Employ a Parallel Algorithm for the given Problem 3. Demonstrate the usage of Parallel Programming Tools						
Course Content:							
Module 1	Motivation, History & Scope of Parallel Computing, Concurrency	Assignment	Write about parallel computing application areas				11 Sessions
	Topics: The significance of parallel computing, Motivating parallelism, scope and applications, types of computing – concurrent, parallel and distributed computing; Types of Parallel Systems: Shared Memory Systems and Distributed Memory Systems; Parallelism in uniprocessor systems – Implicit parallelism - pipelining and superscalar execution, Parallel processing mechanisms, Parallel Computer structures – pipeline computers, array processors, multiprocessor systems						
Module 2	Parallel Hardware	Assignment	Programming activity using OpenMP				10 Sessions

Flynn's Classification – SIMD , MIMD, interconnection networks, Performance evaluation criteria, The Effect of Granularity on Performance, Message-Passing Programming, Send and Receive Operations, Interconnection networks, Shared memory interconnects: Bus, Crossbar; Distributed Memory Model, Basic communication operations-One to all Broadcast and All to one Reductions, Ring, Mesh, Hypercube					
Module 3	Parallel Software, I/O, Performance, Parallel Algorithm Design	Case Study	Application of Foster's design methodology to Boundary Value problem		12 Sessions
Introduction to Decomposition, tasks and dependency graphs; granularity, concurrency and task interaction; Processes and mapping; processes versus processors; Decomposition techniques – recursive decomposition, data decomposition, exploratory decomposition, speculative decomposition, hybrid decomposition; Characteristics of tasks and interactions; Parallel algorithm models – data parallel, task graph, work pool, master slave, producer-consumer, hybrid models					
Module 4	Parallel Programming	Assignment	Programming activity using MPI		12 Sessions
Modelling parallel computation: Multiprocessor Models- Random-Access Machine, The Local-Memory Machine, The Memory-Module Machine, Parallel Programming Models: Shared Memory Model, Shared programming model with OpenMP, Message Passing Models, Message passing interface, MPI_init, MPI_Comm_rank, MPI_finalize, Running MPI Programs, collective Communication					
Targeted Application & Tools that can be used: OpenMP programming					
Text Book 1. T. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition. Noida, India: Pearson Education, Ltd., 2003. Web Links: 1. Technology Enabled Learning - NPTEL offers as Course on "Introduction to Parallel Programming in OpenMP" by Yogish Sabharwal, IIT, Delhi. 2. https://swayam.gov.in/nd1_noc19_cs45/preview Students can enroll for the course that starts on 26th Aug – 20th Sep, 2019. 3. https://nptel.ac.in/courses/105105157 4. https://puniversity.informaticsglobal.com:2229/login.aspx					
References 1. Michael J Quinn, "Parallel computing: Theory and Practice", 2nd edition. New Delhi, India: Tata MacGraw Hill Education Private Limited, 2002. 2. Michael J Quinn, "Parallel Programming in C with MPI and OPENMP", Indian edition. Chennai, India: Tata MacGraw Hill Education (India) Private Limited, 2004. 3. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", Indian edition, New Delhi, India: MacGraw Hill Education (India) Private Limited, 2012 4. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Burlington, USA, 2011. 5. V.Rajaraman, C. Siva Ram Murthy, "Parallel Computers: Architecture and Programming", 2nd edition, PHI Learning Private Limited, Delhi, India, 2016.					

	Topics relevant to “EMPLOYABILITY SKILLS”: Shared Memory Systems and Distributed Memory Systems, Data Parallelism, Functional Parallelism, Pipelining, Flynn’s Classification, SIMD systems, MIMD systems, for developing Employability Skills through Problem Solving methodologies . This is attained through assessment component mentioned in course handout.
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Course Code: CSE3033	Course Title: INFORMATION VISUALIZATION Type of Course: Integrated	L-T- P- C			2	0	2	3
Version No.		1.0						
Course Pre-requisites		Basic Programming Concepts.						
Anti-requisites		NIL						
Course Description		This course offers foundational principles, methods, and techniques of visualization to enable creation of effective information representations suitable for exploration and discovery. Covers the design and evaluation process of visualization creation, visual representations of data, relevant principles of human vision and perception, and basic interactivity principles.						
Course Objective		The objective of the course is to familiarize the learners with the concepts Of Information Visualization and attain Employability through Experiential Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to CO 1: Choose appropriate visualization methods for a given data type. CO 2: Implement interactive visualization interface for different types of data such as time oriented, textual, and spatial. CO 3: Design an effective visualization using design and human perception principles.						
Course Content:								
Module 1	Data Visualization & Techniques	Quiz		Data Collection/Interpretation	20 Sessions			
		Topics: Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Human Visual Perception, Scalar and point techniques – vector visualization techniques – matrix visualization, Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data.						
Module 2	Visual Analysis of data from various domains	Assignment		Programming	20 Sessions			
		Topics: Time-oriented data visualization – Spatial data visualization and case studies, Text data visualization – Multivariate data visualization, and case studies,						

Module 3	Designing Effective Dashboard and Visual Story Telling	Assignment		Programming	20 Sessions
	Topics: Guidelines for designing successful visualizations, Data visualization dos and don'ts, Dashboard Design principles, Effective Dashboard Display Media, Dashboard creation using visualization tools for the use cases: Finance- marketing-insurance-healthcare etc.				
	List of Laboratory Tasks:				
	Targeted Application & Tools that can be used Targeted application: Business intelligence tools. Tools: Tableau, Google data studio, Openheatmap				
	Project work/Assignment:				
	Assignment: Programming				
	Text Book T1 Tamara Munzer, "Visualization Analysis and Design", CRC Press, 2018. T2 Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", CRC Press, Second Edition, 2015.				
	References R1 Stephen Few, "Now You See It", Analytics Press, 2019. . R2 Stephen Few, "Information Dashboard Design: the effective visual communication of data", Oreilly, 2016. Web resources: https://www.coursera.org/specializations/information-visualization , https://presiuniv.knimbus.com				
	Topics relevant to development of "EMPLOYABILITY SKILLS": Human Visual Perception, Effective Dashboard Display, for development of Employability Skills through Experiential Learning techniques. This is attained through assessment component as mentioned in course handout.				

Course Code: CSE3102	Course Title: Malware Analysis Type of Course: Discipline Elective in Cyber Security Basket				L- T-P- C	3	0	0	3
Version No.	1.0								
Course Pre-requisites	Should Have the knowledge of Cryptography and Network Security								
Anti-requisites	NIL								
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.								
Course Objective	The objective of the course is to familiarize the learners with the concepts of Malware Analysis and attain Employability through Participative Learning techniques.								
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understanding the nature of malware, its capabilities, and how it is combated through detection and classification. 2. Apply the methodologies and tools to perform static and dynamic analysis on unknown executables. 3. Analyze scientific and logical limitations on society's ability to combat malware.. 4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.								
Course Content:									
Module 1	Introduction to MALWARE ANALYSIS		Assignment	Programming activity					12 Hours
	Topics: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types viruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. Assignment: Brief study on types of spyware								
Module 2	Static Analysis		Assignment	Programming activity					11 Hours
	Topics: X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, ReverseEngineering- x86 Architecture Assignment: Static analysis on malware (PeStudio & ProcMon)								

Module 3	Dynamic Analysis		Assignment	Programming activity		11 Hours
	<p>Topics: Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark</p> <p>Assignment: Demonstration of wireshark</p>					
Module 4	Malware Functionality and Detection Techniques		Assignment	Programming activity		12 Hours
	<p>Topics: Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection. Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences</p> <p>Assignment: Packet malware signature</p>					
	Targeted Application & Tools that can be used: eCMAP (Certified Malware Analysis Professional)					
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
	Any appropriate tool can be given to demonstrate.					
	<p>Text Book</p> <p>1. Michael Sikorski and Andrew Honig, 2012: “ Practical Malware Analysis”, No Starch Press.</p> <p>E-Resources</p> <p>W1. https://www.geeksforgeeks.org/introduction-to-malware-analysis/</p> <p>W2. https://ine.com/learning/courses/malware-analysis</p> <p>W3: https://sm-nitk.vlabs.ac.in/</p>					
	<p>References</p> <p>1. Jamie Butler and Greg Hoglund, 2005: “Rootkits: Subverting the Windows Kernel”, Addison-Wesley.</p> <p>2. Dang, Gazet and Bachaalany, 2014: “Practical Reverse Engineering”, Wiley.</p> <p>3. Reverend Bill Blunden, 2012: “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System” Second Edition, Jones & Bartlett.</p>					
	Topics relevant to “EMPLOYABILITY SKILLS”: X86 Architecture, Packet Sniffing, Wireshark, for development of Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.					

Course Code: CSE3129	Course Title: Middleware Technologies	L-T-P- C	3	0	0	3
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	Type of Course: Program Core Theory Based Course						
Version No.		1.0					
Course Pre-requisites		Familiarity with basics of Internet technologies would be essential.					
Anti-requisites		NIL					
Course Description		The main objective of the course is to create a practical, wide-ranging discussion on Middleware Technologies to help students understand what is going on so they can pick out the real issues from the imaginary issues and start building complex distributed systems with confidence.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Middleware Technologies and attain Employability through Participative Learning techniques.					
Course Outcomes		At the end of the course the student will be able to <ol style="list-style-type: none"> 1. Learn how to use Middleware to Build Distributed Applications 2. Implement Business Processes 3. Learn about Middleware Technologies 4. Implement Business Processes 5. Learn application design and IT architecture 					
Course Content:							
Module 1			Case studies				11 Hours
	Topics: Moving to e-business, what is IT architecture? Why is this different from what we did before? Rewrite or evolve? Who develops the architecture? Early days, Preliminaries, Remote procedure calls, Remote database, Distributed transaction processing, Message queuing, Message queuing versus distributed transaction processing, what happened to all this technology? OBJECTS, COMPONENTS, AND THE WEB: Using object middleware, Transactional component middleware, COM, EJB, Final comments on TCM, Internet Applications. WEB SERVICES: Service concepts, Web services, and Using Web services: A pragmatic approach.						
Module 2			Case studies				11 Hours
	Topics: Middleware elements, the communications link, the middleware protocol, the programmatic interface, Data presentation, Server control, Naming and directory services, Security, System management, Comments on Web services, Vendor architectures, Vendor platform architectures, Vendor distributed architectures, Using vendor architectures, Positioning, Strawman for user target architecture, Marketing, Implicit architectures, Middleware interoperability.						
Module 3			Quiz				12 Hours
	Topics: What is middleware for? Support for business processes, Information retrieval, Collaboration, Tiers, The presentation tier, The processing tier, The data tier, Services						

	versus tiers, Architectural choices, Middleware bus architectures, Hub architectures, Web services architectures, Loosely coupled versus tightly coupled.				
Module 4		Case studies			11 Hours
	Topics: What is a process? Business processes, Information and processes, Architecture process patterns, Clarification and analysis, Error Handling, Timing, Migration, Flexibility.				
	Targeted Application & Tools that can be used: To design and develop distributed application.				
	Project work/Assignment:				
	Project Assignment: NIL Assignment 1: Paper Review of distributed application using web services				
	Text Books 1. Chris Britton and Peter Eye, "IT Architectures and Middleware: Strategies for Building Large, Integrated Systems", 2nd Edition, Pearson Education, 2004.				
	References 1. Qusay H. Mahmoud, "Middleware for Communications", 1st Edition, John Wiley and Sons, 2004. 2. Michah Lerner, "Middleware Networks: Concept, Design and Deployment of Internet Infrastructure", 1st Edition, Kluwer Academic Publishers, 2000.				
	Topics relevant to "EMPLOYABILITY SKILLS": Middleware Protocol, Architecture process patterns, for developing Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.				

Course Code: CSE 3030	Course Title: Mining Massive Datasets Type of Course: Program Core Theory and Lab Integrated Course			L- T-P- C	2	0	2	3
Version No.	1.0							
Course Pre-requisites	CSE2021- Data Mining							
Anti-requisites	NIL							
Course Description	<p>The purpose of the course is to provide knowledge of data mining, and to emphasize the importance of choosing suitable tools for processing and analyzing massive datasets to gain insights.</p> <p>The student should have the knowledge and skill to select and use the most appropriate mining tools to solve business problems.</p> <p>The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills. With a good knowledge of data mining technology, the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volumes of data.</p>							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Mining Massive Datasets and attain Skill Development through Experiential Learning techniques. .							
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <ul style="list-style-type: none"> Identify the right machine learning/mining algorithm for handling massive data Apply classification and regression models with Spark and Mahout Implement clustering models using Spark and Mahout Apply semi-supervised learning for clustering and classification 							
Course Content:								
Module 1	MapReduce Based Machine Learning	Programming Assignment	Data Collection and Analysis					15 Classes
	MapReduce Based Machine Learning K-Means, PLANET, Parallel SVM, Association Rule Mining in MapReduce, Inverted Index, Page Ranking, Expectation Maximization, Bayesian Networks							
Module 2	Classification and Regression models with Spark and Mahout	Programming Assignment	Data Collection and Analysis					15 Classes
	Classification and Regression models with Spark and Mahout Linear support vector machines - Naive Bayes model- Decision Trees – Least square regression. Decision trees for regression							
Module 3	Clustering in Spark and Mahout	Programming Assignment	Data analysis					15 Classes

Clustering in Spark and Mahout Hierarchical Clustering in a Euclidean and Non-Euclidean Space - The Algorithm of Bradley, Fayyad, and Reina - A variant of K-means algorithm - Processing Data in BFR Algorithm CURE algorithm - Clustering models with Spark - Spectral clustering using Mahout					
Module 4	Mining Social-Network Graphs and Semi-Supervised Learning	Programming Assignment	Data Collection and Analysis		15 Classes
Mining Social-Network Graphs Clustering of Social-Network Graphs - Direct Discovery of Communities - Partitioning of Graphs Finding Overlapping Communities - Counting Triangles using MapReduce Neighbourhood Properties of Graphs Semi-Supervised Learning Introduction to Semi-Supervised Learning, Semi-Supervised Clustering, Transductive Support Vector Machines					
Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • Business Analytical Applications • Social media Data Analysis • Predictive Analytics Tools: Data analytical tools like Spark, Mahout, map reduce.					
Project work/Assignment:					
After completion of each module, student will be asked to develop a mini project for Data mining.					
Text Book <ol style="list-style-type: none"> 1. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Stanford Press, 2016. 2. Nick Pentreath, "Machine Learning with Spark", Packt Publishing, 2017 3. Olivier Chapelle, Bernhard Scholkopf, Alexander Zien "Semi-Supervised Learning", The MIT Press, 2016. 					
References <ol style="list-style-type: none"> 1. Ron Bekkerman, Mikhail Bilenko, John Langford "Scaling Up Machine Learning: Parallel and Distributed Approaches", Cambridge University Press, 2016. 2. Jimmy Lin, Chris Dyer, "Data-Intensive Text Processing with MapReduce", Morgan Claypool Publishers, 2017. 3. Hennessy, J.L. and Patterson, D.A., 2016. Computer architecture: a quantitative approach. Elsevier. 4. Chandramani Tiwary "Learning Apache Mahout", Packt Publishing, 2015. 5. Fuchen Sun, Kar-Ann Toh, Manuel Grana Romay, KezhiMao, "Extreme Learning Machines 2013: Algorithms and Applications", Springer, 2014. 					
E-resources https://online.stanford.edu/courses/soe-yics0007-mining-massive-data-sets https://www.edx.org/course/mining-massive-datasets https://www.my-mooc.com/en/mooc/mmds/ http://infolab.stanford.edu/~ullman/mmds/book.pdf					
Topics relevant to “SKILL DEVELOPMENT”: Hierarchical Clustering in a Euclidean and Non-Euclidean Space for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.					

Course Code: CSE3009	Course Title: Optimization Techniques for Machine Learning		L-T-P- C	3	0	0	3
	Type of Course: Discipline Elective in Artificial Intelligence and Machine Learning Basket Theory						
Version No.		1.0					
Course Pre-requisites		CSE3008 Machine Learning Techniques					
Anti-requisites		NIL					
Course Description		This course introduces a range of machine learning models and optimization tools that are used to apply these models in practice. Course will introduce what lies behind the optimization tools often used as a black box as well as an understanding of the trade-offs of numerical accuracy and theoretical and empirical complexity. For the students with some optimization background this course will introduce a variety of applications arising in machine learning and statistics as well as novel optimization methods targeting these applications.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Optimization Techniques for Machine Learning and attain Employability through Problem Solving Methodologies.					
Course Outcomes		On successful completion of this course the students shall be able to: 1. Describe fundamentals of Machine learning [Knowledge]. 2. Explain Machine learning models [Comprehension]. 3. Discuss Convex optimization models [Comprehension]. 4. Apply Methods for convex optimization [Application].					
Course Content:							
Module 1:	Fundamentals of Machine learning	Quiz		Knowledge based Quiz	11 Sessions		
	Topics: Machine learning paradigm, empirical risk minimization, structural risk minimization, learning guarantees, introduction of VC-dimension.						
Module 2:	Machine learning models	Quiz		Comprehension based Quiz	11 Sessions		
	Topics: logistic regression, support vector machines, sparse regression, low dimensional embedding, low rank matrix factorization, sparse PCA, multiple kernel learning.						
Module 3	Convex optimization models	Assignment		Batch-wise Assignments	12 Sessions		
	Topics: linear optimization, convex quadratic optimization, second order cone optimization, semidefinite optimization, convex composite optimization						
Module 4:	Methods for convex optimization	Assignment and Presentation		Batch-wise Assignment and Presentations	11 Sessions		
	Topics: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient.						
	Targeted Application & Tools that can be used: Use of Matlab tool						
	Project work/Assignment: Survey on Methods for convex optimization						
	Text Book						

	<p>T1. Charu C. Aggarwal, “<i>Linear Algebra and Optimization for Machine Learning</i>”, Springer, 2020.</p> <p>T2. Sra Suvrit, Nowozin Sebastian, and Wright Stephen J, “<i>Optimization for Machine Learning</i>”, The MIT Press, 2012.</p>
	<p>References</p> <p>R1. Guanghui Lan, “<i>First-order and Stochastic Optimization Methods for Machine Learning</i>”, Springer Cham, 2020.</p> <p>Web References</p> <p>W1. https://sm-nitk.vlabs.ac.in/</p> <p>W2. https://nptel.ac.in/courses/</p>
	<p>Topics related to development of “EMPLOYABILITY SKILL”: Convex optimization models and Methods for convex optimization, for development of Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout.</p>

Course Code: CSE3063	Course Title: Privacy and Security in IoT Type of Course: Program Core & Theory only		L- T- P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		[1] The primary prerequisite is a working knowledge of basic algebraic number theory, which includes number fields, rings of integers, factorization of ideals into primes [2] A working knowledge of basic algebraic number theory. [3] Basic concepts of cryptography like encryption decryption, Signature generation and verifications.					
Anti-requisites		NIL					
Course Description		The purpose of this course is to enable the students to appreciate the need for cryptography and to identify the applications of cryptography in Internet of Things (IoT). The course is both conceptual and analytical in nature and needs fair knowledge of mathematics and computing. The course develops the critical thinking and analytical skills. The course also enhances the programming abilities through assignments.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Privacy and Security in IoT and attain Skill Development through Problem Solving Methodologies.					
Course Outcomes		On successful completion of this course the students shall be able to: 1. Explain benefits of modern cryptographic algorithms 2. Apply the Elliptic curve Diffie Hellman and digital signature algorithms to encrypt-decrypt , generate and verify the signatures 3. Estimate the performance of ECC with other traditional cryptography algorithms.					
Course Content:							
Module 1	Introduction to Elliptic Curves	Quiz		Comprehension based Quizzes and assignments;		15 Classes	
	Topics: Elliptic Curve Cryptosystems (ECC): Introduction to ECC, Method of Diophantus, Elliptic curves in Cryptography, Discrete Logarithms in Finite Fields, Elliptic Curve on a finite set of Integers, Definition of Elliptic curves,General form of a EC, Weierstrass Equation, Points on the Elliptic Curve (EC),The Abelian Group, Operations on ECC- Point addition, Point doubling.						
Module 2	Elliptic Curve Cryptosystems	Quizzes and assignments		Comprehension based Quizzes and assignments;		15 Classes	
	Topics: Elliptic Curve Cryptosystems (ECC): Public-Key Cryptosystems, Public-Key Cryptography, What Is Elliptic Curve Cryptography (ECC)?,Using Elliptic Curves In Cryptography, Generic Procedures of ECC, Example – Elliptic Curve Cryptosystem Analog to El Gamal, Diffie-Hellman (DH) Key Exchange, ECC Diffie-Hellman, Example – Elliptic Curve Diffie-Hellman Exchange, Elliptic Curve Digital Signature Algorithm (ECDSA) Why use ECC?, Security of ECC, Applications of ECC, Benefits of ECC.						

Module 3	IOT Protocols	Assignment and Lab projects with presentation		Project implementations in software, batch wise presentations	15 Classes
	<p>Topics:</p> <p>IoT Communication model and Protocols :</p> <p>Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (COAP), Advanced Message Queuing Protocol (AMQP), Extensible Messaging and Presence Protocol (XMPP), Introduction, Principle of RFID, Components of an RFID system.</p>				
	<p>Targeted Application & Tools that can be used:</p> <p>Application areas are to secure crypto currency- Bitcoin, Ethereum and Ripple using ECC in key agreement, digital signatures.</p> <p>Professionally Used Software: elliptic2 : https://www.graui.de/code/elliptic2/</p>				
	Project work/Assignment:				
	<p>Each batch of students (self-selected batch mates) will identify projects from searching on Google, and implement with the most suitable 2 or 3 NIST /SECP curves</p> <p>Project Assignment:</p> <p>Assignment: 1] Collect the running time of ECC on different standard NIST curves.</p> <p>Assignment 2: Prepare a compressive report on the efficiency of NIST Vs SECP curves.</p>				
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. I. Blake, G. Seroussi, N. Smart, Elliptic Curves in Cryptography , Cambridge University 2020 2. Arshdeep Bagha, Vijay Madiseti, “Internet of Things - A hands on approach”, Universities Press, 2021. 				
	<p>References</p> <ol style="list-style-type: none"> 1. Joseph H Silver man The Arithmetic of Elliptic Curves: Springer; 2nd Edition April 2016 2. Darrel Hankerson, Scott Vanstone, Alfred J. Menezes Guide to Elliptic Curve Cryptography Springer 2018 				
	<p>Topics related to development of “SKILL DEVELOPMENT”: IOT Protocols, Elliptic Curve Cryptosystem, for Skill Development through Participative Learning Techniques. This is attained through assessment components as mentioned in the course handout.</p>				

Course Code: CSE2038	Course Title: Privacy and Security in Online Social Media Type of Course: Program Core & Theory Only	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic of Network security and cryptography.					
Anti-requisites	NIL					
Course Description	Objective of this course is to make students learn the basics of privacy and security in online social media and develop ability to understand the importance of privacy in anyone’s life and their consequences if it is in peril. This course is both conceptual and analytical in nature that would help the student to predict the effects of any activity on Social Media. The students should have prior knowledge of some Social media platforms. After successful completion of the Course, the students would acquire knowledge to protect themselves from the online data theft on social media from attacker.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Privacy and Security in Online Social Media and attain Employability through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Recognize the significance of the Privacy and how to protect it [Knowledge] 2] Summarize the privacy and security Encryption for Peer to Peer Social Networks. [Comprehension] 3] Understand the function of stealing Reality and K-Anonymity. [Knowledge] 4]Use the Link Reconstruction attack in privacy Social Networks. [Application]					
Course Content:						
Module 1	ANALYSIS OF PRIVACY IN SOCIAL NETWORKS	Assignment	Knowledge	11 Sessions		
Topics: Three-Layered Framework-Characteristics Used to Analyze Social Web Privacy-Privacy Issues Related to Social Web Users-Privacy Issues Related to Service Providers-Security and Privacy for Digital Facets-Identifiable Facets-Private Facets. Assignment: Find real world problems and suggest solutions.						

Module 2	ENCRYPTION FOR PEER-TO-PEER SOCIAL NETWORKS	Assignment	Comprehension	12 Sessions
Topics: Essential Criteria for the P2P Encryption Systems-Existing P2P OSN Architectures-Evaluations of Existing Encryption Schemes Based on Our Criteria-Broadcast Encryption-Predicate Encryption. Assignment: - Survey of Unethical Behavior and Influencing factors.				
Module 3	STEALING REALITY AND K-ANONYMITY	Quiz	Comprehension	11 Sessions
Topics: Stealing Reality- Social Attack Model- Social Learnability- k-Anonymity- k-Degree Anonymity- k-Neighborhood Anonymity- k- Automorphism- k-Isomorphism-L-diversity- Attack Model and Privacy Guarantee- Insights from an ℓ -Diversified Graph.				
Module 4	PRIVACY IN SOCIAL NETWORKS- LINKS RECONSTRUCTION ATTACK	Assignment/Case study	Application	11 Sessions
Privacy in Social Networks- Link Prediction- Feature Extraction- Communities Datasets- Electronic Currencies- Anonymity- The Bit coin System- The Transaction Network- The User Network- Anonymity Analysis- Integrating Off-Network Information. Use Case and the Threat Model- Use Case for Private Record Linkage- Use Case for Privacy-Preserving Record Linkage- Assignment: - The Bit coin Faucet- Voluntary Disclosures- TCP/IP Layer Information- Context Discovery- Flow and Temporal Analyses.				
Text Book / References T1. Yaniv Altshuler, Yuval Elovici, Armin B. Cremers Nadav Aharony, Alex Pentland,” Security and Privacy in Social Networks”, Springer Publisher,2012,1 st Edition Online Resources: - W1: https://presiuiv.knimbus.com/user#/searchresult?searchId=Privacy%20and%20Security%20in%20Online%20Social%20Media%20&curPage=0&layout=list&sortFieldId=none&topresult=false W2: https://onlinecourses.nptel.ac.in/noc21_cs28/preview				
Topics relevant to “EMPLOYABILITY SKILLS”: Link Prediction, features extraction, for developing Employability Skills through Participative Learning Techniques. This is attained through the assessment component mentioned in the course handout.				

Course Code: CSE 2028	Course Title: Software Project Management Type of Course: Theory Only Course		L-T-P- C	3	0	0	3
Version No.		1					
Course Pre-requisites		Basics of Programming					
Anti-requisites							
Course Description		Effective software project management is crucial to the success of any software development or maintenance project. The roles and responsibilities of the project manager is numerous and varied. However, at the broad level, these can be classified in to the project planning and monitoring and control activities. Project planning involves making cost, effort, and duration estimation and preparing various types of plans such as schedule, configuration management, risk management, quality management. Staffing plan etc. The monitoring and control activities encompass keeping track of progress and removing bottlenecks using techniques such as PERT, GANTT, and also effective risk management, team building etc.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Software Project Management and attain Employability through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand the different project contexts and appropriate management strategy.• Practice the role of professional ethics in successful software development.• Identify the key phases of project management.• Determine an appropriate project management approach through an evaluation of the business context and scope of the project.					
Course Content:							
Module 1	Conventional & Modern Software Management	Assignment		Case studies	11 Sessions		
Topics: Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, Reducing software product size, Improving software processes. Principles of Conventional Software Engineering, Principles of Modern Software Management, Transitioning to an interactive Process.							
Module 2	Software Management Process Framework	Case studies / Case let		Case studies	11 Sessions		
Topics: Life cycle phases, The artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; ModelBased Software Architectures - A management perspective and A technical perspective.							

Module 3	Project Organization and Planning	Quiz		Case studies	12 Sessions
Topics: Work breakdown structures, Planning guidelines, The cost and schedule estimating process, The iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.					
Module 4	Project Control and Process Instrumentation	Quiz		Case studies	11 Sessions
Topics: PROJECT CONTROL AND PROCESS INSTRUMENTATION :The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.					
Targeted Application & Tools that can be used:					
Project work/Assignment:					
Assignment:					
Text Book T1. Walker Royce, “Software Project Management : A unified Framework”, 1st Edition, Pearson Education, 2021					
References R1. Bob Hughes and Mike Cotterell, “Software Project Management”, 3rd Edition, Tata McGraw Hill Edition, 2005. R2. Joel Henry, “Software Project Management”, 1st Edition, Pearson Education, 2006. E book link T1: https://www.edutechlearners.com/download/Software%20Project%20Management.pdf Web resources: https://onlinecourses.nptel.ac.in/noc19_cs70/preview library resources: https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=doc_title_str&topresult=false&content=*software%20project%20management*&sub_category_name=Computer%20Science%20and%20IT					
Topics relevant to development of “EMPLOYABILITY SKILLS”: Life cycle Phases, Seven Core Metrics, for development of Employability Skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in the course handout.					

Course Code: CSE250	Course Title: System Administration and IT Infrastructure Type of Course: Theory & Integrated Laboratory		L-T-P-C	2	0	4	4
Version No.		1.0					
Course Pre-requisites		[1] Preliminary knowledge on cloud computing and services-CSE 233					
Anti-requisites		Nil					
Course Description		The main goal of this course is to study the fundamentals of system administration and infrastructure services such as Managing Operating system, Upgrading, installing, and configuring application software and computer hardware, Creating and managing system permissions and user accounts, performing regular security tests and security monitoring, Maintaining networks and network file systems. The course aims to introduce the popular cloud infrastructure services such as managing cloud resources, virtual machine usage and storage management. The student will also learn how to manage and configure servers and way of using industry tools to manage computers, user information, and user productivity. Finally, the student will learn how to recover your organization's IT infrastructure in the event of a disaster.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of System Administration and IT Infrastructure and attain Employability through Experiential Learning techniques .					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Demonstrate the knowledge of different directory services and how a centralized system admin can support different parts of IT Infrastructure. 2. Apply the concepts of system administration to real life scenarios. 3. Understand the working of user Management and Directory management commands. 4. Demonstrate the knowledge of cloud infrastructure services. 5. Identify appropriate methods of system recovery and back-up.					
Course Content:							
MODULE 1	Introduction to System Administration	Quiz		Programming/ Problem Solving	05 Hours		

	Topics: Define System Administration, Basics of system administration, organizational policies, IT infrastructure services, user and hardware provisioning, routine maintenance, troubleshooting, and managing potential issues. [Blooms 'level selected: Comprehension]				
Module 2	Network and Infrastructure Services	Lab evaluation		Programming/ Problem Solving	06 Hours
	Topics: Introduction to network and infrastructure services, what IT infrastructure services are and what their role is in system administration, server operating systems, virtualization, network services, DNS for web services, and how to troubleshoot network services, introduction to system administration tasks. [Blooms 'level selected: Comprehension]				
Module 3	Software and Platform Services	Lab evaluation		Programming/Problem Solving	07 Hours
	Topics: Explore software and platform services, types of software and platform services such as configure email services, security services, file services, print services, and platform services. Explore the ways to troubleshoot platform services and common issues to look out for. To setup and manage the IT infrastructure services to help a business stay productive, keep information secure, and deliver applications to its users. [Blooms 'level selected: Application]				
Module 4	Directory Services	Lab evaluation/ Assignment		Programming/Problem Solving	07 Hours
	Topics: Learn about directory services -two of the most popular directory services, Active Directory and OpenLDAP, work in action. Explore the concept of centralized management and support in SysAdmins to maintain and support all the different parts of an IT infrastructure, how to add users, passwords, and use group policies in Active Directory and OpenLDAP. Introduction to RAID storage, Need of RAID storage, Types of Raid Storage in the cloud. [Blooms 'level selected: Application]				
Module 5	Data Recovery & Backups	Assignment		Programming /Problem Solving	05 Hours
	Topics: Data recovery and backups, Backup and recovery of data, explore common corporate practices like designing a disaster recovery plan and writing post-mortem documentation. Study the trade-offs between on-site and off-site backups, understand the value and importance of backup and recovery testing, know different options for data backup and understand the purpose and contents of a disaster recovery plan. An introduction to edge computing- A new revolution in cloud computing. [Blooms 'level selected: Comprehension]				
	List of Laboratory Tasks: Experiment No 1: Demonstrate basic Commands, Visual Interface (Vi Editor), User and Group Administration. [6 hours: Application Level] Level 1: Demonstrate Linux basic commands. Experiment No. 2: Demonstrate the use of permissions, access control list, change ownership of files and directories, using simple Filters, advanced Filters. [4 hours: Application Level] Level 1: Work with basic file permissions, access control list. Experiment No. 3: Demonstrate the working of User Management, Directory management commands, Start-up & Shutdown scripts, Process management commands and their execution. [4 hours: Application Level]				

	<p>Level 1: Understand use of User Management, Directory management commands. Experiment No. 4: Demonstrate the working of Firewall configuration in Linux, Study of Important LINUX Services. [4 hours: Application Level] Level 1: Understand use of Firewall configuration in Linux, Study of Important LINUX Services. Experiment No. 5: Practicing of some sample Shell Script programs. [6 hours: Application Level] Level 1: Working with shell script programs. Experiment No. 6: Create an Amazon EC2 Instance (Linux) or use equivalent other cloud platform such as Google Cloud or Azure to create a virtual machine service. [8 hours: Application Level] Level 1: Explore cloud infrastructure service.</p> <p>Experiment No. 7: Create an Amazon S3 Bucket or use equivalent other cloud platform such as Google Cloud or Azure to create a storage service. [8 hours: Application Level] Level 1: Explore cloud infrastructure service. Experiment No.8: Configuring a Static Website with S3 and CloudFront. [6 hours: Application Level] Level 1: Explore cloud infrastructure service. Experiment No.9: Demonstrate the use of S3 Bucket Policies and Conditions to Restrict Specific Permissions. [8 hours: Application Level] Level 1: Explore cloud infrastructure service. Experiment No.10: Working with AWS Backup Services. [6 hours: Application Level] Level 1: Explore cloud infrastructure service.</p>
	<p>Targeted Application & Tools that can be used: Application Area is to understand and apply concept of system administration and infrastructure services. Tools/Simulator used: Linux operating system, AWS cloud service subscription or equivalent cloud platform subscription.</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
1.	<p>2. Problem Solving: Understanding different system administration services. 2. Programming: Implementation of different cloud infrastructure services.</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. AEleen Frisch, “Essential System Administration”, Published by O’Reilly Media, 3rd Edition, 2014. 2. Donald Coffelt, Chris Hendrickson, “Fundamentals of Infrastructure Management”, Donald Coffelt and Chris Hendrickson, 2017.
	<p>References:</p> <ol style="list-style-type: none"> 1. Thomas A. Limoncelli, Christina J. Hogan, Strata R. Chalup, “The Practice of System and Network Administration”, McGraw Hill Education, Pearson Education, Second Edition, 2022. 2. IBM Information Infrastructure Solutions Handbook, June 2010, © Copyright International Business Machines Corporation. 3. Hideo Nakamura, Kotaro Nagasawa, Kazuaki Hiraishi, Atsushi Hasegawa, KE Seetha Ram, Chul Ju Kim, and Kai Xu, “PRINCIPLES OF INFRASTRUCTURE-Case Studies and Best Practices“, Mitsubishi Research Institute, Inc., 2019.

	Topics relevant to “EMPLOYABILITY SKILLS”: Demonstrate the use of permissions, access control list, change ownership of files and directories, using simple Filters for developing Employability Skills through Experiential Learning techniques . This is attained through the assessment component as mentioned in the course handout.
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Course Code: CSE257	Course Title: Network Programming Type of Course: Laboratory only	L-T-P-C	0	0	4	2
Version No.		2.0				
Course Pre-requisites		C language				
Anti-requisites		NIL				
Course Description		Network Programming intends to explore the opportunities for developing, maintaining and supporting distributed and network applications. The Course covers the basics of computer networks to designing and implementing networks.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Network Programming and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques				
Course Outcomes		On successful completion of this laboratory based course the students will be able to: 1. Outline the basic network troubleshooting commands in windows/Linux. 2. Configure various networks using cisco packet tracer tool. 3. Demonstrate the working of client-server TCP/IP socket programming. 4. Demonstrate the usage of Wireshark tool in networking. 5. Simulate networking scenarios using NS2 simulator.				
Course Content:						
	List of Laboratory Tasks Task 1: Troubleshoot using network DOS command Task 2: Demonstration of Cisco Packet Tracer Tool 2.1: Introduction to Cisco Packet Tracer 2.2: User interface and simulation view 2.3: Configure user name and password for the three modes in router 2.4: Configure the DHCP Server using 2 wireless router 2.5: Configure the TELNET Service for 2 different network 2.6: Demonstrate the static routing with multiple networks using serial port and interface 2.7: Demonstrate the RIP routing with multiple networks using serial port and interface 2.8: Configure the Static and dynamic NAT for private network					

	<p>Task 3: Demonstrate the working of client-server TCP/IP socket programming</p> <p>Task 4: Demonstrate the Wireshark tool Usage</p> <p>Task 5: Demonstration of Network Simulator Version 2</p>
	<p>Targeted Application & Tools that can be used:</p> <p>Simulate networking scenarios using Cisco Packet Tracer.</p> <p>Demonstrate the usage of Wireshark tool in networking.</p> <p>Practice the simulation-based network performance evaluation techniques using NS2.</p>
	<p>Textbooks:</p> <p>1. Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2017.</p>
	<p>References</p> <p>R1. “Network Simulation Lab Manual” Presidency University.</p> <p>E-Resource</p> <p>18 Most Popular Network Simulation Software Tools in 2022 (networkstraining.com)</p> <p>Virtual Labs (vlab.co.in)</p> <p>NPTEL course- Computer Networks and Internet Protocol - Course (nptel.ac.in) By Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty IIT Kharagpur https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Troubleshoot using network DOS command,</p> <p>Demonstration of Cisco Packet Tracer Tool for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE465	Course Title: Reinforcement Learning		L-T-P-C	3	0	0	3
	Type of Course: Theory Only						
Version No.		1.0					
Course Pre-requisites	•	<ul style="list-style-type: none">• Knowledge of programming in Python is required.• Knowledge of probabilities/statistics, calculus and linear algebra is required.• Machine learning background, as provided for example by COMP-551 or COMP-652 is required.					
Anti-requisites		NIL					
Course Description		The goal of this class is to provide an introduction to reinforcement learning, a very active research sub-field of machine learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as power plant optimization or dynamical system control, to game playing, inventory control, and many other fields. Notably, reinforcement learning has also produced very compelling models of animal and human learning. During this course, we will study theoretical properties and practical applications of reinforcement learning. We will follow the second edition of the classic textbook by Sutton & Barto (available online for free, or from MIT Press), and supplement it as needed with papers and other materials.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Reinforcement Learning and attain Skill Development through Problem Solving Methodologies.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Knowledge of basic and advanced reinforcement learning techniques. 2. Identification of suitable learning tasks to which these learning techniques can be applied. 3. Appreciation of some of the current limitations of reinforcement learning techniques. 4. Formulation of decision problems, set up and run computational experiments, evaluation of results from experiments.					
Course Content:							
Module 1	Introduction		Assignment		Programming		No. of Classes:10
	Topics: Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. Probability Primer Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.						
Module 2	Markov Decision Process		Assignment		Programming		No. of Classes:10

	Topics: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.				
Module 3	Prediction and Control by Dynamic Programming	Assignment		Programming	No. of Classes:10
	Topics: Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions Monte Carlo Methods for Model Free Prediction and Control Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.				
Module 4	TD Methods and Policy Gradients	Assignment		Programming	No. of Classes:10
	Topics: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants. Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.				
	Targeted Application & Tools that can be used: While Convolution Neural Network (CNN) and Recurrent Neural Network (RNN) are becoming more important for businesses due to their applications in Computer Vision (CV) and Natural Language Processing (NLP), Reinforcement Learning (RL) as a framework for computational neuroscience to model decision making process seems to be undervalued. Besides, there seems to be very little resources detailing how RL is applied in different industries. Despite the criticisms about RL's weaknesses, RL should never be neglected in the space of corporate research given its huge potentials in assisting decision making. Tools: Torch, Google Colaboratory, Spider, Jupiter Notebook				
	Project work/Assignment:				
	This part is written for general readers. At the same time, it will be of greater value for readers with some knowledge about RL. <ul style="list-style-type: none"> Resources management in computer clusters Designing algorithms to allocate limited resources to different tasks is challenging and requires human-generated heuristics. The paper "Resource Management with Deep Reinforcement Learning" [2] showed how to use RL to automatically learn to allocate and schedule computer resources to waiting jobs, with the objective to minimize the average job slowdown. State space was formulated as the current resources allocation and the resources profile of jobs. For action space, they used a trick to allow the agent to choose more than one action at each time step. Reward was the sum of $(-1/\text{duration of the job})$ over all the jobs in the system. Then they combined REINFORCE algorithm and baseline value to calculate the policy gradients and find the best policy parameters that give the probability distribution of actions to minimize the objective. Traffic Light Control 				

	<p>Researchers tried to design a traffic light controller to solve the congestion problem. Tested only on simulated environment though, their methods showed superior results than traditional methods and shed a light on the potential uses of multi-agent RL in designing traffic system.</p> <p>Five agents were put in the five-intersection traffic network, with a RL agent at the central intersection to control traffic signalling. The state was defined as eight-dimensional vector with each element representing the relative traffic flow of each lane. Eight choices were available to the agent, each representing a phase combination, and the reward function was defined as reduction in delay compared with previous time step. The authors used DQN to learn the Q value of the {state, action} pairs.</p> <ul style="list-style-type: none"> • <u>Robotics</u> <p>There are tremendous works on applying RL in Robotics. Readers are referred to for a survey of RL in Robotics. In particular, trained a robot to learn policies to map raw video images to robot's actions. The RGB images were fed to a CNN and outputs were the motor torques. The RL component was the guided policy search to generate training data that came from its own state distribution.</p> <ul style="list-style-type: none"> • <u>Web System Configuration</u> <p>There are more than 100 configurable parameters in a web system and the process of tuning the parameters requires a skilled operator and numerous trial-and-error tests. The paper "A Reinforcement Learning Approach to Online Web System Auto-configuration" showed the first attempt in the domain on how to do autonomic reconfiguration of parameters in multi-tier web systems in VM-based dynamic environments.</p> <p>The reconfiguration process can be formulated as a finite MDP. The state space was the system configuration, action space was {increase, decrease, keep} for each parameter, and reward was defined as the difference between the given targeted response time and measured response time. The authors used the model-free Q-learning algorithm to do the task.</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition 2. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia 3. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy
	<p>References</p> <ol style="list-style-type: none"> 1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019. 2. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018). 3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012):
	<p>E-Resources</p> <p>NPTEL course – https://onlinecourses.nptel.ac.in/noc19_cs55/preview https://archive.nptel.ac.in/courses/106/106/106106143/ https://www.digimat.in/nptel/courses/video/106106143/L35.html</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Real time Data Analysis using Reinforcement learning for Skill Development through Problem Solving techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: PIP103	Course Title: Professional Practice– II Type of Course: NTCC	L- T-P- C	-	-	-	15
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Version No.	1.0
Course Pre-requisites	Knowledge and Skills related to all the courses studied in previous semesters.
Anti-requisites	NIL
Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques.
Course Outcomes	On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Identify the engineering problems related to local, regional, national or global needs. 2. Apply appropriate techniques or modern tools for solving the intended problem. 3. Design the experiments as per the standards and specifications. 4. Interpret the events and results for meaningful conclusions. 5. Appraise project findings and communicate effectively through scholarly publications.

Course Code: CSE 208	Course Title: Theory of Computation Type of Course: Theory Only	L- T-P- C	3	1	0	4
Version No.	2.0					
Course Pre-requisites	The students should have the Knowledge on Set Theory					
Anti-requisites	Nil					
Course Description	The course deals with introduction of formal languages and the correspondence between language classes and the automata that recognize them. Topics include: Formal definitions of grammars and acceptors, Deterministic and Nondeterministic systems, Grammar ambiguity, finite state and push-down automata; normal forms; Turing machines and its relations with algorithms.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Theory of Computation as mentioned above and attain Skill Development through Problem Solving Methodologies .					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Describe various components of Automata. (Knowledge) 2. Illustrate Finite Automata for the given Language. (Application) 3. Distinguish between Regular grammar and Context free grammar. (Comprehension) 4. Construct Push down Automata. (Application) 5. Construct Turing machine for a Language. (Application)					
Course Content:						
Module 1	Introduction to automata theory	Assignment	Problems on Strings and Language operations		06 Sessions	
Topics: Introduction to Automata Theory, Applications of Automata Theory, Alphabets, Strings, Languages & operations on languages, Representation of automata, Language recognizers, Finite State Machines (FSM): Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs						
Module 2	Finite Automata	Assignment	Problems on DFA, NFA's		13 Sessions	
Topics: Basic concepts of Finite automata, DFA- definitions of DFA, Deterministic Accepters Transition Graphs and Languages and DFA's, Regular Languages, NFA- Definition of a Nondeterministic Acceptor, Languages and NFA's Why Non-determinism? Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata.						
Module 3	Regular Expressions & Context Free Grammar	Assignment	Problems on RE, CFG, PT, PL and Ambiguity		12 Sessions	
Topics: Formal Definition of a Regular Expression, Languages Associated with Regular Expressions, Languages, Regular Languages (RL) and Non-regular Languages: Closure properties of RLs, to show some languages are not RLs, Closure Properties of Regular Context Free Grammars-Examples of Context-Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity, Chomsky Normal Form, Gribiche Normal Form.						
Module 4	Push down Automata	Assignment	Problems on pushdown Automaton		08 Sessions	

Topics: Definition of a Pushdown Automaton, Language Accepted by a Pushdown Automaton, Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack Equivalence of PDA's and CFG's: From Grammars to Pushdown Automata.				
Module 5	Turing Machine	Assignment	Problems on Turing Machine	07 Sessions
Topics: Definition of a Turing Machine, Turing Machines as Language Acceptors, Example Languages to construct Turing machine, Turing Machines as Transducers, Halting Programming Techniques for Turing Machines				
Targeted Application & Tools that can be used: Targeted Application: <ol style="list-style-type: none"> 1. Text Processing 2. Compilers 3. Text Editors 4. Robotics Applications 5. Artificial Intelligence Tools: <ol style="list-style-type: none"> 1. JFLAP (Java Formal Language and Automata Package) Software simulation tool. It's interactive educational software written in Java to experiment topics in automata theory. 2. Turing machine Online simulators. 				
Text Book 1. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6 th Ed, 2018.				
References 1. Aho, Ullman and Hopcroft, "Theory of Computation", Pearson India 3rd Edition 2008. 2. Michael Sipser, "Theory of Computation", Cengage India 3rd Ed, 2014.				
E-Resources NPTEL course – https://onlinecourses.nptel.ac.in/noc21_cs83/preview				
Topics relevant to "SKILL DEVELOPMENT": Deterministic and Non-Deterministic Automaton, Regular Expressions, CFGs, Turing Machine and Pushdown automaton for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.				

Course Code: CSE310	Mobile Applications and Development & CSE 310	L- T-P- C	1	0	4	3
Version No.	1.0					
Course Pre-requisites	The student needs to have fundamental understanding of object-oriented programming concepts with Java/C#, XML, usage of any integrated development environment.					
Anti-requisites						

Course Description	<p>The course deals with the basics of android platform and application life cycle. The goal of the course is to develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server.</p> <p>Topics include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.</p>			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Mobile Applications and Development as mentioned above and attain Employability Skills through Experiential Learning Techniques.			
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Discuss the fundamentals of mobile application development and its architecture. (Comprehension) 2. Illustrate mobile applications with appropriate android view. (Application) 3. Demonstrate the use of services, broadcast receiver, Notifications and content provider.(Application) 4. Apply data persistence techniques, to perform CRUD operations. (Application) 5. Use advanced concepts for mobile application development. (Application) 			
Course Content:				
Module 1	Introduction and Architecture of Android	Assignment	Simulation/Data Analysis	10 Sessions
Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.				
Module 2	User Interfaces, Intent and Fragments	Assignment	Numerical from E-Resources	15 Sessions
Views, Layout, Menu, Intent and Fragments.				
Module 3	Components of Android	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Activities, Services, Broadcast receivers, Content providers, User Navigation				
Module 4	Notifications and Data Persistence	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase				
Module 5	Advance App Development	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Graphics and Animation, App Widgets, Sensors, Performance, Location, Places, Mapping, Custom Views, Canvas.				
List of Laboratory Tasks <ol style="list-style-type: none"> 1.a. Design an app to read user inputs using edit text and display the result of arithmetic operations using toast message. 1.b. Create an android app to calculate the current age of yourself, select your DOB using date picker. 				

- 2.a. Design an app to input your personal information. Use autocomplete text view to select your place of birth.
- 2.b. Design an app to select elective course using spinner view and on click of the display button, toast your ID and selected elective course.
3. Design a restaurant menu app to print the total amount of orders.
4. Develop an android app that uses intent to maintain the following scenario.
Check the eligibility criteria for voting. Input the Aadhar no., Name & age in the first activity. If the age is above 18, display the voter's detail in the second activity. Else, display, "You are not eligible to vote" in the second Activity.
5. Demonstrate the use of fragment with list of buttons representing various colors, and on click of these buttons, the appropriate color is filled in the next fragment.
Create an Android application to input the vitals of a person (temperature, BP). If the vitals are abnormal, give proper notification to the user.
6. Create an android app to for movie ticket booking. Save the user name of the customer using shared preferences. After completion of booking, retrieve the username from the shared preferences and print the ticket details.
7. Create an android application to manage the details of students' database using SQLite. Use necessary UI components, which perform the operations such as insertion, modification, removal and view. Presidency University needs an APP for Admission eligibility checking for students, for that you need to take the following information from the Student: registration ID, physics, chemistry and mathematics marks (PCM), fees is allotted as below criteria.

PCM (Total marks %)	Fee concession
90 above	80 %
70 to 89	60 %
Below 69 %	no concession
- On click on the button "Registration" details should be stored in the database using SQLite. Create button DISPLAY ALL (full students list) on click on the button it should display the students list per the fee concession.
8. A company need to design an app that plays soft music automatically in the background. Create an app to achieve this functionality.
9. Create an android application such that your view object in the Activity can be Animated with fade-in effect. Create an appropriate XML file named fade-in and write the application to perform the property animation.
10. Demonstrate how to send SMS and email.
11. Create an android application to transfer a file using WiFi. Create an android application

"Where am I" with an Activity that uses the GPS Location provider to find the device's last known location.

Targeted Application & Tools that can be used:

Text Book

- T1. Pradeep kothari "Android Application Development - Black Book", dreamtechpress
- T2. Barry Burd (Author), "Android Application Development" ALL – IN – ONE FOR Dummies
- T3. Jeff Mcherter (Author), Scott Gowell (Author), "Professional mobile Application Development" paperback, Wrox - Wiley India Private Limited
- T4. Wei-Meng Lee (Author) "Beginning Android Application Development" Wrox – Wiley India Private Limited

References

<ol style="list-style-type: none"> 1. Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) “Android Programming” 3rd edition, 2017. The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by” 2. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. 3. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015. 4. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580 5. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2 6. Reto Meier “Professional Android Application Development” <p>E-Resources: https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/</p>
<p>Topics relevant to the development of SKILLS: Graphics and Animation, App Widgets Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE202	Course Title: DIGITAL DESIGN Type of Course: Theory Only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Electronics: AC & DC Circuits, Boolean Algebra, Number Systems, Logic Gates					
Anti-requisites						
Course Description	This Course will provide the fundamental background needed to understand how digital systems work and how to design digital circuits. Students will gain experience with several digital systems, from simple logic circuits to programmable logic devices. Topics include: Number systems and codes, Boolean algebra, logic circuits and minimization, Combinational and sequential logic circuits, Programmable Logic devices, State table and state diagrams, Counters and shift registers, Arithmetic operations and algorithms, fault diagnosis and tolerance.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital design and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Apply minimization techniques to Boolean equations to drawing digital circuits 2. Select the appropriate combinational circuits for simple applications 3. Apply the knowledge of state table and state diagram to draw sequential circuits					
Course Content:						
Module 1	Introduction to Digital Systems	Application				10 Sessions
Fundamentals of Digital Systems, Number System and Codes, Boolean algebra, Logic Circuits and Minimization, Hardware Description Language(HDL) using Computer design tools.						

Module 2	Fundamentals of Digital System Design	Comprehension		14 Sessions
Minimization using K-Map and QM Method, Combinational Circuits, Programmable Logic Devices, Design of arithmetic/logic and control units-Half Adders and Full , Half Subtractors and Full subtractors, Multiplexers, 1:8 Demux, 1:16 Demux 1-Bit Comparator, 2-bit comparator Decoders, etc.				
Module 3	Sequential Circuits and its Applications	Application	Simulation/Data Analysis	15 Sessions
Sequential Vs Combinational Ckts, Sequential Logic Circuits, State Tables and State Transition Diagrams, Shift Registers and Counters, Fault Diagnosis and Tolerance				
Targeted Application & Tools that can be used: Xilinx Tool				
Text Book				
1. Mano, M. Morris and Ciletti Michael D., “Digital Design”, 5th Edition 2017, Pearson Education				
References				
1. Donald P Leach, Albert Paul Malvino and Gautam Saha, “Digital Principles and its applications”, 7th Edition 2010, McGraw Hill Education.				
E-Resources				
NPTEL course – https://nptel.ac.in/courses/106105185				
Topics relevant to “SKILL DEVELOPMENT”: Boolean Equations Simplifications, HDL, Sequential and Combinational Circuits for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE206	Course Title: Microprocessor & Microcontrollers		L-T-P-C	3	0	0	3
	Type of Course: Theory Only						
Version No.		2.0					
Course Pre-requisites		Number Systems, basics of Digital Electronics, basics of Computers.					
Anti-requisites		NIL					
Course Description		This course introduces the assembly level language programming of 8086. The course introduces the core concept of microprocessor and develops in students the assembly language programming skills along with real time applications of microprocessor. It gives a practical training to students to perform interfacing peripheral devices with 8086 microprocessors. This lab focusses mainly on software and few interfacing programs with microprocessor					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Microprocessor & Microcontrollers and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Describe the fundamental principles of 8086 Microprocessor and 8051 Microcontroller. 2. Apply the programming knowledge of 8086 and 8051 to write Assembly language Programs. 3. Explore interfacing of 8086 to I/O devices using 8255 Programmable Peripheral Interface.					
Course Content:							
Module 1	Fundamentals of 8086 Microprocessor	Introduction		Knowledge		12 Sessions	
	Topics: Organization of Computer Systems, architecture of computers, RISC and CISC, microprocessor evolution. 8086 Microprocessor architecture: main features of 8086, Modular Programming, 8086 internal architecture, assembly language program development tools.						
Module 2	Programming the 8086 Microprocessor	Application		Programming		16 Sessions	

	<p>Topics:</p> <p>8086 Instructions set, addressing modes, simple sequence programs, Jumps, flags, and conditional jumps, unconditional jumps, Multiprocessor configurations — Coprocessor, Closely coupled and loosely Coupled configurations, repeated until programs, strings, procedure and macros</p>				
Module 3	Basic of I/O Interfacing and Introduction to Microcontroller	Application		Programming	10 Sessions
	<p>Topics:</p> <p>Basic I/O interface, programmable peripheral interface and programming. I/O Pins Ports and Circuits — Instruction set, overview of 8051 family, 8051 assembly language programming.</p>				
	<p>Targeted Application & Tools that can be used:</p> <p>Microsoft Assembler (MASM), TASM and KELL</p>				
	<p>Text Book</p> <p>T1: Microprocessors and Interfacing (SIE), 3rd ed. by Douglas V. Hall & S.S.S.P. Rao, 3rd edition, Mc Graw Hill, 2012.</p> <p>T2: Barry B Brey, “The Intel Microprocessors”, 8th edition, Pearson, 2014.</p>				
	<p>References</p> <p>R1: Muhammad Ali Mazidi, “Microprocessors and Microcontrollers”, First Impression, Pearson Education.</p> <p>R2: Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 4e, Prentice Hall, 1998</p> <p>Web resources:</p> <p>https://nptel.ac.in/courses/108107029</p> <p>https://puniversity.informaticsglobal.com:2229/login.aspx</p>				
	<p>Topics relevant to development of “SKILL”: Engineering Mechanics and its relevance. Force and its Characteristic, Laws of Motion. 8 bit microprocessors vs 16 bit microprocessors, Memory Read and Memory Write Cycle of 8086, Simple Program to interface 8255 and 8086, Simple programs to understand instruction set of 8051 for Skill Development through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.</p>				

Course Code: CSE311		Course Title: Web Services Type of Course: Laboratory integrated		L-T-P- C	1	0	4	3
Version No.		2.0						
Course Pre-requisites		Web Services						
Anti-requisites		NIL						
Course Description		The course includes the basic principles of service-oriented architecture, its components and techniques. It provides an understanding of the architecture, technology, underlying service design and development aspects of web services. The students will also gain knowledge on the operational aspects of cloud services, which form the basic building blocks of cloud computing. Topics include: Introduction to Service Oriented Architecture, Web Service fundamentals, WS-* extensions, Building Service Oriented Architecture, Web Services framework, Service Descriptions (WSDL), Messaging (SOAP & RESTful), Web Service Transactions, Orchestration and Choreography, Policies, Security.						
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Web Services and attain Employability Skills through Experiential Learning techniques.						
Course Out Comes		On successful completion of this course the students shall be able to: 1) Describe the concepts of web services and service oriented architecture.[Knowledge] 2) Develop a SOAP based Web Services for a given scenarios. [Application] 3) Develop a RESTful architecture based Web Services for a given scenario.[Application] 4) Demonstrate the cloud based micro services. [Comprehension]						
Course Content:								
Module 1		Fundamentals of SOA and Web Services (Knowledge)	Assignment		Programming activity		13 Sessions	
	Evolution and Emergence of Web Services – Evolution of distributed computing. Core distributed computing technologies – client/server, CORBA, JAVA RMI, Micro Soft DCOM, MOM, Challenges in Distributed Computing, Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services							
Module 2		SOAP Web Services (Application)	Assignment		Programming activity		10 Sessions	

	Overview of SOAP protocol, SOAP Messaging Format, WSDL, WSDL related XML Schema, WSDL language basics, Creating Web Services using SOAP, Deployment of SOAP services, Real-world applications of SOAP based Web services.				
Module 3	RESTful Web Services (Application)	Assignment		Programming activity	10 Sessions
	Overview of REST architectural style, URIs and Resources, REST Principles, REST Methods, Design, Development and Deployment of RESTful Web Services, Real-world applications of RESTful Web Services.				
Module 4	Advances in Web services (Knowledge)	Assignment	Programming activity		8 Sessions
	Cloud Services overview, Design, Development and Deployment of cloud services; Concept of Micro Services, Architecture and Development.				
	Text book(s): Thomas Erl, “ <i>Service-Oriented Architecture: Concepts, Technology, and Design</i> ”, Pearson Education. 2005				
	Reference Book(s): 1. Heather Williamson, “ <i>XML, The Complete Reference</i> ”, McGraw Hill Education.2001 2. Frank. P. Coyle, “ <i>XML, Web Services And The Data Revolution</i> ”, Pearson Education.2002 3. James Snell, Doug Tidwell, Pavel Kulchenko, “ <i>Programming Web Services with SOAP</i> ”, O’Reilly publishers. 2002 E-References https://puniversity.informaticsglobal.com:2229/login.aspx				
	Topics relevant to “SKILL DEVELOPMENT”: Case studies of design and development of web services for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE233/CSE306	Course Title: Cloud Computing Type of Course: Theory	L-T-P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		Basics of Distributed Computing, Service Oriented Architecture				
Anti-requisites		nil				
Course Description		This Course is designed to impart the knowledge of Cloud Computing as a new computing paradigm. The course explores various Cloud Computing terminology, principles and applications. The course also demonstrates the different views of the Cloud Computing such as theoretical, technical and commercial aspects.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Cloud Computing and attain Employability through Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">Describe fundamentals of cloud computing, virtualization and cloud computing services.Explain security and standards in cloud computing. Discuss Cloud mechanisms to optimize the QoS parameters. Develop applications using Cloud services and VM instances.				
Course Content:						
Module 1				10 Sessions		
	Introduction to Cloud Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Technology Examples, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Economics of Cloud					
Module 2				10 Sessions		
	Virtualization Techniques Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization.					
Module 3				09 Sessions		
	Cloud QoS and Management Cloud Infrastructure Mechanisms, SLAs, Specialized Cloud Mechanisms, Cloud Management Mechanisms, Cloud Security Mechanisms.					
Module 4				09 Sessions		
	Cloud Platforms, Advances in cloud: introduction to Amazon Web Services: Introduction to Google App Engine , Introduction to Microsoft Azure .					

	Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Cloud
	Text Book <ol style="list-style-type: none"> 1. John Rittinghouse and James Ransome, “Cloud Computing, Implementation, Management and Security”, CRC Press. 2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education.
	References <ol style="list-style-type: none"> 1. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press. 2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill. <p>Web resources: https://puniversity.informaticsglobal.com:2229/login.aspx</p>
	Topics relevant to development of “Skill Development Aws, Azure, APIs, Aneka Cloud Platform, EC2, Installation of VM Workstation, Infrastructure Security Challenges for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE307	Course Title: Data Mining Type of Course: Discipline Elective/ Theory Only Course	L- T- P- C	3	0	0	3
Version No.		2.0				
Course Pre-requisites		Students are expected to be familiar with the basics of Linear Algebra, Probability and Statistics and should have a knowledge on DBMS.				
Anti-requisites		NIL				
Course Description		Introduction, Applications, issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, different approaches for classification, clustering, outlier detection. Recent trends in data mining.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Employability through Problem Solving Methodologies				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Apply the various pre-processing techniques needed for a data mining task.• Understand the functionality of the various data mining algorithms.• Appreciate the strengths and limitations of various data mining models.• Understand the advances in data mining for real life applications.				
Course Content:						
Module 1	Introduction to Data Mining	Assignment		Data Collection	5 Sessions	
	Topics: Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Merits and Demerits.					
Module 2	Data preprocessing	Quiz		Problem Solving	9 Sessions	
	Topics: Types of data – Pre Processing steps – Data Preprocessing Techniques – Similarity and Dissimilarity measures.					
Module 3	Data Mining – Frequent Patterns	Assignment		Problem Solving	7 Sessions	
	Topics: Market Basket Analysis, item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FPGrowth.					
Module 4	Classification and clustering	Assignment		Problem Solving	11 Sessions	
	Classification and Clustering Decision tree Induction – Bayesian classification –Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve					

	classification accuracy. Clustering Analysis – portioning method – Hierarchical methods – Density based method													
Module 5	Outlier detection & Data mining trends	Assignment		Problem Solving										
5 Sessions														
Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining- Demonstration of Weka tool.														
Project work/Assignment:														
Assignments 1. From the dataset given, find the Entropy, Gain value of the attributes and also draw the decision tree using entropy for the given dataset. 2. Transactional Data Base, D given below which contains set of items find the frequent item set using the Apriori Algorithm and generate the Association Rules. Minimum Support count is 2%. Minimum confidence is 60%.														
<table><tr><td>T_{id}</td><td>Items</td></tr><tr><td>10</td><td>1, 3, 4</td></tr><tr><td>20</td><td>2, 3, 5</td></tr><tr><td>30</td><td>1, 2, 3, 5</td></tr><tr><td>40</td><td>2, 5</td></tr></table>					T _{id}	Items	10	1, 3, 4	20	2, 3, 5	30	1, 2, 3, 5	40	2, 5
T _{id}	Items													
10	1, 3, 4													
20	2, 3, 5													
30	1, 2, 3, 5													
40	2, 5													
Text Book T1 T1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining” ,Pearson Education, 2016.														
References R1 Han J & Kamber M, “Data Mining: Concepts and Techniques”, Elsevier, Second Edition, 2006 R2 G K Gupta, “Introduction to Data Mining with Case Studies”, PHI, Third Edition, 2014. R3 Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, Tata McGraw – Hill Additional web-based resources W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012. W2. https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWWhvc3QtbGl2ZQ%3d%3d#AN=377411 &db=nlebk 3. https://nptel.ac.in/courses/105105157														
Topics relevant to “EMPLOYABILITY SKILLS”: Data Mining Techniques, FP Growth for developing Employability Skills through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.														

Course Code: CSE225	Course Title: Introduction to Combinatorics and Graph Theory Type of Course:		L- P- C	3	0	3
Version No.	2.0					
Course Pre-requisites	Discrete Mathematical Structures					
Anti-requisites	NIL					
Course Description	This course is a blend of the mathematical techniques applicable to Computer science, Information Technology and Statistics. Graph Theory gives us, both an easy way to pictorially represent many major mathematical results, and insights into the deep theories behind them. In this course, among other intriguing applications, we will see how GPS systems find shortest routes, how engineers design integrated circuits, how biologists assemble genomes, why a political map can always be colored using a few colors. Topics Include: Principles of Inclusion and Exclusion, Rook Polynomial, Derangements. Graph Theory: Graph Terminologies, Isomorphism, Coloring, Matching, Planar Graphs, Trees Terminologies, Traversals, Spanning Trees, Shortest path algorithms, Prefix Codes.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Introduction to Combinatorics and Graph Theory and attain SKILL DEVELOPMENT through PROBLEM SOLVING Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Discuss the fundamental concepts of Graph theory, theorems of matching, connectivity, coloring, and planar graphs. [L2: Comprehension] CO2: Discuss different types of trees and traversal techniques. [L2: Comprehension] CO3: Apply different algorithms to find optimal path for a given graph. [L3: Applications] CO4: Application of different mathematical proofs techniques in proving theorems. [L3: Applications]					
Module 1	Principles of Counting	Assignment and Quiz	Comprehension based Quizzes and Assignment	12 Sessions		
The Principle of Inclusion and Exclusion, Generalizing Inclusion – Exclusion Principles, Derangements – Nothing is in its Right Place, First order and second order homogeneous recurrence relations – Non-homogeneous recurrence relations, Generating functions –Exponential generating function.						
Module 2	Introduction to Graph Theory	Assignment and Quiz	Comprehension based Quizzes and Assignment	18 Sessions		
Basic Concepts: definition, types of graphs, Graph Terminology and Special Types of Graph, representation of a graph and connectedness graph: (paths, walk. cycles, edge deleted and vertex deleted). Graph isomorphism, Eulerian graph, Hamiltonian graph, Planar graph (three utility problem), Graph traversal- BFS, DFS, Transport network-Max-flow/Min-cut algorithm ,Graph coloring.						
Module 3	Trees	Assignment and Quiz	Comprehension based Quizzes and Assignment	18 Sessions		

<p>Tree: Definitions, properties, Binary search tree, Rooted trees-M-ary tree, weighted tree, Prefix code-Huffman code, Game Tree, Decision tree, Tree traversal: in-order, pre-order, post-order, infix, postfix, prefix, spanning tree,</p> <p>Algorithm on networks: Shortest path algorithm- Dijkstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm.</p>
<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
<p>Text Book</p> <ol style="list-style-type: none"> 1. K H Rosen, "Discrete Mathematics and its Application", McGraw Hill. 2. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004.
<p>References</p> <ol style="list-style-type: none"> 1. Harris, Hirst and Mosshinghoff," Combinatorics and Graph theory", Springer. [R1] 2. Grimaldi," Graph Theory and Combinatorics", Pearson Education. [R2] 3. J Nestril and etal," Introduction to Discrete Mathematics", Oxford University Press. [R3]
<p>Weblinks</p> <p>https://puniversity.informaticsglobal.com:2229/login.aspx</p>
<p>Topics relevant to "SKILL DEVELOPMENT": Rooted trees-M-ary tree, weighted tree, Prefix code-Huffman code, Game Tree for Skill Development through Problem Solving Methodologies. This is attained through assessment component mentioned in the course handout.</p>

Course Code: CSE218	Course Title: Human-Computer Interaction				L- T- P- C	3	0	0	3
Version No.	2.0								
Course Pre-requisites	Basic knowledge of HTML and web design								
Anti-requisites									
Course Description	This course highlights the fundamental theories to introduce students about the basic concepts of human-computer interaction. It will cover the theory and methods that exist in the field. Human-computer interaction is an interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design, and many other areas. It stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. It helps in categorizing the interfaces based on the processes, methods and programming used. It focuses on applications of emerging fields in human computer interaction.								
Course Objective	The objective of the course is to familiarize the learners with the concepts of Human Computer Interaction and attain Skill Development through Participative Learning techniques.								
Course Out Comes	On successful completion of the course the students shall be able to: 1) Identify the factors influencing user interfaces; [Knowledge] 2) Apply guidelines, principles, theories and methodologies for designing interfaces; [Application] 3) Select user interfaces based on interface design evaluation. [Comprehension] 4) Identify the applications of emerging fields in human computer interaction; [Comprehension]								
Course Content:									
Module 1	Introduction to HCI	Knowledge						20 Sessions	
Introduction to HCI – Importance of HCI - Human Perception - Input output channels, Human memory, Thinking: Reasoning and problem solving, Emotion, Psychology and the design of interactive systems – Cognition – Cognitive frameworks – Models of interaction, Frameworks and HCI – Ergonomics – Universal usability.									
Module 2	Interface design	Application						10 Sessions	
Good and Bad design – Interaction design – Guidelines – Principles – Theories – The process of design – Prototyping and Construction - Conceptual design – Physical design – The four pillars of design – Development methodologies – Participatory design – Scenarios development – Social impact statement for early design review – Legal issues.									

Module 3	Evaluating interface design	Comprehension		11 Sessions
Evaluating interface design – Evaluation, Goals of evaluation, Expert Reviews, Usability testing and Laboratories, Survey Instruments, Acceptance Tests, evaluating during Active Use, Controlled Psychologically Oriented Experiments, Choosing an evaluation method, Natural Language in Computing				
Module 4	Information presentation	Term paper/Assignment	Comprehension	9 Sessions
Information presentation – Data type by task taxonomy, Challenges for Information Visualization – Groupware – Goals of collaboration and participation, Asynchronous distributed interfaces, Synchronous distributed interfaces, Face to Face interfaces - Speech and auditory interfaces – Multi modal interaction - Design for diversity – Graphical user interfaces – The web mobile devices.				
Targeted Application & Tools that can be used:				
Assignment:				
<ol style="list-style-type: none"> 1. Explain the role of cognition in human computer interaction. 2. Explain any three expert review methods 				
Text Book				
T1. Ben Shneiderman and Catherine Plaisant, “ <i>Designing the User Interface: Strategies for Effective Human-Computer Interaction</i> ”, 6 th Edition, Pearson Addison Wesley, 2016. T2. Dix A. et al. “ <i>Human-Computer Interaction</i> ”, 3 rd Edition, Pearson Prentice Hall, 2004.				
References				
R1. Yvonne Rogers, Helen sharp, Jenny Preece, “Interaction Design: Beyond Human Computer Interaction”, 5 th Edition, Wiley, 2019. R2. The Essentials of Interaction Design, Fourth Edition by Cooper, Reimann, Cronin, & Noessel (2014).				
E-Resources				
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live				
Topics relevant to the development of SKILLS:				
<ol style="list-style-type: none"> 1. Screen navigation and flow 2. Statistical graphics 3. Human interaction speeds 4. Icons and increases – Multimedia 				
for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE325	Course Title: Introduction to Bioinformatics Type of Course: General CSE Basket, Theory based			L- P- C	3	0	3
Version No.	2.0						
Course Pre-requisites	Basics of Biology, basics of Computers.						
Anti-requisites	NIL						
Course Description	This course is designed to provide the knowledge of the concepts related to bioinformatics. The course is aimed at understanding the DNA and Protein sequences and databases. It also deals with Pairwise comparison and calculating the scoring matrix. Further, it focuses on Sequence Alignment techniques, discovering the Motifs in the sequence. Students will also learn the overview of Structural Bioinformatics and Genome sequencing.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Introduction to Bioinformatics and attain Employability through Participative Learning techniques.						
Course Outcomes	C.O.1: Understand the DNA Protein sequence and structures. (Bloom's Level: Knowledge) C.O.2: Explain the file formats and sequence alignments of DNA sequence. (Bloom's Level: Comprehension) C.O.3: Apply the techniques of the motifs discovery for the analysis of Protein Sequence. (Bloom's Level: Application)						
Course Content:							
Module 1	Fundamentals of Bioinformatics	Quiz	Comprehension based Quizzes and assignments;			9 Classes	
Topics: Introduction to Bioinformatics: Introduction to molecular biology, Cell, DNA, RNA, Transcription, Translation, Folding, Gene Structure, Introduction to Bioinformatics, Components and fields of bioinformatics, Omics, basic principles of structural/functional analysis of biological molecules, Biological Data Acquisition, Types of DNA sequences, Genomic DNA, Mitochondrial DNA, DNA Sequencing tools, Protein sequencing and structure determination methods, Finding Reverse complement of a sequence.							
Module 2	Genome and Similarity databases Sequence	Quizzes and assignments	Comprehension based Quizzes and assignments			8 Classes	
Topics: Types and classification of genome databases, DNA sequence retrieval system, various DNA and protein sequence file formats, Common sequence file formats; Files for multiple sequence alignment; Files for structural data, Frequent words and k-mers in Text, String Reconstruction problem, Sequence Similarity searching, Sequence Similarity searching tools, NCBI BLAST, PSI BLAST, Significance of sequence alignments, Alignment scores and gap penalties.							
Module 3	DNA sequence analysis and applications	Quizzes and assignments	Comprehension based Quizzes and assignments			10 Classes	

Sequence similarity searches and alignment tools, Finding alignment using Needleman-Wunsch and Smith-Waterman algorithm, Heuristic Methods of sequence alignment, Pair-wise and multiple sequence alignments, DNA sequence analysis, Motif in protein sequence ,Motif discovery using Gibbs sampling,Motif finding, Gene Prediction models: Hidden Markov model(HMM), Generalized Hidden Markov model(GHMM), Bayesian method.

Targeted Application & Tools that can be used:

BLAST, FastA, , ClustalW, MEGA

Project work/Assignment:

Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments

Textbook(s):

1. Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2004.
2. Introduction to Bioinformatics, Arthur Lesk, Fifth Edition, Oxford University Press, 2019

References

1. Bioinformatics Methods and Applications, S. C. Rastogi, N.Mendiratta, P.Rastogi, Fourth Edition, Prentice Hall India.
- 2.Bioinformatics Algorithms- An Active Learning Approach, Phillip Compeau & Pavel Pevzner, 2nd Edition, Vol. I & II, Active Learning Publishers, 2015

E-References

1. <https://puniversity.informaticsglobal.com:2229/login.aspx>

Topics related to development of “Employability skills”: Batch wise presentations on selected topics

1. String Reconstruction problem
2. Sequence Similarity searching
3. Alignment scores and gap penalties
4. Protein sequencing
5. Gene Prediction models: Hidden Markov model(HMM)
6. Finding similarities by performing pairwise and multiple sequence alignment,
7. Evaluating phylogenetic trees.

for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE396	Course Title: Software Testing and Quality assurance		L- T-P- C	2	0	2	3
	Type of Course: Lab Integrated						
Version No.	2.0						
Course Pre-requisites	Basic knowledge of software engineering and programming knowledge						
Anti-requisites							
Course Description	<p>This Course is designed to make the students understand the strategies, methods and technologies of software testing effectively. It aims at Designing test plans and test cases, doing automatic testing; reporting on software defects; assessing the software product correctly; and distinguish the relationship between software testing and quality assurance. In addition, students are expected to do a group assignment on software testing tools of their choice.</p> <p>Topics include: Testing techniques, integration, code inspection, peer reviews, verification and validation, statistical testing methods, preventing and detecting errors, selecting and implementing project metrics, and defining test plans and strategies that map to system requirements. Testing principles, formal models of testing, all aspects of quality assurance, performance measuring and monitoring.</p>						
Course Objective	This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIAL LEARNING Techniques.						
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Describe the fundamentals of software testing for Quality assurance 2. Select the appropriate Testing type to test Applications/Softwares 3. Report the bugs found in Testing 						
Course Content:							
Module 1	Basics of software testing	Knowledge					8 Sessions
Phases of Software Project, Quality, Quality assurance and Quality Control, Testing, Verification and Validation, Life Cycle Models. Software Testing life Cycle (STLC)							
Module 2	Types of testing	Comprehension					10 Sessions
Introduction to White Box Testing, Static Testing, structural Testing. Challenges in White Box Testing, Fundamentals of Black Box Testing, When and How to do Black Box Testing. Problems on Boundary value Analysis. Equivalence Partition, Problems on Equivalence Partition							
Module 3	TYPES OF TESTING, continued	Comprehension					12 Sessions
Integration Testing overview, Integration Testing as a Phase of Testing, Defect Bash System Testing Overview, Functional and Non-Functional Testing, Acceptance Testing. Compatibility Testing , Stress and Interoperability Testing , Test case Preparation.							
Module 4	Specialized testing techniques	Comprehension					9 Sessions
Performance Testing, Regression Testing, Internationalization Testing, Ad-hoc testing Defect Life Cycle, Bug Reporting, Basics of Software Test Automation, Metrics, Metrics Types, Project Metrics.							
Targeted Application & Tools that can be used: MS office							
Assignment: Writing Test Cases and Bug Reports for simple Applications							

Text Book

1. . Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education

References

- 1 Aditya P. Mathur, “Foundations of Software Testing _ Fundamental Algorithms and Techniques”, Pearson Education.
2. KshirasagarNaik, PriyadarshiTripathy “Software Testing and Quality Assurance Theory and Practice”, Wiley and sons.

E-Resources

<https://puniversity.informaticsglobal.com:2229/login.aspx>

Topics relevant to “EMPLOYABILITY SKILLS”:

1. Black Box testing
2. White Box Testing
3. Test Case preparations
4. Bug Reports

for developing **Entrepreneurial Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE 299	Course Title: Data Analytics using R Type of Course: Integrated	L- T- P- C	2	0	2	3
Version No.		2.0				
Course Pre-requisites		Fundamentals of Computers and Basic Knowledge of Statistics.				
Anti-requisites		NIL				
Course Description		This course is designed to provide the core concepts of data analytics in the R environment. Initially train them with basic R, then progressively increase the difficulty as they move along in the course, capping with advanced techniques through case studies. Mastering the core concepts and techniques of data analytics in R, will help the students to apply their knowledge to a wide range of Data Analytics. R is now considered one of the most popular analytics tool in the world.				
Course Objective		This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIAL LEARNING Techniques				
Course Outcomes		On successful completion of this course the students shall be able to: 1). Apply basic R functions pertaining to fundamental data analysis. [Application] 2). Interpret data using appropriate statistical methods. [Application] 3). Demonstrate the decision trees concept with the given dataset. [Application] 4). Demonstrate the Mining concepts for both Data and Text. [Application]				
Course Content:						
Module 1	Introduction to Data Analysis and R	Quiz		Coding Assignment	6 Sessions	
	Topics: Introduction to R, Overview of data analysis, Working with Directory in R, Loading and Handling data in R, Exploring Data in R, Classification of Data: Structured, Semi-Structured, Applications of Data Analytics, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages.					
Module 2	Exploratory Data Analytics	Coding Assignment		Case Study	11 Sessions	
	Topics: Exploring a new dataset, Anomalies in numerical data, Visualizing relations between variables, Analysis of Variance and Correlation, Data Transformation, Merging Data Frames, Outlier Detection, Combining multiple vectors, Assumptions of Linear Regression, Simple and multi linear regression, KNN, Support Vector Machine, Logistic Regression, PCA.					
Module 3	Decision Tree and Clustering	Coding Assignment		Project	12 Sessions	

	Topics: What is Decision Tree, Decision Tree Representation in R, Basic Decision Tree Learning Algorithm, Measuring Features, Issues in Decision Tree Learning, performance evaluation of Decision tree. Basic concepts of Clustering, Hierarchical Clustering, k-means Algorithm, CURE Algorithm.				
Module 4	Association Rules and Text Mining	Quiz		Project	8 Sessions
	Topics: Frequent Itemset, Mining Algorithm Interfaces, Distance-based Clustering Transaction and Associations, Definition of Text Mining, A few Challenges in Text Mining, Text Mining Vs Data Mining, Text Mining in R, Core Text Mining Operations.				
	Targeted Application & Tools that can be used: Tools: RStudio / Google Colab				
	Project work/Test:				
	During the course, students would need to do coding assignments to learn to train and use different models. Sample coding assignments include: Analysis of Sales Report of a Clothes Manufacturing Outlet. Comcast Telecom Consumer Complaints. Web Data Anslsysis				
	Text Book(s): 1. Data Analytics Using R – Seema Acharya, Mc Graw Hill.				
	Reference(s): 1. Exploratory Data Analytics Using R, Ronald K Pearson, CRC Press				
	Web link(s): 1. https://r4ds.had.co.nz/ 2. https://puniversity.informaticsglobal.com:2229/login.aspx				
	Topics relevant to “Entrepreneurial SKILLS”: <ol style="list-style-type: none"> 1. Linear Regression 2. Logistic Regression 3. K-means Algorithm 4. Hierarchical clustering 5. CURE Algorithm 6. Decision Tree Learning <p>for developing Entrepreneurial Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>				

Course Code: CSE3006	Course Title: Artificial Intelligence and Neural Networks		L-T-P-C	3	0	0	3
	Type of Course: Theory only						
Version No.		2.0					
Course Pre-requisites		NIL					
Anti-requisites		NIL					
Course Description		<p>This Course highlights the basic principles in Artificial Intelligence. It will cover representation schemes, problem solving paradigms, , search strategies, knowledge representation, probabilistic reasoning, elements of Artificial Neural Network.</p> <p>Topics include: AI methodology and fundamentals, intelligent agents, search algorithms, game playing, probabilistic reasoning in AI, Elements of Artificial Neural Network, models of neuron, architecture and learning laws. Several assignments will be given to enable the student to gain practical experience in using these techniques.</p>					
Course Objective		<p>The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Neural Networks and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques</p>					
Course Out Comes		<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. CO 1: Apply techniques of Knowledge Representation [Application] 2. CO 2: Apply Artificial Intelligence techniques for problem solving [Application] 3. CO3: Understand the models of Neuron [Knowledge] 4. CO4: Explain the basic elements of Artificial Neural Network [Comprehension] 					
Course Content:							
Module 1	Introduction to Artificial Intelligence and Knowledge Based Systems	Assignment		Theory			14 Sessions
	<p>Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agent, Structure of Intelligent agent and its functions; Introduction to Knowledge representation, approaches, Knowledge-Based Systems; Frame Structures, Conceptual graphs. Logic- Propositional Logic, First order Logic</p>						
Module 2	Problem Solving by Searching	Assignment		Theory			13 Sessions
	<p>Topics: Introduction to Problem space and state space, State space search techniques solving problems by searching: Classical Search, Adversarial Search, and Constraint Satisfaction Problems, Introduction to reasoning, Probabilistic reasoning in AI, Bayesian networks, Hidden Markov Model, Certainty factors, rule-based systems and Demster Shafer Theory.</p>						

Module 3	Introduction to Artificial Neural Network	Assignment		Theory	9 Sessions
	Topics : Introduction to learning, Forms of Learning: Statistical learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning, Learning rules of AI, Learning Laws. Historical Development of Neural Network Principles, Characteristics of Neural Networks and Artificial Neural Networks: Terminology, Models of Neuron				
Module 4	Essentials of Artificial Neural Network	Assignment		Theory	07 Sessions
	Topics: Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Single-Layer Feed forward Networks, Multilayer Feed forward Networks, Types of Application				
	Targeted Application & Tools that can be used: Use of PowerPoint software for lecture slides and use of Google's Colab cloud service https://www.tutorialspoint.com/google_colab/index.html for executing and sharing of lab exercises.				
	Text Books <ol style="list-style-type: none"> 1. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, (2002) 3rd edition, Upper Saddle River, Prentice Hall. 2. Yegnanarayana, Bayya. Artificial neural networks. PHI Learning Pvt. Ltd., 2009. 				
	References <ol style="list-style-type: none"> 1. N J Nilsson (1997). Artificial Intelligence- A new synthesis, Elsevier Publications. 2. N J Nilsson (1982). Principles of Artificial Intelligence, Springer. 3. Elaine Rich, Kevin Knight and Shivashankar B. Nair, "Artificial Intelligence", Tata McGraw- Hill, Third Edition, 2009 [R.N.]. 4. Patterson, D. W. (1990). Introduction to artificial intelligence and expert systems. Englewood Cliffs, Prentice Hall. 5. Luger, G. F. (2002). Artificial intelligence: Structures and strategies for complex problem solving, Harlow, Pearson Education. 6. Simon Haykin (2009), Neural Networks and Learning Machines, Third Edition, PHI 7. Laurene Fausett (2004), Fundamentals Of Neural Networks, Prentice-Hall, Inc, USA E-References <ol style="list-style-type: none"> 8. https://presiuniv.knimbus.com/user#/home 				
	Topics relevant to development of "EMPLOYABILITY SKILLS": <ol style="list-style-type: none"> 1. Statistical Concepts for Knowledge representation. 2. Classical Search 3. Constraint Satisfaction Problems 4. Conceptual graphs 5. Multilayer Feed forward Networks for developing Employability Skills through Problem Solving methodologies . This is attained through assessment component mentioned in course handout.				

Course Code: CSE397	Course Title: Digital and Mobile Forensics Type of Course: Theory				L- T- P- C	3	0	0	3
Version No.		2.0							
Course Pre-requisites		Operating System, Computer Networks.							
Anti-requisites		Nil							
Course Description		This course demonstrates the use of Mobile phones and digital devices across the globe has increased dramatically. These devices are more susceptible to information security attacks and thus they also possess huge evidences which shall be used during crime scene investigation. This makes the Course on mobile and digital forensics an inevitable one for the security professionals. This Course on mobile and digital forensics will provide a better understanding on different forms of evidences in many digital devices, collection and interpretation of the same. Topics include: Wireless technologies and security-wireless protocols, wireless threats, cell phones and GPS, SMS and data interception in GSM. Mobile phone forensics - files present in SIM card, device data, external memory dump, Android forensics. Digital forensics: - evaluating digital evidence, Digital forensics examination principles							
Course Objective		The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain EMPLOYABILITY SKILLS through PARTICIPATIVE Learning techniques							
Course Outcomes		On successful completion of this course the students shall be able to: CO 1: Outline the basic concepts of Cybercrime and digital Forensics. (L1) CO 2: Employ various digital Forensic tools to perform Forensic investigation(L3) CO 3: Interpret security challenges and Forensic examination process of wireless devices. (L2) CO 4: Produce digital evidence through the usage of mobile device Forensic tools (L3)							
Course Content:									
Module 1	Cybercrime and Digital Forensic Principles	Assignment		Seminar		10 Sessions			
	Cybercrime: Definition, Nature and Scope of Cyber crime, Types of cyber crime, Categories of cyber crime, Investigating Cybercrime, Digital Evidence, Prevention of cyber crime, Overview of Digital Forensics, Phases of Digital Forensics, Digital devices in society, Evidential Potential of Digital Devices: closed and open systems, Digital investigation process models: Staircase Model, Evidence Flow Model, Increasing awareness of digital evidence, Case studies on Cyber Crimes.								
Module 2	Digital Forensics examination process	Case Studies		Case Study		11 Sessions			
	Language of Computer crime investigation, preparing a Digital Forensics Investigation, Chanllenging aspects of digital evidence, Presenting digital evidence, Device usage, Profiling and cyberprofiling, Contamination, Digital forensics examination principles: Previewing, Imaging, Continuity and hashing, Evidence locations, A seven-element security model, A developmental model of digital systems.								

Module 3	Wireless technologies and Wireless threats	Quiz		GSM, Parben's Cell Seizure	12 Sessions
	Overview of Modern Wireless Technology, Wireless Crime Prevention Techniques, War-Driving, War-Chalking, War Flying, Voice SMS, GSM and Identification Data Interception in GSM, Cell Phone Hacking and Phreaking, Who's Tracking You and Your Cell Phone? How Does Cellular Fraud Occur? Cell Phone Forensics, Forensic Rules for Cellular Phones, Cell Phone Flowchart Processes Using Paraben's Cell Seizure.				
Module 4	Mobile phone Forensics	Quiz	Forensic Tools		10 Sessions
	Importance and Motivation behind Mobile Forensics, Mobile Phone Forensics: Crime and Mobile Phones, the Evidence, Forensic Procedures of mobile phones, The SIM Card, Files Present in SIM Card, Device Data, SMS Spam, What Data Is Available from Mobile Phones?, Handling Instructions for Mobile Phones, Mobile Phone Forensics Tools and Methods, Social Media Forensics on Mobile Devices.				
	Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • Wireless Security • Digital Forensics • Android Forensics 				
	Textbooks: T1 Gregory Kipper, "Wireless Crime and Forensic Investigation", Auerbach Publications, 1st Edition, September 19, 2019.				
	References: R1 Losif I. Androulidakis, "Mobile phone security and forensics: A practical approach", Springer publications, 2nd Edition, 2016. R2 Andrew Hoog, "Android Forensics: Investigation, Analysis and Mobile Security for Google Android", Elsevier publications, 1st Edition, 15th June 2011. R3 Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, November 2008, p 180. Web references: https://presiuniv.knimbus.com/user#/home				
	Topics relevant to "Employability": <ol style="list-style-type: none"> 1. Prevention of cybercrime 2. preparing a Digital Forensics Investigation 3. Mobile Phone Forensics: Crime and Mobile Phones. 4. Mobile Phone Forensics Tools for developing Employability Skills through Participative Learning techniques . This is attained through assessment component mentioned in course handout.				

Course Code: CSE2051	Course Title: Information Retrieval			L-T-P- C	3	0	0	3
	Type of Course: Theory Only Course							
Version No.	1							
Course Pre-requisites	Basic Knowledge in Data Structures and algorithms and probability and statistics, background in machine learning							
Anti-requisites	NIL							
Course Description	The course studies the theory, design and implementation of Text-based information systems. The Information Retrieval core concepts of the course include statistical characteristics of text, representation of information needs and documents. Topics Include Several important retrieval models (Basic IR Models, Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model, Latent Semantic Indexing Model, Neural Network Model). Retrieval Evaluation, Retrieval Metrics, Text Classification and Clustering algorithms, Web Retrieval and Crawling. Recommender Systems: Basics of Content-based Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Information Retrieval and attain SKILL DEVELOPMENT through Participative Learning techniques							
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval. [Knowledge] CO2: Evaluate the effectiveness and efficiency of different information retrieval methods. [Application] CO3: Explain different indexing methodology requirements and the concept of web retrieval and crawling. [Comprehension] CO4: Classify different recommender system and its aspect. [Comprehension]							
Course Content:								
Module 1	Introduction to Information Retrieval	Assignment	Data collection				7 Sessions	
	Information Retrieval – Early Developments – The IR Problem – The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes							
Module 2	Modeling and Retrieval Evaluation	Assignment	Problem solving				10 Sessions	
	Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.							
Module 3	Indexing & Web-Retrieval	Term paper/Assignment	Data analysis				8 Sessions	
	Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing. The Web – Search Engine Architectures – Cluster based Architecture - Search Engine Ranking –							

	Link based Ranking – Simple Ranking Functions, Evaluations — Search Engine Ranking – Applications of a Web Crawler.			
Module 4	Recommender System	Term paper/Assignment	Problem solving	8 Sessions
	Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models.			
	Targeted Application & Tools that can be used: Information Retrieval System, Collaborative Filtering System, Feedback System, Evaluation Metrics			
	Assignment:			
	Group assignment, Quiz			
	Text Book T1 Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —”Modern Information Retrieval: The Concepts and Technology behind Search”, Third Edition, ACM Press Books, 2018. Link: https://people.ischool.berkeley.edu/~hearst/irbook/ T2 Ricci, F, Rokach, L. Shapira, B.Kantor, —”Recommender Systems Handbook”, Fourth Edition, 2018.			
	References R1 Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —” <i>Information Retrieval: Implementing and Evaluating Search Engines</i> ”, The MIT Press, 2017. R2 Jian-Yun Nie Morgan & Claypool – “ <i>Cross-Language Information Retrieval</i> ”, Publisher series 2011. R3 Stefan M. Rüger Morgan & Claypool – “ <i>Multimedia Information Retrieval</i> ”, Publisher series 2014. R4 B. Liu, Springer, - “ <i>Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data</i> ”, Second Edition, 2013. R5 C. Manning, P. Raghavan, and H. Schütze, —”Introduction to Information Retrieval”, Cambridge University Press, 2015. Link: https://nlp.stanford.edu/IR-book/ Web Based Resources and E-books: https://puniversity.informaticsglobal.com/login			
	Topics relevant to the development of SKILLS: Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood models for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.			

Course Code: CSE2036	Course Title: Programming in C++ Type of Course: Discipline Elective Theory & Integrated Laboratory		L-T-P-C	1	0	4	3
Version No.		2.0					
Course Pre-requisites		C with Arduino CSE 1002					
Anti-requisites		Nil					
Course Description		The main goal of this course is to study the fundamentals of object-oriented paradigm with concepts of streams, classes, functions, data, and objects. The course aims to provide the basic characteristics of OOP through C++, to impart skills on various kinds of overloading and inheritance, to introduce pointers and file handling in C++ together with exception handling mechanism.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Programming in C++ and attain Employability through Experiential Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 2. Explain the need and features of OOP and idealize how C++ differs from C. 3. Understand knowledge on various types of overloading and streams. 4. Choose suitable inheritance while proposing solution for the given problem. 5. Implement the concept of pointers and effective memory management, illustrate the application of pointers in virtual functions. 6. Apply the attained knowledge by applying the learned techniques to solve various real-world problems.					
Course Content:							
Module 1	Introduction to object-oriented programming	Quiz		Programming/ Problem Solving		07 Hours	
	Topics: Beginning with C++ and its features: Introduction to C++, Applications and structure of C++ program, Different Data types, Variables, Different Operators, expressions, Control structures, arrays, Functions, Inline function, function overloading. [Blooms ‘level selected: Comprehension]						
Module 2	Classes and Objects, Static member	Lab evaluation		Programming/ Problem Solving		08 Hours	
	Topics:						

	Functions, classes and Objects: Define class, data members and member functions (methods), method overloading, arrays within a class, array of objects, static members, pointers in C++, new and delete. [Blooms 'level selected: Comprehension]				
Module 3	Constructors, Destructors and Operator overloading, Strings	Lab evaluation		Programming/Problem Solving	07 Hours
	Topics: Constructors, Destructors and Operator overloading: Constructors, constructor overloading, copy constructor, Destructors, Polymorphism: operator overloading, Overloading Unary and binary operators, friend function, operator overloading using friend function, strings and its operators. [Blooms 'level selected: Application]				
Module 4	Inheritance, Virtual Functions, Polymorphism	Lab evaluation/ Assignment		Programming/Problem Solving	08 Hours
	Topics: Inheritance, Pointers, Virtual Functions, Polymorphism: Define inheritance, base and derived Classes, types of inheritance: Single, multilevel, multiple inheritance, Multi-Path inheritance, Pointers to objects and derived classes, "this" pointer, Run time polymorphism: Virtual functions and pure virtual functions. [Blooms 'level selected: Application]				
Module 5	Streams and Working with files, Templates, Manipulators	Assignment		Programming /Problem Solving	05 Hours
	Topics: Streams and Working with files: Controlling output with manipulators, Templates: Function templates and class templates. [Blooms 'level selected: Comprehension]				
	List of Laboratory Tasks: Experiment No 1: Demonstrate control structures, arrays, inline functions. [2 hours: Application Level] Level 1: Demonstrate control structures in C++. Level 2: Use of arrays in C++. Experiment No. 2: Demonstrate the use of functions, inline functions and function overloading. [2 hours: Application Level] Level 1: Use of functions and inline function. Level 2: Use of function overloading. Experiment No. 3: Demonstrate the working of classes, objects, member functions and method overloading. [2 hours: Application Level] Level 1: Understand use of classes, objects, member functions. Level 2: Use of method overloading. Experiment No. 4: Demonstrate the working of array of objects, static members, new and delete. [2 hours: Application Level] Level 1: Understand use of array of objects.				

	<p>Level 2: Use of static members, new and delete.</p> <p>Experiment No. 5: Implement the concept of constructors, destructors, constructor overloading and copy constructor. [2 hours: Application Level] Level 1: Understand the concept of constructors and destructors and strings. Level 2: Understand the concept of constructor overloading and copy constructor.</p> <p>Experiment No. 6: Implement the concept of operator overloading and friend function. [2 hours: Application Level] Level 1: Use of binary operator overloading. Level 2: Importance of friend function in operator overloading.</p> <p>Experiment No. 7: Implement the use of inheritance. [2 hours: Application Level] Level 1: Understand the concept of single, multi-level inheritance. Level 2: Passing arguments to base and derived classes using constructors.</p> <p>Experiment No.8: Implement the use of Virtual functions. [2 hours: Application Level] Level 1: Understand the concept of constructor in derived class. Level 2: Understand the concept of virtual function.</p> <p>Experiment No.9: Apply the knowledge of manipulators and function templates [2 hours: Application Level] Level 1: Understand the concept manipulators. Lever 2: Understand the concept of function template.</p> <p>Experiment No.10: Apply the knowledge of class templates. [2 hours: Application Level] Level 1: Understand the class templates. Lever 2: Real time scenario problem to cover all the concepts.</p>
	<p>Targeted Application & Tools that can be used: Application Area is to understand and apply concept of object oriented concepts using C++. Tools/Simulator used: GCC compiler/ Linux terminal.</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
3.	<p>4. Problem Solving: Understanding different OOPS and implementation of programs. 3. Programming: Implementation of given scenario using C++.</p>
	<p>Text Book 2. Herbert Schildt, “C++: The Complete Reference”, McGraw Hill Education, 4th Edition, 2017. 3. Behrouz A. Forouzan, Richard F. Gilberg, “ C++ Programming: An Object-Oriented Approach”, McGraw Hill Education, 1st edition, 2022.</p>
	<p>References 2. Robert Lafore, “Object Oriented Programming using C++”, Galgotia publication, 2010. 3. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Education, 2004. 4. Stanley B. Lippman and Josee Louie, “C++ Primer”, Pearson Education, 2003. 5. K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, “Mastering C++”, TMH, 2003. 6. E. Balaguruswamy, “Object Oriented Programming with C++”, TMH, 6th Edition, 2013.</p>

	Topics relevant to “ EMPLOYABILITY SKILLS ”: Object, Class, Inheritance, Polymorphism, Abstraction, Encapsulation for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.
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Course Code: CSE2032	Course Title: Introduction to Fog Computing Type of Course: 1] Discipline Elective 2] Lab Integrated Course	L-T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course will provide a solid base for understanding the challenges and problems underlying the design and development of fog computing systems and applications. Thus, this course will teach how to specify, design, program, analyze and implement such systems and applications. Fog computing is a decentralized computing infrastructure in which data, compute, storage and applications are located somewhere between the data source and the cloud. Like edge computing, fog computing brings the advantages and power of the cloud closer to where data is created and acted upon. Many people use the terms fog computing and edge computing interchangeably because both involve bringing intelligence and processing closer to where the data is created. This is often done to improve efficiency, though it might also be done for security and compliance reasons.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Introduction to Fog Computing and attain SKILL DEVELOPMENT through Problem Solving techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 1. Understand the basic principles and concepts of fog computing systems and their relation to other models such as Cloud Computing and Near-Far computing. 2. Understand the challenges of developing fog based applications and middleware, and the possible solutions. 3. Specifically, understand the issues mostly related to fog computing, namely: introduction to the fog programming model and related models, security, offloading, Software Defined Network, load balancing, communication, containers and orchestration, application areas. 4. Able to decide which is the best approach for a particular problem regarding the design and development of a fog computing system. 5. Able to design and implement an application using containers. 6. Able to measure and analyze the performance of a fog computing application.					

Course Content:					
Module 1	INTRODUCTION TO FOG COMPUTING	Assignment	Programming activity		11 Sessions
	Topics: Fog Computing, Characteristics, Application Scenarios, Issues and challenges. Fog Computing, Internet of Things-Pros and Cons-Myths of Fog Computing -Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT , FOG, CloudBenefits.				
Module 2	ARCHITECTURE	Assignment	Programming activity		10 Sessions
	Topics: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles. Fog Computing Communication Technologies: Introduction ,IEEE 802.11,4G,5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.				
Module 3	FOG PROTOCOLS AND COMMUNICATION TECHNOLOGIES	Assignment	Programming activity		10 Sessions
	Topics: Fog Protocol-Fog Kit- Proximity Detection Protocols- DDS/RTPS computing protocols, Introduction ,IEEE 802.11,4G,5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range				
Module 4	MANAGEMENT AND ORCHESTRATION	Assignment	Programming activity		11 Sessions
	Topics: Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background , Network Slicing in 5G , Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog , Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds , IoT Integration , Security Management for Edge Cloud Architectures. Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.				
Module 5	FOG COMPUTING REQUIREMENTS WHEN APPLIED TO IOT	Assignment	Programming activity		11 Sessions
	Topics: Fog computing requirements when applied to IoT: Scalability,Interoperability,Fog-IoT: architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, DataManagement,filtering,EventManager,DeviceManagement,cloudification,virtualization, security and privacy issues. Integrating IoT,Fog, Cloud Infrastructures: Methodology , Integrated C2F2T Literature by Modeling Technique re by Use-Case Scenarios , Integrated C2F2T Literature by Metrics.				

	<p>Targeted Application & Tools that can be used: Case Study: Wind Farm - Smart Traffic Light System, Wearable Sensing Devices, Wearable Event Device ,Wearable System, Demonstrations , Post Application Example . . Event Applications Example.</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya. 2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by RajkumarBuyya and Satish Narayana Srirama. 3. Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things Paperback by SudipMisra , Subhadeep Sarkar , Subarna Chatterjee. <p>Web Links:</p> <p>Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya. Fog Computing Wiley Online Books</p> <p>Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by RajkumarBuyya and Satish Narayana Srirama. Fog and Edge Computing: Principles and Paradigms Wiley</p> <p>Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things Paperback by SudipMisra , Subhadeep Sarkar , Subarna Chatterjee. Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of (routledge.com)</p>
	<p>References</p> <ol style="list-style-type: none"> 1. FlavioBonomi, Rodolfo Milito, Jiang Zhu, SateeshAddepalli, —Fog Computing and Its Role in the Internet of Thingsl, MCC’12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978-1-4503-1519-7/12/08... \$15.00. 2. Shanhe Yi, Cheng Li, Qun Li, —A Survey of Fog Computing: Concepts, Applications and Issuesl, Mobidata’15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China.. 3. Amir M. Rahmani ,PasiLiljeberg, Preden, Axel Jantsch, —Fog Computing in the Internet of Things - Intelligence at the Edgel, Springer International Publishing, 2018. 4. Ivan Stojmenovic, Sheng Wen, “The Fog Computing Paradigm: Scenarios andSecurity Issues”, Proceedings, Federated Conference on Computer Science and Information Systems, pp. 1–8, 2014 5. Fog Computing: Helping the Internet of Things Realize its Potential Amir VahidDastjerdi and RajkumarBuyya, University of Melbourne. 6. Multi-Dimensional payment Plan in Fog Computing with Moral Hazar,YanruZhang,Nguyen H. Tran,DusitNiyato, and Zhu Han,IEEE,2016
	<p>Topics relevant to “SKILL DEVELOPMENT”:</p> <p>Fog Computing requirements for SKILL DEVELOPMENT through Problem Solving Techniques. This is attained through the assessment component mentioned in course handout.</p>

Course Code: CSE3046	Course Title: DevOps Tools And Internals Type of Course: Theory & Integrated Laboratory			L-T-P-C	2	0	2	3
Version No.		1.2						
Course Pre-requisites		Fundamentals of Devops						
Anti-requisites		NIL						
Course Description		<p>This course is designed to offer profound perceptions and knowledge in various tools like Git, Ansible, Selenium and Jekins. With the proficient learning of DevOps course, a student will be able to work in all the above tools and become a trained practitioner in the integration and monitoring of software.</p> <p>DevOps Tool is an application that helps the software development process to industrialize. It mainly focuses on communication and collaboration between product management, software development, and operations professionals. The objective of this course is to discuss and implement the various tools usage and internals practically.</p>						
Course Objective		The objective of the course is to familiarize the learners with the concepts of DevOps Tools And Internals and attain Skill Development through Experiential Learning techniques.						
Course Out Comes		<p>On successful completion of this course the students shall be able to:</p> <p>1] Apply the features and common Git workflow. [Application]</p> <p>2] Practice the filters and plugins to populate, manipulate, and manage data used by Ansible Playbooks. [Application]</p> <p>3] Compute the features of selenium IDE. [Application]</p> <p>4] Interpret the installation and features of Jenkins and build jobs. [Application]</p>						
Course Content:								
Module 1	Git		Quiz		Quiz on Git commands		5L +4P Classes	
	Topics: Introduction to Git, Features of Git, Benefits, Workflow, Git vs GitHub, Installation of Git on Windows/Linux and Environment set up, All Git Commands-Working with local and							

	remote repositories, Running first Git command, Fundamentals of Repository structure and file status life cycle, Working locally with staging, unstaging and commit.				
Module 2	Containerization Docker	Using Quiz		Quiz on Ansible tool usage	5L +4P Classes
	Topics: Docker Life Cycle,Docker Installation, Docker Operations,Docker Concepts - Registry, Repository, Tag, Image and Containers, Create A Docker Hub Account, Docker Images and Containers, Pushing Docker To Container Hub, Docker File.				
Module 3	Ansible	Assignment		Assignments on Selenium tool usage and test case	5L +4P Classes
	Topics: Ansible Workflow, Architecture, Installation in Linux/Windows, ad-hoc Commands, Playbooks, Tower, Roles, Variables open link, Tags, Galaxy, Commands Cheat Sheets, Modules, Shell, Templates, YAML, Inventory, Debug, Apt, Lineinfile, Copy, Command, File, Vault, Windows, Yum, AWX, Unarchive, Ansible Pip				
Module 4	Jenkins	Assignment	Assignments on Jenkins tool usage and Build jobs	5L +4P Classes	
	Topics: Introduction To Continuous Integration, Jenkins Architecture, Managing Nodes On Jenkins, Jenkins Master Node Connection, Jenkins Integration With Devops Tools, Understanding CI/CD Pipelines, Creating A CI/CD Pipeline				
	List of Laboratory Tasks: Git 1. Level 1: Installation of Git on windows Level 2: Git commands-Local repositories Level 2: Git commands-Remote repositories 2. How Git can handle automatically file modifications when they are not related to the same lines of text. Level 1: You are in a new repository located in C:\Repos\Exercises\Ch2-1. Level 1: You have a master branch with two previous commits: the first commit with a file1.txt file and the second commit with a file2.txt file. Level 2: After the second commit, you created a new branch called File2Split. You realized that file2.txt is too big, and you want to split its content by creating a new file2a.txt file. Do it, and then commit the modifications. 3. How to resolve conflicts when Git cannot merge files automatically. Level 1: You are in the same repository used earlier, C:\Repos\Exercises\Ch2-1. On the master branch, you add the file3.txt file and commit it.				

	<p>Level 2: Then, you realize that it is better to create a new branch to work on file3.txt, so you create the File3Work branch. You move in this branch, and you start to work on it, committing modifications.</p> <p>Level 2: The day after, you accidentally move to the master branch and make some modifications on the file3.txt file, committing it. 5. Then, you try to merge it.</p> <p>4. Level 1: Installation of Ansible Level 2: Create a basic inventory file Level 2: Running your first Ad-Hoc Ansible command.</p> <p>Ansible</p> <p>5. Ansible Archive Level 1: Compressing the Directory with TAR and tar and gz Level 1: Compress the file – Default File Compress format and Remove the Source files after archiving Level 2: Create a ZIP file archive – File and Directory Level 2: Create a BZIP archive – File and Directory</p> <p>6. A Quick Syntax of Ansible Shell module – ADHOC Level 1: A Quick Syntax of Ansible Shell module in a Playbook Level 1: Ansible Shell Examples Level 2: Execute a Single Command with Ansible Shell Level 2: Execute a Command with Pipe and Redirection</p> <p>7. Level 1: Run playbook Level 2: Create the file on the target machines or servers as mentioned in the inventory file and the webserver's group, save the below code with .yaml extension and run the playbook. Level 2: Create multiple directories. To create multiple directories with one single task you can use the loop with_items statement. So when you run the below playbook it is interpreted as 3 different tasks.</p> <p>Selenium</p> <p>8. Level 1: Selenium IDE Download and Install Level 2: Selenium IDE - First Test Case, Login Test and command usage</p> <p>9. Level 1: Write a script to open google.co.in using chrome browser (ChromeDriver). Level 2: Write a script to open google.com and verify that title is Google and also verify that it is redirected to google.co.in.</p> <p>10. Level 1: Write a script to open google.co.in using internet explorer (InternetExplorerDriver). Level 2: Write a script to create browser instance based on browser name.</p> <p>11. Level 1: Write a script to close all the browsers without using quit() method. Level 2: Write a script to search for specified option in the listbox</p>
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	<p>Jenkins</p> <p>12. Level 1: Environment Setup</p> <p>Level 2: Jenkins downloading and installation</p> <p>13. Level 1: 1. Setup a Jenkins Job with Apache Ant Build Tool 2. Setup a Jenkins Job with Apache Maven</p> <p>Level 2 : 1. Setup a Jenkins Job with Batch Script.</p> <p>14. Level 1: Add a Linux Node (Also Check SSH Slaves plugin plugins) Level 1: Add a Windows Node Level 2: Assign a Java Based Job to Linux and Build it Level 2: Assign a MSBuild Based to Windows and Build it</p>
	<p>Targeted Application & Tools that can be used:</p> <p>Tracking changes in the source code and source code management Automates web browsers Configuration Management and IT automation. Integration of Individual Jobs and Effortless Auditing Tools: Git, Ansible, Selenium and Jenkins</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
	<p>Each batch of students (self-selected batch mates) will identify projects from searching on Google and implement with the most suitable 2 or 3 antecedents.</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. Craig Berg, “<i>DevOps For Beginners: A Complete Guide to DevOps Best Practices (Including How You Can Create World-Class Agility, Reliability, And Security In Technology Organizations With DevOps)</i> (Code tutorials)”, Paperback – June 12, 2020. 2. Ferdinando Santacroce, “<i>Git Essentials</i>”, Packt Publishing, April 2015, ISBN: 9781785287909 3. John Ferguson Smart. “<i>Jenkins: The Definitive Guide</i>”, O'Reilly Media, Inc., July 2011, ISBN: 9781449305352
	<p>References</p> <ol style="list-style-type: none"> 1. Jeff Geerling, “<i>Ansible for DevOps: Server and configuration management for humans</i>”, Leanpub, August 5, 2020 2. Unmesh Gundecha, Carl Cocchiaro, “<i>Learn Selenium</i>”, Packt Publishing, July 2019, ISBN: 9781838983048 3. Gaurav Agarwal, “<i>Modern DevOps Practices: Implement and secure DevOps in the public cloud with cutting-edge tools, tips, tricks, and techniques</i>”, July 2021. 4. Mikael Krief, “<i>Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps</i>”, October 2019 <p>Weblinks:</p>

	<ol style="list-style-type: none"> 1. https://git-scm.com/book/en/v2 2. https://www.simplilearn.com/tutorials/git-tutorial/git-tutorial-for-beginner 3. https://www.javatpoint.com/selenium-tutorial 4. https://www.javatpoint.com/ansible 5. https://www.tutorialspoint.com/jenkins/jenkins_managing_plugins.htm 6. https://nptel.ac.in/courses/128106012
	Topics relevant to “SKILL DEVELOPMENT”: Git&Junit, Ansible, Selenium, Jenkins for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3045	Course Title: Development Automation		L-T-P-C	2	0	2	3
	Type of Course: Elective in Devops Basket Theory & Integrated Laboratory						
Version No.		1.0					
Course Pre-requisites		NIL					
Anti-requisites		Scripting Language Knowledge, Linux Fundamentals					
Course Description		The Objective of this course is to give a strong foundation of the Development Automation. DevOps refers to the integration of an organization’s development (dev) and operations (ops) teams. It encompasses an organization’s culture, processes, and philosophies. DevOps tools enable faster development cycles and higher software quality. DevOps speeds delivery of higher quality software by combining and automating the work of software development and IT operations teams.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Development Automation and attain SKILL DEVELOPMENT through Experiential Learning techniques.					
Course Outcomes		On successful completion of the course, the students shall be able to <ol style="list-style-type: none"> Understand the automated software delivery and deployment process[Knowledge] Analyze the various automation scenarios .[Comprehension] Demonstrate the interaction with linux environment[Application] Implement scripts[Application] Implement makefiles to automate tasks[Application] 					
Course Content:							
Module 1	Introduction to Automation	Assignment/Quiz	Fully Automated Software delivery process				06 Session

Topics: The Software Delivery Pipeline, Overview of the Continuous Delivery Pipeline, Fully Automated Software Delivery Process, The Build Process, Automated build, Automated Test, Automated Deployment, Benefits of Automated Deployment, Automated Deployment and DevOps Adoption, Automated Deployment and DevOps Adoption, Overview of Rapid Application Development (RAD), Phases in RAD, Essential Aspects of RAD, Code generation, Categories of Code Generators, Common. Assignment: The build process				
Module 2	Advantages of Automation	Case study	Automation scenarios	06 Session
Topics: Advantages of Automation, Automation Scenarios, Archiving Logs, Auto-Discard Old Archives, MySQL (RDBMS) Backups, Email Web Server Summary, Ensure Web Server is Running, User Command Validation, Disk Usage Alarm, Sending Files to Recycle Bin, Restoring Files from Recycle Bin, Logging Delete Actions, File Formatter, Decrypting Files, Bulk File Downloader, System Information, Install LAMP Stack, Get NIC's IP, Scenarios Where Automation Prevents Errors . Assignment: Email web server summary				
Module 3	Interacting with Linux Environment	Case study	Linux File system	06 Session
Topics: The Linux System, Linux File System, Partitions, Common System Directories, Shell, User Groups and Permissions, User Accounts, The passwd File, Creating User Accounts, File Ownership, File Permissions, Working with Bash, Shell Features Assignment: Linux File System				
Module 4	Scripting Development Tasks	Case study	Linux commands	06 Session
Topics: Writing Automation Scripts, Task Scheduling Using Cron, Basic Linux Commands, Best Practices for Scripting, Make use of Shell's Built-In Options, Naming Conventions, Annotations Make the Logic Clean, Command Substitution, Always Begin with a Shebang, Variable Substitution, Conditionals, Regular Expressions. Assignment: Shell's built-in options				
Module 5	"Make" and "Makefiles"	Case study	Makefile arguments and source code creation	06 Session
Topics: Why "Make"? Why not Others?, Why not use "Bash Script" instead of "Makefile"?, features of "Make", Various versions and Variants of "Make", Structure of a "Makefile", What is a Rule?, Structure of a "Makefile" Rule, Targets, Some Special Built-in Target Names, Automatic Variables, Suffix Rules, Pattern Rules, The "Make" command, "Make" arguments, recursive makefile, Building Binary from				

	<p>Source Code, Conditionals in “Makefile”, Best Practices in writing “Makefiles”.</p> <p>Assignment: Best practices in writing Makefiles</p>
	<p>List of Laboratory Tasks:</p> <p>Experiment No 1: Working with Basic Linux Commands, make use of shells built in options, naming conventions, Level 1: basic linux commands Level 2: Advanced linux commands</p> <p>Experiment No 2: Working with Linux File System, Partitions, Common System Directories Level 1: Simple commands for exploring partitions, common system directories Level 2: configuring linux system</p> <p>Experiment No 3: Working with writing automation scripts Level 1: Simple automation scripts Level 2: Complicated automation scripts</p> <p>Experiment No 4: Working with variable substitution, conditionals, regular expressions Level 1: Simple regular expressions, conditionals Level 2: Advanced regular expressions, conditionals</p> <p>Experiment No 5: creation of makefile , Structure of makefile Level 1: Simple makefile creation Level 2: Advanced program on makefile</p> <p>Experiment No 6: Working with automatic variables, pattern rules , make command Level 1: Basic pattern rules, make command Level 2: Advanced pattern rules</p> <p>Experiment No 7: Building binary from source code Level 1: basic binary from source code Level 2: Advanced binary from source code</p> <p>Experiment No 8: Working with Conditionals in “Makefile”, Best Practices in writing “Makefiles Level 1: Basic conditionals in makefile Level 2: Advanced conditions and best practices in writing makefiles</p>
	<p>Targeted Application & Tools that can be used: Application Area includes Online Financial Trading Company, Network Cycling, Car manufacturing industries, Airlines industries, GM Financial, Bug Reduction. Companies like Amazon, Target, Esty, Netflix, Google, Walmart use Devops in their day to day processes to increase efficiency and improve delivery time.</p> <p>Professionally Used Software: Red hat Linux Operating system, GIT</p> <p>Besides these software tools Visual studio code also used</p> <p>Project work/Assignment:</p>

	<p>1. Case Studies: At the end of the course students will be given a real-world scenario for any application on automating software development and deployment process, automation scenarios, working with linux environment using script and makefile.</p> <p>2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link.</p> <p>3. Presentation: There will be a group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.</p>
	<p>Text Book(s):</p> <p>a. Running Linux – Book by Matthias Kalle Dalheimer, Matt Welsh b. Mastering Linux Shell Scripting – Book by Andrew Mallett .</p>
	<p>Reference(s): Reference Book(s):</p> <p>1. DevOps Handbook: How to Create World-Class Agility, Reliability and Security in Technology Organizations – IT Revolution Press; Illustrated edition (October 6, 2016), Gene Kim, Jez Humble, Patrick Debois, John Allspaw and John Willis 2. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale 1st Edition, O'Reilly Media; 1st edition (May 30, 2016), Jennifer davis, Ryn daneils</p> <p>Online Resources (e-books, notes, ppts, video lectures etc.):</p> <p>Coursera:</p> <p>1. DevOps on AWS Coursera 2. DevOps, Cloud, and Agile Foundations Coursera 3. Introduction to DevOps Coursera</p> <p>E-books :</p> <p>1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii 2. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Simple automation Scripts, Linux commands for SKILL DEVELOPMENT through Experiential Learning Techniques. This is attained through the assessment component mentioned in the course handout.</p>

Course Code: CSE 3043	Course Title: Automated Test Management Type of Course: Integrated				L-T- P- C	2	0	2	3
Version No.		1.0							
Course Pre-requisites		Introductory course on Software Engineering.							
Anti-requisites		NA							
Course Description		This course is intended for understanding the principles of automation and the application of tools for the analysis and testing of software. The automated analysis encompasses both approaches to automatically generate a very large number of tests to check whether programs meet requirements, and also means by which it is possible to prove that software meets requirements and that it is free from certain commonly-occurring defects, such as divide-by-zero, overflow/underflow, deadlock, race-condition freedom, buffer/array overflow, uncaught exceptions, and several other commonly-occurring bugs that can lead to program failures or security problems. The learner will become familiar with the fundamental theory and applications of such approaches, and apply a variety of automated analysis techniques on example programs.							
Course Objective		The objective of the course is to familiarize the learners with the concepts of Automated Test Management and attain SKILL DEVELOPMENT through Experiential Learning techniques.							
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand testing in DevOps.• Learn its approaches to testing.• Understand to design test cases.							
Course Content:									
Module 1			CA1		Lab Experiments	10 Sessions			
	Topics: Seven Principles - SDLC vs STLC - Testing Life Cycle - Usability Testing - Functional Testing - End to End Testing - Compatibility Testing - GUI Testing - API testing.								
Module 2			CA2		Lab Experiments	10 Sessions			
	Topics: Usability Testing - Functional Testing - End to End Testing - Compatibility Testing - GUI Testing - API testing.								
Module 3			CA3		Lab Experiments	10 Sessions			
	Topics: Manual Testing - Automation Testing - Unit Testing - Integration Testing - Smoke-Sanity Testing - Regression Testing , Reasons for Automated Testing: Controlling Costs, Application Coverage, Scalability, Repeatability.								
Module 4			CA4		Lab Experiments		10 Sessions		

	Topics : Test Scenario - Test Case Design - Test Basis - Traceability Matrix				
Module 5		CA4	Lab Experiments		8 Sessions
	Topics : ESTIMATION TECHNIQUES :Estimating automation - Test Plan Document - Bug Life Cycle				
	List of Laboratory Tasks: Introduction and installation of DevOps. SDLC, STLC, GUI and API testing modules. Unit Testing and Integration testing modules. Creating test scenarios. Bug Life Cycle				
	Targeted Application & Tools that can be used DevOps				
	Project work/Assignment:				
	Assignment: CA1, CA2, CA3, CA4				
	Text Book T1.Flexible Test Automation - by Vitaliano Inglese, Pasquale Arpaia T2.Experiences of Test Automation: Case Studies of Software Test Automation - by Mark Fewster, Dorothy Graham				
	References Web resources: W1. https://presiuniv.knimbus.com/user#/home				
	Topics relevant to “SKILL DEVELOPMENT”: Unit testing, Functional testing for Skill Development through Experiential Learning Techniques . This is attained through assessment component mentioned in course handout.				

Course Code: CSE 3040	Course Title: Agile Structures and Frameworks Type of Course: School Core	L-T- P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		Software Engineering				
Anti-requisites		NIL				
Course Description		This course imparts knowledge to students in the basic concepts of Agile Software Process, methodology and its development The objective of this course is to provide the fundamentals concepts of Agile and its Significance. This course covers the Agile and its methodologies. The objective of the course is to understand the Agility and Assurance.				
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Agile Structures and Frameworks and attain Skill Development through Participative Learning techniques.				
Course Out Comes		On successful completion of this course the students shall be able to: 1] Understand the basic concepts of Agile Software Process. (Knowledge level) 2] Comprehend the various Agile Methodologies. (Comprehension level) 3] Develop Agile Software Process. (Knowledge level) 4] Apply principles of Agile Testing. (Application level)				
Module 1	Introduction	Assignment		Agile Estimation		08 Sessions
	Introduction to Agile technology, Iterative and Evolutionary Methods, Agile – Agile Development. Agile Values, Agile Principles, Compare and Contrast the agile with traditional methods. Agile Benefits. Agile Estimation Techniques. Case Study					
Module 2	Agile and Its Significance	Assignment		Comparison of Agile technologies with traditional methods		09 Sessions
	Agile Story : Evolutionary delivery ,Scrum Demo, Planning game, Sprint back log, adaptive planning. Agile Motivation – Problems With The Waterfall - Research Evidence. Scrum : Method Overview ,Life cycle phases and Work product roles and practices.					
Module 3	Agile methodology			Case Study		12 Sessions
	Extreme Programming: Method Overview ,Life cycle phases and Work product roles and practices. Unified process : Method Overview ,Life cycle phases and Work product roles and practices. EVO : Method Overview ,Life cycle phases and Work product roles and practices. Case Study.					
Module 4	Agility and Quality Assurance	Assignment		Apply the testing concepts using Programing		09 Sessions

	Agile product development – Agile Metrics – Feature Driven Development (FDD). Agile approach to Quality Assurance. Test Driven Development – Agile approach in Global Software Development. Agile Technology Tools.
	Targeted Application & Tools that can be used: JIRA
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1.	<ol style="list-style-type: none"> 2. Agile Estimation 2. Comparison of Agile technologies with traditional methods 3. Case Study: Student group must collaborate and report together along with assigned batch members. Collect the requirements from the client and adopt the suitable agile practice method for your project 4. Installation and features of JIRA tool.
	Text Book 1] Craig Larman, “Agile and Iterative Development – A Manager’s Guide”, Pearson Education – 2006 2] Edward Scatter “Brilliant Agile Project Management: A Practical Guide to Using Agile, Scrum and Kanban, 2015
	References 1] Chetankumar Patel, Muthu Ramachandran, Story Card Maturity Model (SMM): A Process Improvement Framework for Agile Requirements Engineering Practices, Journal of Software, Industry Publishers, Vol 4, No 5 (2009), 422-435, Jul 2009. 2] Hazza& Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer 2009 3]Kevin C. Desouza, Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann, 2007. Web resources: https://presiuniv.knimbus.com/user#/home
	Topics relevant to "SKILL DEVELOPMENT": Agile Estimation techniques for skill development through Participative Learning techniques . This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3145	Course Title: Intrusion Detection and Prevention System		L- T- P- C	3	0	0	3
	Type of Course: 1] Program Core 2] Theory Only						
Version No.		1.0					
Course Pre-requisites		Fundamental knowledge in Operating Systems, Information Security and Networks					
Anti-requisites		NIL					
Course Description		Objective of the course is to Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise. Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems and Analyze intrusion detection alerts and logs to distinguish attack types from false alarms.					
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Intrusion Detection and Prevention System and attain Skill Development through Participative Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand about the intruders.• Define intrusion detection and prevention policies• Explain the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets.• Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.					
Course Content:							
Module 1	Introduction to Intrusion Detection and Prevention System	Assignment	Programming Task		10 Sessions		
Topics Understanding Intrusion Detection – Intrusion detection and prevention basics – IDS and IPS analysis schemes, Attacks, Detection approaches –Misuse detection – anomaly detection – specification based detection – hybrid detection. Internal and external threats to data, Need and types of IDS, Information sources,Host based information sources, Network based information sources.							
Assignment: Demonstrating the skills to capture and analyze network packets using network packet analyzer.							

Module 2	Intrusion Prevention System	Assignment	Programming Task	10 Sessions
<p>Topics: Intrusion Prevention Systems, Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques, Responses, requirement of responses, Types of responses, mapping responses to policy Vulnerability analysis, credential analysis, non-credential analysis. Architecture models of IDs and IPs.</p> <p>Assignment: Applying Intrusion detection in security applications.</p>				
Module 3	Applications and tools	Assignment	Programming/Data analysis task	12 Sessions
<p>Topics: Tool Selection and Acquisition Process – Bro Intrusion Detection – Prelude Intrusion Detection – Cisco Security IDS – Snorts Intrusion Detection – NFR security. Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes</p> <p>Assignment: Demonstrate the working with Snort Rules, Rule Headers, Rule Options and The Snort Configuration File.</p>				
Module 4	Legal issues and organizations standards	Assignment	Programming/Data analysis task	9 Sessions
<p>Law Enforcement / Criminal Prosecutions – Standard of Due Care – Evidentiary Issues, Organizations and Standardizations.</p> <p>Assignment: Addressing common legal concerns and myths about Intrusion Detection system</p> <p>Textbooks T1. Carl Endorf, Eugene Schultz and Jim Mellander “ Intrusion Detection & Prevention”, 1st Edition, Tata McGraw-Hill, 2004. T2. Earl Carter, Jonathan Hogue, “Intrusion Prevention Fundamentals”, Pearson Education, 2006.</p>				
References				

	<p>R1. Rafeeq Rehman : “ Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID,” 1st Edition, Prentice Hall , 2003.</p> <p>R2. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna: “Intrusion Detection and Correlation Challenges and Solutions”, 1st Edition, Springer, 2005.</p> <p>R3. Paul E. Proctor, “The Practical Intrusion Detection Handbook “,Prentice Hall , 2001.</p> <p>Weblinks: https://www.youtube.com/watch?v=RYB4cG8G2xo https://www.coursera.org/lecture/detecting-cyber-attacks/intrusion-detection-systems-UeDqJ</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Agent development for intrusion detection for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE2040	Course Title: Cyber threats for IOT and Cloud			L- T-P- C	3	0	0	3
	Type of Course: 1] Program Core 2] Theory Only							
Version No.		1.0						
Course Pre-requisites		Cyber Security, Information Security and Networks						
Anti-requisites		NIL						
Course Description		Objective of the course is to understand the most important cyber threats for IOT and Cloud. Cyber attackers discover new possibilities in the areas of Internet of Things and cloud services. It mainly focuses on multiple security challenges facing the IoT and cloud computing especially concerns surrounding privacy and cyber security threats of the users and the how can the cyber risks relating to them be mitigated.						
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Cyber threats for IOT and Cloud and attain Skill Development through Participative Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand the different types of cyber threats for IOT and cloud• Develop a deeper understanding and familiarity with various types of cyber-attacks, cybercrimes, vulnerabilities and remedies thereto.• Plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.						
Course Content:								
Module 1	Introduction to IOT and Cloud computing	Assignment	Programming Task		12 Sessions			
	Topics What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IOT Architecture and protocols, Various platforms for IoT, Real-Time examples of IoT, Overview of IoT components and IoT communication Technologies. Introduction to Cloud Computing, The Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Distributed Systems, Virtualization, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies. Assignment:							
	Module 2	Cyber Threats	Assignment	Programming Task	8 Sessions			

Topics: What are Cyber Security Threats? Common Sources of Cyber Threats, Types of Cyber security Threats-Malware attacks, Social Engineering attacks, Supply chain attacks, Man-in-the middle Attack, Threat Detection Tools, Cyber Defense for Individuals. Assignment:				
Module 3	Cyber Threats in Internet of Things	Assignment	Programming/Data analysis task	10 Sessions
Topics: IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats-Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats. Assignment:				
Module 4	Cyber Threats in Cloud computing	Assignment	Programming/Data analysis task	9 Sessions
Topics: Cybersecurity Threats to Cloud Computing-Identity First Security, Cloud misconfiguration, Denial of Service, Insider Threats, Reduced Infrastructure Visibility, Unauthorized use of Cloud workloads, Insecure API's, Compliance and regulation issues, Mitigating cyber risks in cloud computing Assignment:				
Text Books T1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives" ,Wiley India Pvt Ltd,2013 T2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743) T3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education				
References R1. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons,2018 R2. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014				

	<p>R3. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9</p> <p>Weblinks:</p> <p>https://www.coursera.org/learn/cloud-security-basics</p> <p>https://www.imperva.com/learn/application-security/cyber-security-threats/</p> <p>https://presiuniv.knimbus.com/user#/home</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”:</p> <p>Cyber threats in IoT and Cloud Computing for skill development through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.</p>

Course Code: CSE 3097		Course Title: Web Security			L- T-P- C	2	0	2	3
Version No.		1							
Course Pre-requisites		Advanced Computer networks(CSE3070)							
Anti-requisites		NIL							
Course Description		The purpose of this course this course is to introduce you to the field of web security by understanding web functionality and various security validations. The web is our gateway to many critical services and is quickly evolving as a platform to connect all our devices. Web vulnerabilities are growing on a year-to-year basis and designing secure web applications is challenging. The course covers fundamental concepts of web security principles, web vulnerability and exploitation, various attacks on web applications, and a few basic topics on web encryption.							
Course Objective		The objective of the course is to familiarize the learners with the concepts of Web Security and attain Skill Development through Experiential Learning techniques.							
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">Define the fundamentals of web applications and validation [Knowledge]Recognize the significance of password and authentication in web applications [Comprehension]Explain the importance of session management in web [Comprehension]Apply web attack techniques to find vulnerabilities in web applications [Application]							
Course Content:									
Module 1		Introduction	Quiz		Comprehension based Quiz on web fundamentals			10 Sessions	
	Topics: Web Functionality, Encoding Schemes, Mapping the Application - Enumerating the Content and Functionality, Analyzing the Application Bypassing, Client-Side Controls: Transmitting Data Via the Client, Capturing User Data, Handling Client-Side Data Securely - Input Validation, Blacklist Validation - Whitelist Validation - The Defense in-Depth Approach - Attack Surface Reduction, Rules of Thumb, Classifying and Prioritizing Threats.								
Module 2		Web Application Authentication	Assignment		Comprehensive based assignment on Web authentication			11 Sessions	
	Topics: Authentication Fundamentals- Two Factor and Three Factor Authentication, Web Application Authentication- Password Based, Built-in, HTTP, Single Sign-on, Custom Authentication, Validating credentials - Secured Password Based Authentication: Attacks against Password, Importance of Password Complexity - Design Flaws in Authentication Mechanisms - Implementation Flaws in Authentication Mechanisms - Securing Authentication.								

Module 3	Session Management & Web Security Principles	Quiz		Comprehension based Quiz on web security techniques.	11 Sessions
	Topics: Need for Session Management, Weaknesses in Session Token Generation, Weaknesses in Session Token Handling, Securing Session Management; Access Control: Access Control Overview, Common Vulnerabilities, Attacking Access Controls, Securing Access Control. Origin Policy, Exceptions, Browser security Principles- Cross Site Scripting and Cross Site Request Forgery, File Security Principles: Source Code Security, Forceful Browsing, Directory Traversals.				
Module 4	Web Application Vulnerability	Assignment		Comprehension based assignment on web vulnerabilities	10 Sessions
	Topics: Attacking data-stores and backend components- Injecting into Interpreted Contexts, injecting into SQL, NoSQL, XPath, LDAP, Injecting OS Commands, Manipulating File Paths, Injecting into XML Interpreters, Injecting into Back-end HTTP Requests, Injecting into Mail Services, Attacking application logic-real world logic flaws, Attacking users-Cross site scripting-varieties of XSS,XSS attacks in action, finding and exploiting XSS vulnerabilities, preventing XSS attacks, Other techniques-cookie based Attacks, HTTP Header Injection				
	List of Laboratory Tasks: Task 01: Practical knowledge of known vulnerabilities in CGI, LAMP stacks, REST APIs cross-site scripting Task 02: HTTP and setting up stacks, the various types of databases Access Controls, Vulnerabilities Task 03: SQL injection and prevention Task 04: Study of web authoring tools Task 05: Testing web applications Task 06: Cross site request forgery attack lab Task 07: Web tracking				
	Targeted Application & Tools that can be used 1. Wordpress tool can be used for building websites with possible vulnerabilities. 2. Tools such as Nmap and Nessus can be used for web attack demonstration.				
	Project work/Assignment:				
	Assignment: Group assignment to identify and write different web exploits to demonstrate vulnerabilities in web applications.				
	Text Book T1 Dafydd Stuttard, Marcus Pinto, “The Web Application Hacker’s Handbook”, Willey Publishing Inc.				

	<p>References</p> <p>R1 B. Sullivan, V. Liu, and M. Howard, “Web Application Security”, A B Guide. New York: McGraw-Hill Education, 2011.</p> <p>R2 Web Application Security: Exploitation and Countermeasure for Modern Web Applications, by Andrew Hoffman</p> <p>E book link R1: https://presiuniv.knimbus.com/user#/home</p> <p>E book link R2 : https://presiuniv.knimbus.com/user#/home</p> <p>Web resources:</p> <p>NPTEL / Swayam Link : Introduction to Information Security I, IIT Madras</p> <p>PU Library Link : https://nptel.ac.in/courses/106106129 https://puniversity.informaticsglobal.com/login</p>
	<p>Topics relevant to “EMPLOYABILITY SKILLS”:</p> <p>Session Management & Web Security Principles and Web Application vulnerability for Skill Development through Experiential Learning Techniques. This is attained through the assessment component mentioned in the course handout.</p>

Course Code: CSE2037	Course Title: Cyber Forensics Type of Course: Program Core			L-T- P- C	2	0	2	3
Version No.		1.0						
Course Pre-requisites		Cryptography and Network Security						
Anti-requisites		NIL						
Course Description		The purpose of this course is to introduce to the students Cyber Forensic concepts. The course is both conceptual and analytical and is understood with various open-source software's. The course develops critical thinking like correctly collect and analyze computer forensic evidence, analyze and validate Forensics Data, study the tools and tactics associated with Cyber Forensics. The course involves quizzes, assignments with various open-source software.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of <u>Cyber Forensics</u> and attain <u>Skill Development</u> through <u>Experiential Learning</u> techniques.						
Course Outcomes		On successful completion of this course the students shall be able to: (1) understand various digital investigation terminologies and methods (knowledge) (2) understand various file formats (knowledge) (3) Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications (Comprehension) (4) Apply techniques for forensic investigation (Application)						
Course Content:								
Module 1		DIGITAL INVESTIGATION	Quiz		MCQ/Based on Investigation process		No. of Sessions: 09	
	Digital Evidence and Computer Crime - History and Terminology of Computer Crime Investigation - Technology and Law - The Investigative Process -Investigative Reconstruction - Modus Operandi, Motive and Technology -Digital Evidence in the Courtroom.							
Module 2		UNDERSTANDING INFORMATION	Quiz		MCQ/Based on file format		No. of Sessions: 09	
	Methods of storing data: number systems, character codes, record structures, file formats and file signatures - Word processing and graphic file formats - Structure and Analysis of Optical Media Disk Formats - Recognition of file formats and internal buffers - Extraction of forensic artifacts– understanding the dimensions of other latest storage devices – SSD Devices.							
Module 3		COMPUTER BASICS FOR DIGITAL INVESTIGATORS	Assignment		Writing task		No. of Sessions: 09	

	<p>Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology -Steps taken by computer forensic specialists.</p> <p>Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime-Identity Theft and Identity Fraud – Organized Crime & Terrorism. Computer forensic cases: Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.</p> <p>Assignment: Computer Crime</p>				
Module 4	Computer Forensic Evidence and Data Recovery	Assignment		Writing task	No. of Sessions: 09
	<p>Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data.</p> <p>Data Collection and Data seizure: why collect evidence? - Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody. Reconstructing the Attack.</p> <p>Assignment: Data Recovery</p>				

	<p>List of Laboratory Tasks:</p> <ol style="list-style-type: none"> 1. Case Studies of Opensource Forensic Tools 2. FTK Forensic Tool kit for taking mirror image <p>Disk Forensics-</p> <ol style="list-style-type: none"> 3. Identify digital evidences 4. Acquire the evidence 5. Authenticate the evidence 6. Preserve the evidence 7. Analyze the evidence 8. Report the findings <p>Network Forensics:</p> <ol style="list-style-type: none"> 9. Intrusion detection 10. Logging 11. Correlating intrusion detection and logging <p>Device Forensics</p> <ol style="list-style-type: none"> 12. Mobile phone 13. Digital Music 14. Printer Forensics 15. Scanner Forensics 16. Credit Card Forensics 17. Telecommunications Forensics 18. Forensic Analysis of a Virtual Machine 19. Forensic analysis of Cloud storage and data remnants 20. RAM Dumping Tool
	<p>Targeted Application & Tools that can be used:</p> <ol style="list-style-type: none"> 1. FTK Forensic Toolkit 2. Encase 3. Kali Linux- Vinetto, galatta 4. Autopsy – Disk Forensics
	<p>Project work/Assignment:</p> <p>Each batch of students (self-selected batch mates) will identify projects based on the content and implement with the most suitable 2 or 3 antecedents.</p>
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2019
	<p>References</p> <ol style="list-style-type: none"> 1. Ravi Kumar & B Jain, 2006, “Cyber Forensics - Concepts and Approaches”, icfai university press 2. Christof Paar, Jan Pelzl, “Understanding Cryptography: A Textbook for Students and Practitioners”, Springer’s, Second Edition, 2010, 3. Ali Jahangiri, “Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts”, First edition, 2009 4. Computer Forensics: Investigating Network Intrusions and Cyber Crime”, Ec-Council Press, 2010. 5. C. Altheide & H. Carvey, “Digital Forensics with OpenSource Tools, Syngress”, 2011, ISBN: 781597495868., https://esu.desire2learn.com

	NPTEL: https://onlinecourses.swayam2.ac.in/cec21_ge10/preview Udemy: https://www.udemy.com/topic/digital-forensics/ E-book Link(PU): Links http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14073&query_desc=ti%2Cwrdl%3A%20CYBER%20FORENSIC
	Topics relevant to "Skill Developemnt": Cyber Forensics techniques for Skill development through Experiential Learning techniques . This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3342	Course Title: Ethical Hacking Type of Course: Discipline Elective in Cyber Security Basket		L- T-P- C	1	0	4	3
Version No.	1.0						
Course Pre-requisites	Basic networking tools knowledge and Cryptography & Network Security						
Anti-requisites	NIL						
Course Description	This course introduces students to a wide range of topics related to ethical hacking. It also provides an in-depth understanding of how to effectively protect computer networks. These topics cover some of the tools and penetration testing methodologies used by ethical hackers and provide a thorough discussion of what and who an ethical hacker is and how important they are in protecting corporate and government data from cyber-attacks						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Ethical Hacking and attain Skill Development through experiential Learning techniques.						
Course Outcomes	On successful completion of this course the students shall be able to: 1. Illustrate the importance of ethical hacking 2. Categorize the various techniques for performing reconnaissance. 3. Demonstrate various types of system scanners and their functions 4. Demonstrate the function of sniffers on a network						
Course Content:							
Module 1	Introduction to Hacking (Knowledge, Application)	Assignment	Programming activity				12 Hours
	Topics: Introduction to Hacking-Important Terminologies - Asset - Vulnerability - Penetration Test - Vulnerability Assessments versus Penetration Test - Penetration Testing Methodologies - Categories of Penetration Test. Assignment: Different phase methodologies on penetration testing						
Module 2	Linux Basics	Assignment	Programming activity				10 Hours
	Topics: Major Linux Operating Systems - File Structure inside of Linux - BackTrack - Changing the Default Screen Resolution - Some Unforgettable Basics. Assignment: Penetration testing distribution						
Module 3	Information Gathering Techniques	Assignment	Programming activity				11 Hours

<p>Topics: Sources of Information Gathering - Copying Websites Locally - NeoTrace - Xcode Exploit Scanner - Interacting with DNS Servers - DNS Cache Snooping - DNS Lookup with Fierce - SNMP - SMTP. Assignment: Domain internet groper</p>					
Module 4	Target Enumeration and Port Scanning Techniques	Assignment	Programming activity		13 Hours
<p>Topics: Target Enumeration and Port Scanning Techniques - Host Discovery - Scanning for Open Ports and Services - Types of Port Scanning - Vulnerability Assessment. Assignment: Demonstrations for port scanning</p>					
<p>List of Laboratory Tasks: Experiments:</p> <ol style="list-style-type: none"> 1. Installing BackTrack 2. Netcraft 3. Keyloggers 4. Acunetix 5. Nslookup 6. SNMP 7. Port Scanning 8. NetStumbler 9. Performing an IDLE Scan with NMAP 10. Network Sniffing 					
<p>Targeted Application & Tools that can be used: Application Software and open source tools</p>					
<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>					
<p>Any appropriate tool can be given to demonstrate i.e Sql injections.</p>					
<p>Text Book</p> <ol style="list-style-type: none"> 1. Rafay Baloch, 2014: "Ethical Hacking and Penetration Testing Guide" Apple Academic Press Inc. 					
<p>References</p> <ol style="list-style-type: none"> 2. Gary Hall, Rrin Watson, 2016: "Hacking: Computer Hacking, Security Testing, Penetration Testing, and Basic Security". 3. James Corley, Kent Backman, Michael Simpson, 2010: "Hands-On Ethical Hacking and Network Defense", 2nd Edition, Cengage Learning. 					
<p>Topics relevant to "EMPLOYABILITY SKILLS": Ethical hacking techniques for Skill Development through Experiential Learning techniques. This is attained through the assessment component mentioned in course handout.</p>					

Course Code: CSE241	Course Title: Wireless Sensor and Adhoc Networks Type of Course:1] Discipline Elective 2] Lab Integrated Course			L- T- P- C	3	0	0	3
Version No.	1.0							
Course Pre-requisites	NIL							
Anti-requisites	NIL							
Course Description	This course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, unicast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks.							
Course Objectives	The objective of the course is to familiarize the learners with the concept of Wireless Sensor and Ad-Hoc Networks for SKILL DEVELOPMENT by using PARTICIPATIVE LEARNING techniques.							
Course Out Comes	On successful completion of this course the students shall be able to: 1. Explain the basic working of the Wireless systems. (Knowledge) 2. Describe different protocols being used by wireless networks including ABR and MANETS.(Knowledge) 3. Illustrate the Fundamental Concepts and applications of ad hoc and wireless sensor networks.(Comprehension) 4. Interpret the WSN routing issues by considering related QoS measurements.(Application)							
Course Content:								
Module 1	Overview of Wireless Sensor and Adhoc Networks	Assignment	Programming activity					10 Hours
	Topics: Introduction, Sensor Network Technology background, Elements of basic Sensor Network Architecture, Survey of Sensor Networks, Network Characteristics and Challenges, Applications of Wireless Sensor Networks, Range of Applications, Category 2 WSN Applications – Home Control, Industrial Automation, Medical Applications, Category 1 WSN Applications – Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Introduction to Cellular and Adhoc Networks, Issues in Adhoc Networks – Routing, Multicasting, QoS, Security, Scalability.							
Module 2	Wireless Transmission Technology and MAC Protocols for Adhoc	Assignment	Programming activity					10 Hours

<p>Topics: Introduction, Radio Technology Primer – Propagation and Modulation, Propagation and Modulation impairments, Available Wireless Technologies, Campus Applications, MAN/WAN Applications, Medium Access Control Protocols – Fundamentals, Performance Requirements, MAC Protocols for WSNs -Schedule based Protocols and Random Access based Protocols, Sensor MAC case study, Issues in Designing MAC Protocol for Adhoc Networks - Bandwidth efficiency, QoS support, Synchronization, error-prone broadcast channel, Mobility of nodes.</p>					
Module 3	Routing Protocols for Adhoc and WSN	Assignment	Programming activity		10 Hours
<p>Topics: Background, Data Dissemination and gathering, Routing challenges, Network Scale and Time-Varying Characteristics,, Routing Strategies, characteristics of an ideal Routing Protocol for Adhoc Networks, WSN Routing Techniques, Classifications of Routing Protocols, Table-driven and on-demand Routing Protocols, Routing Protocols with efficient flooding mechanism.</p>					
Module 4	Demonstration of WSN Adhoc Network using Simulators	Assignment	Programming activity		6 Hours
<p>Topics: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools (MATLAB wireless module, NS2, etc).</p>					
<p>Targeted Application & Tools that can be used: Case Study: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools -MATLAB wireless module, NS2, etc.</p>					
<p>Text Book 1. T1: Kazem Soharby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks : Technology, Protocols and Applications, Wiley Publication, 2016, ISBN : 978-81-265-2730-4 2. T2: C. Siva Ram Murthy and B. S. Manoj, Adhoc Wireless Networks – Architecture and Protocols, Pearson Publication, 2013. ISBN : 978-81-317-0688-6 Web Links: R3: https://networksimulationtools.com/glomosim-simulator-projects/ R4 : http://vlabs.iitkgp.ac.in/ant/8/</p>					
<p>References 1. R1: Jagannathan Sarangapani, Wireless Adhoc and Sensor Networks – Protocols, Performance and Control, CRC Press 2017, e-book ISBN: 9781315221441 2. R2: Chai K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall Publisher 2007, ISBN : 0-13-007617-4 Ivan Stojmenovic, Sheng Wen, “The Fog Computing Paradigm: Scenarios and Security Issues”, Proceedings, Federated Conference on Computer Science and Information Systems, pp. 1–8, 2014 3. Fog Computing: Helping the Internet of Things Realize its Potential Amir VahidDastjerdi and RajkumarBuyya, University of Melbourne.</p>					
<p>Topics relevant to “SKILL DEVELOPMENT”: Campus Applications and Routing Protocol for Adhoc Networks for Skill Development through Participative Learning techniques. This is attained through the Presentation as mentioned in the assessment component.</p>					

Course Code: CSE 262	Course Title: CLIENT SERVER COMPUTING		L-T-P- C	3	0	0	3
	Type of Course: Theory Only						
Version No.	2.0						
Course Pre-requisites	Knowledge of Computer networks.						
Anti-requisites	NIL						
Course Description	Course description: The course covers basic concepts of client server computing, client side services, server side services, protocols for implementation of client server environment. The students will learn the concepts of client server architecture, components of client server computing, Client/Server Database Architecture, Network operating system, Middleware and RPC.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Client Server Computing and attain Skill Development through Participative Learning techniques.						
Course Out Comes	On successful completion of the course the students shall be able to: 1) Describe the basic concepts of client server computing and types of client server architecture [knowledge] 2) Discuss the components and operating system of client server computing [Comprehension] 3) Understand the Client/Server Database Computing. [Comprehension] 4) Distinguish the different category of client server applications. [Comprehension]						
Course Content:							
Module 1	Client Server System Concepts and Architecture	Assignment	Client Server Architecture		8 Sessions		
Topics: Client Server System Concepts - Introduction – Server, Clients, client – client server topology: Single Client, Multiple Clients Single Servers, Multiple clients Multiple Server. Characteristics and types of Server: File server Print server Application server Mail server. Characteristics and types of Clients: Thin and Fat clients. Client Server Architecture: Two-Tier Architecture – Three-Tier Architecture - N-Tier Architecture- client server Advantage and Disadvantage - Client /server Building Blocks							
Module 2	Client Server Computing Components and Operating system	Assignment/Quiz1	Components of Client Server Computing, Components of Server, Network operating system		8 Sessions		
Topics: Components of Client Server Computing , Client: Hardware, Operating System, communication, GUI. Role of the Client , Client Services :Request for Service , Components of Server: Server – File server, Fax server, Mail,Server Functionality in detail.Network operating system : server operating system.							
Module 3	Client/Server Database Computing	Assignment/Quiz2	Client/Server Database Architecture, Database Middleware Component		10 Sessions		

<p>Topics:</p> <p>Client/Server Database Computing: Service of client/server application. Client/Server Database Architecture: process per client architecture, multi-threaded architecture, Hybrid architecture. Database Middleware Component: API, Database translator, Network translator..Distributed Client/Server Database Systems: Web/Database System for Client/Server Applications , Design Approach.</p>				
Module 4	Client/Server Applications	Assignment/Quiz2	Categories Of Client/Server Applications, DDE, OLE	12 Sessions
<p>Topics:</p> <p>Client/Server Application: Technologies for client/server applications. Categories Of Client/Server Applications: File sharing, Database centered system, Groupware, Transactional processing. Inter Process Communication: socket interface -RPC-RMI. Dynamic Data Exchange (DDE)- Object Linking and Embedding (OLE)- Middleware - Role and Mechanism of Middleware- Types of Middleware.</p>				
<p>Targeted Application & Tools that can be used:</p> <p>This course helps the student to understand the concepts of client server architecture, components of client server computing, Client/Server Database Architecture, Network operating system, Middleware and RPC.</p>				
<p>Text Book</p> <p>T1. Robert Orfali, Dan Harkey and Jerri Edwards: Essential Client/Server Survival Guide, John Wiley & Sons Edition 3 2019</p> <p>T2. Patrick Smith & Steave Guengerich, “Client/Server Computing”. PHI 2011 Edition 2</p>				
<p>References</p> <p>R1. Subhash Chandra Yadav : An Introduction to Client/Server Computing newagepublishers; First edition January 2009</p>				
<p>E-Resources</p> <p>NPTEL course –NPTEL :: Computer Science and Engineering - NOC:Cloud computing IIT Kharagpur, Prof. Sowmya Kanti Gosh.</p> <p>https://presiuniv.knimbus.com/user#/home</p>				
<p>Topics relevant to “SKILL DEVELOPMENT”: Socket Programming, RMI and RPC for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>				

Course Code: CSE240	Course Title: Information Security Type of Course: Open Elective/ Theory Only Course	L-T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-	CSE-236 Principles of Data Communications and Computer Networks					

requisit es					
Anti- requisit es		NIL			
Course Descript ion		The course explores information security through some introductory material and helps gain an appreciation of the scope and context of information security. It includes a brief introduction to cryptography, security management, network and computer security. It allows a student to begin a fascinating journey into the study of information security and develop an appreciation of some key security concepts. The course concludes with a discussion of a simple model of the information security in industry and explores skills, knowledge and roles required for employability. A student will be able to determine and analyze potential career opportunities in this profession.			
Course Objectiv e		The objective of the course is to familiarize the learners with the concepts of Course Title as mentioned above and attain Entrepreneurship through Participative Learning techniques.			
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> • Describe the basic concept of information security. (Knowledge) • Explain the concepts and methods of cryptography. (Comprehension) • Demonstrate the aspects of risk management. (Application) • Illustrate Network Security concepts. (Application) 			
Course Content :					
Module 1	Introduction to Information Security	Assignmen t	Data Collection/Interpretatio n	08 Sessions	
	Topics: What is Information Security, The CIA Triad: Confidentiality Integrity and Availability, why study information security, Basic principles of information system security, Information classification, A model for Network Security.				
Module 2	Introduction to Cryptography	Assignmen t	Basics and Interpretation	13 Sessions	
	Topics: Introduction to Cryptography, Role of cryptography in information security, OSI Security architecture, Security Attacks, Security Services, Security Mechanism, Types of Cryptography, Overview of Public and Private Key Cryptography.				
Module 3	Information Security Management & Risk Analysis	Quiz	Questions Set	9Sessions	
	Topics: Information Security Managements, Security Policy, Standards and Procedures, Risk Analysis of Information Security, Risk Analysis.				
Module 4	Securityin Networks	Quiz	Questions Set	8Sessions	
	Topics: Biometrics for security, Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, IP Security, Web Security, Intrusion Detection, Firewalls.				

<p>Targeted Application & Tools that can be used:</p> <p>This course helps the students to understand the concepts related to information and network security. InfoSec provides coverage for cryptography, mobile computing, social media, as well as infrastructure and networks containing private, financial, and corporate information, and tools includes Web vulnerability, scanning tools, Antivirus software, Network intrusion detection, Packet sniffers, Firewall tools.</p>
<p>Project work/Assignment:</p>
<p>Project Assignment:</p> <p>1) Projects for students interested in this Antivirus, Online Fund Transfers with DES Encryption, Firewall Web Application.</p> <p>Assignment:</p> <p>1] What do you understand by Risk, Vulnerability & Threat in a network?</p> <p>2] What are the response codes that can be received from a Web Application?</p> <p>3] What is the difference between Symmetric and Asymmetric encryption?</p>
<p>Text Book</p> <p>T1: Information Security: The Complete Reference, Second Edition, 2nd Edition. by Mark Rhodes-Ousley. Released April 2013. Publisher(s): McGraw-Hill.</p> <p>T2: William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson publication, ISBN: 978-93-325-8522-5</p> <p>T3: Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003</p>
<p>References</p> <p>R1: Cryptography & Network Security (Sie) 2E. Author, Forouzan. Publisher, McGraw-Hill Education (India) Pvt Limited.</p> <p>R2: Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices. Nina Godbole.</p> <p>R3: Information Security: Principles and Practices, 2nd Edition. Mark S. Merkow. Jim Breithaupt. 2014, Pearson</p> <p>R4: Roadmap to Information Security: For IT and Infosec Managers, Michael E. Whitman, Herbert J. Mattord</p> <p>e study</p> <p>link: https://www.researchgate.net/publication/320960482_Information_Security_Management_Practices_Case_Studies_from_India</p> <p>E book link</p> <p>R1: https://d.cxcare.net/InfoSec/Information%20Security%20The%20Complete%20Reference,%202nd%20Edition/Information%20Security%20The%20Complete%20Reference,%202nd%20Edition.pdf</p> <p>E book link R2:</p> <p>https://engineering.futureuniversity.com/BOOKS%20FOR%20IT/Book%20Information%20Security%20Management%206th%20ed.pdf</p> <p>Web resources: https://nptel.ac.in/courses/106106199 - IIT Madra, Prof. Chester Rebeiro</p> <p>Web resources: https://nptel.ac.in/courses/106106129 - IIT Madras Prof. V. Kamakoti.</p> <p>https://presiuniv.knimbus.com/user#/searchresult</p>
<p>Topics relevant to “ENTREPRENEURIAL SKILLS”: Sustainable development tools, Integrity Availability Concepts Policies, procedures, Guidelines, Standards Administrative Measures and Technical Measures, People, Process, Technology for developing Entrepreneurial Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3034	Course Title: BIG DATA SECURITY AND PRIVACY Type of Course: Elective in Big Data Basket Theory			L-T-P-C	3	0	0	3
Version No.	1.0							
Course Pre-requisites	CSE219 Big Data Analytics							
Anti-requisites	NIL							
Course Description	The purpose of this course is to sensitize security in Big Data environments. This course will discover cryptographic principles, mechanisms to manage access controls in Big Data system. This course teaches the principles and practices of big data for improving the privacy and the security of computing systems. Big data is being applied in areas where there is great commercial advantage to be had, and consequently, attacks and failures have become a serious concern. It delves into a set of techniques for defending big data techniques against breaching of bigdata (the privacy aspect) and against malicious attacks (the security aspect).							
Course Objective	The objective of the course is to familiarize the learners with the concepts of BIG DATA SECURITY AND PRIVACY and attain Skill Development through Participative Learning techniques.							
Course Outcomes	On successful completion of this course the students shall be able to: i. Define cryptographic principles and mechanisms to manage access controls in Big Data system.[Knowledge] ii. Explain security risks and challenges for Big Data system.[Knowledge] iii. Recognize all security related issues in big data systems .[Comprehension] iv. Apply Kerberos configuration for Hadoop ecosystem components.[Application]							
Course Content:								
Module 1	Big Data Privacy, Ethics And Security	Assignment/Quiz	Big data security-organizational security	08 classes				
	Topics: Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security. Assignment: Big data security-organizational security							
Module 2	Security, Compliance, Auditing, Protection And	Assignment	communication protocols for each of the Hadoop ecosystem components	08 classes				
	Topics: Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems. Assignment: communication protocols for each of the Hadoop ecosystem components							
Module 3	Hadoop Security Design, Hadoop Ecosystem Security	Case study	Kerberos configuration for ecosystem tools	08 classes				
	Topics:							

Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop. Assignment: Kerberos configuration for Hadoop ecosystem tools				
Module 4	Data Security & Event Logging	Case study	Event monitoring in Hadoop cluster	08 classes
Topics: Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in hadoop cluster Assignment: Event monitoring in Hadoop cluster				
Assignment:				
1. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link . 2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				
Text Book(s): 1. Sudeesh Narayanan, “Securing Hadoop”, Packt Publishing, 2013. 2. Ben Spivey, Joey Echeverria, “Hadoop Security Protecting Your Big Data Problem”, O’Reilly Media, 2015.				
Reference(s): Reference Book(s): 1. Mark Van Rijmenam, “Think Bigger: Developing a Successful Big Data Strategy for Your Business”, Amazon, 1 edition, 2014. 2. Frank Ohlhorst John Wiley & Sons, “Big Data Analytics: Turning Big Data into Big Money”, John Wiley & Sons, 2013. 3. SherifSakr, “Large Scale and Big Data: Processing and Management”, CRC Press, 2014. Online Resources (e-books, notes, ppts, video lectures etc.): 1. Top Tips for Securing Big Data Environments: e-book (http://www.ibmbigdatahub.com/whitepaper/top-tips-securing-big-data-environments-ebook) 2. http://www.dataguise.com/?q=securing-hadoop-discovering-and-securing-sensitive-datahadoop-data-stores 3. Gazzang for Hadoop http://www.cloudera.com/content/cloudera/en/solutions/enterprisesolutions/security-for-hadoop.html 4. eCryptfs for Hadoop https://launchpad.net/ecryptfs . 5. Project Rhino - https://github.com/intel-hadoop/project-rhino . Weblinks: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live				
Topics relevant to “SKILL DEVELOPMENT”: Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE3032	Course Title: Streaming Data Analytics Type of Course: Program Core Theory and Lab Integrated Course			L-T-P-C	2	0	2	3
Version No.	1.0							
Course Pre-requisites	CSE3032 -Big Data Analytics							
Anti-requisites	NIL							
Course Description	<p>The purpose of the course is to introduce theoretical foundations, algorithms, methodologies, and applications of streaming data. It also provides practical knowledge for handling and analyzing streaming data.</p> <p>The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.</p> <p>With good knowledge of the fundamentals of streaming analytics, the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volume of streaming data.</p>							
Course Objectives	<p>The objective of the course is to familiarize the learners with the concepts of Streaming Data Analytics as mentioned above and attain Skill Development through experiential Learning techniques.</p>							
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <ul style="list-style-type: none"> • Recognize the characteristics of data streams that make it useful to solve real-world problems. • Identify and apply appropriate algorithms for analyzing the data streams for a variety of problems. • Implement different algorithms for analyzing the data streams. 							
Course Content:								
Module 1	Introduction to Data Streams	Programming Assignment	Streaming methods					8 Classes
	Introduction to Data Streams: Data Stream Models, Research Issues in Data Streams Management Systems, Knowledge Discovery from Data Streams, Basic Streaming Methods: Counting the Number of Occurrence of the Elements in a Stream, Counting the Number of Distinct Values in a Stream, Bounds of Random Variables, Poisson Processes, Sliding Windows.							
Module 2	Decision Trees and Clustering from Data Streams	Programming Assignment	Streaming Data Collection and Analysis					10 Classes
	Decision Trees and Clustering from Data Streams: Introduction, The Very Fast Decision Tree Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Clustering Examples: Partitioning Clustering, Hierarchical Clustering, Micro Clustering, Grid Clustering .							

Module 3	Frequent Pattern Mining	Programming Assignment	Streaming Data analysis		8 Classes
	<p>Frequent Pattern Mining: Introduction to Frequent Itemset Mining: The FP-growth Algorithm, Summarizing Itemsets, Heavy Hitters, Mining Frequent Itemsets from Data Streams: Landmark Windows, Mining Recent Frequent Itemsets, Frequent Itemsets at Multiple Time Granularities, Sequence Pattern Mining</p> <p>Module 4 7 classes</p> <p>Evaluating Streaming Algorithms Evaluation Issues, Design of Evaluation Experiments, Evaluation Metrics, Error Estimators using a Single Algorithm and a Single Dataset, Comparative Assessment, The 0-1 loss function, Evaluation Methodology in Non-Stationary Environments, The Page-Hinkley Algorithm</p>				
	<p>List of Laboratory Tasks:</p> <p>1. Level 1: Exploring stream processing engine STORM Level 2: Exploring stream processing engine STREAM</p> <p>2. Implementation of decision tree algorithms Level 1: Implementation of VFDT decision tree algorithm Level 2: Implementation of CVFDT decision tree algorithm</p> <p>3. Implementation of partitioning clustering on stream. Level 1: Implementation of partitioning clustering The Leader Algorithm. Level 2: Implementation of Single Pass k-Means partitioning Clustering Algorithm.</p> <p>4. Implementation of micro clustering on stream. Level 1: Implementation of Fractal Clustering algorithm Initialization phase Level 2: Implementation of Fractal Clustering algorithm Incremental phase</p> <p>5. Level 1: Implementation of The ODAC Global Algorithm. Level 2: Implementation of The ODAC: The TestSplit Algorithm</p> <p>6. Level 1 Implementation of the Apriori algorithm to find frequent itemsets Level 2: Implementation of the Apriori algorithm to find association rules</p> <p>7. Level 1: Frequent Itemsets mining of data streams using Lossy Counting algorithm Level 2: Reservoir Sampling for Sequential Pattern Mining over Data Streams.</p> <p style="text-align: center;">•</p>				
	<p>Targeted Application & Tools that can be used:</p> <ul style="list-style-type: none"> • Apache Spark • Social media Data Analysis • Predictive Analytics 				

	Project work/Assignment:
	Students will be asked to develop a mini-project for streaming Data Analysis on streaming data.
	Text Book Joao Gama, “Knowledge Discovery from Data Streams”, CRC Press, 2018.
	References David Luckham, “The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems”, Addison Wesley, 2016. Charu C. Aggarwal, “Data Streams: Models And Algorithms”, Kluwer Academic Publishers, 2017. Weblinks: http://www.liaad.up.pt/area/jgama/DataStreamsCRC.pdf https://presiuniv.knimbus.com/user#/home
	Topics relevant to “SKILL DEVELOPMENT”: Streaming data analysis of twitter data using Apache Spark for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3031	Course Title: Web Intelligence and Analytics Type of Course: Integrated				L- T-P- C	2	0	2	3
Version No.		1.0							
Course Pre-requisites		CSE2021-Data Mining							
Anti-requisites									
Course Description		This course is an introduction to Web Analytics and Web Intelligence - is not intended to provide an in-depth review of marketing principles and concepts. Nor is it intended to provide an in depth explanation or review of statistical analysis principles, though some of these principals and concepts will be mentioned from time to time in the lectures and reading materials. Rather, this course will give you the mastery of analytics to a sufficient degree to deploy Web Analytics platforms within your organizations and gain meaningful insights from them that can drive the bottom line.							
Course Objective		The objective of the course is to familiarize the learners with the concepts of Web Intelligence and Analytics and attain Skill Development through Experiential Learning techniques.							
Course Out Comes		On successful completion of the course the students shall be able to: 1. A grounded understanding of web intelligence and business analytics terminology related to the above. 2. How to deploy web intelligence to improve the outcomes of your marketing or business plan. 3. How Analysts impact the bottom line (their role) within various businesses and lines of business 4. Growth potentials for Web Analysts and Big Data professionals							
Course Content:									
Module 1	INTRODUCTION TO INTELLIGENT WEB	Assignment		Data Collection/Interpretation	6Sessions				
	INTRODUCTION TO INTELLIGENT WEB -Inside the search engine - Examples of intelligent web applications - Basic elements of intelligent applications - Machine learning, data mining – Searching, Reading, indexing, and searching.								
Module 2	LISTEN AND LOAD	Case studies / Case let		Case studies / Case let	6 Sessions				
	LISTEN AND LOAD- Streams, Information and Language, - Statistics of Text - Analyzing Sentiment and Intent – Load - Databases and their Evolution, Big data Technology and Trends.								
Module 3	CLUSTERING AND CLASSIFICATION	Quiz		Case studies / Case let	9 Sessions				
	CLUSTERING AND CLASSIFICATION An overview of clustering algorithms - Clustering issues in very large datasets - The need for classification - Automatic categorization of emails and								

	spam filtering - Classification with very large datasets - Comparing multiple classifiers on the same data.
	<p>Module4- REASONING (4 hours) Reasoning: Logic and its Limits, Dealing with Uncertainty - Mechanical Logic - The Semantic Web - Limits of Logic - Description and Resolution - Collective Reasoning.</p> <p>Module-5 PREDICTING (6 hours) Statistical Forecasting - Neural Networks - Predictive Analytics - Sparse Memories - Sequence Memory - Network Science – Data Analysis: Regression and Feature Selection - Case Study - set of retrieved and processed news stories.</p>
	List of Laboratory Tasks: Laboratory Work: to analyzing the web for various functionalities given in the subject and using various tools and technologies to do the experimentation. It also involves installation and working on tools and technologies in this domain.
	Targeted Application & Tools that can be used
	Project work/Assignment:
	Assignment:
	<p>Text Book</p> <ol style="list-style-type: none"> 1. Gautam Shroff, “Intelligent Web - Search, Smart Algorithms, and Big Data”, Oxford University Press, 2016. 2. HaralambosMarmanis, Dmitry Babenko, “Algorithms of the Intelligent Web”, Manning publications, 2019.
	<p>References</p> <p>Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, “An Introduction to Information Retrieval”, Cambridge University Press, 2019.</p> <p>. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.</p> <p>. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013. R3</p> <p>b resources:</p> <p>https://www.coursetalk.com/coursera/web-intelligence-and-big-data Course code Course Title L T</p> <p>informatics.global,</p> <p>https://sm-nitk.vlabs.ac.in/</p>
	Topics relevant to “Skill Development”: Intelligent Web and Clustering for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3028	Course Title:Blockchain security and performances			L-T-P-C	2	0	2	3
	Type of Course:Program Core Theory and Laboratory Integrated							
Version No.		1.0						
Course Pre-requisites		Blockchain Technology and Applications						
Anti-requisites		NIL						
Course Description		The purpose of this course is to introduce the students to security and privacy techniques in blockchain based systems. The course provides a comprehensive understanding of blockchain security, risks, methods, and best practices. The course develops critical thinking skills by augmenting the student’s ability to tackle security related issues of blockchain The associated laboratory provides an opportunity to validate the concepts taught as well as enhances the ability to visualize the real-world problems in order to provide a solution using various tools and techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: CO1:Comprehend security and performance perspective of blockchain technology. CO2: Apply cryptographic techniques to enhance security in blockchain based systems CO3: Implement secure transaction models. CO4: Apply security techniques to blockchain systems that provide solutions to some real world problems						
Course Outcome		The objective of the course is to familiarize the learners with the concepts of CSE3028_BLOCKCHAIN SECURITY & PERFORMANCE and attain Employability through Experiential Learning techniques.						
Course Content:								
Module 1	Fundamentals of Privacy And Security Techniques In Blockchain	Assignment		Programming		9 Sessions		
	Introduction to Blockchain Technology, Cyber Security Threats and incidents on blockchain networks, Categorization of blockchain threats and vulnerabilities: Client vulnerabilities, Consensus Mechanism vulnerabilities, Mining Pool vulnerabilities, Network vulnerabilities, Smart Contract vulnerabilities; Privacy and security techniques: Mixing, Anonymous Signatures, Homomorphic Encryption, Attribute-Based Encryption, Secure Multi-Party Computation, Non-Interactive Zero-Knowledge (NIZK) Proof, TEE Based Smart Contracts, Game-Based Smart Contracts.							
Module 2	Cryptography	Assignment		Programming		12 sessions		
	Cryptography, Public Key Cryptography and Cryptocurrency, Private Keys, Generating a Private Key from a Random Number, Public Keys, Elliptic Curve Cryptography, Elliptic Curve Arithmetic Operations, Generating a Public Key, Elliptic Curve Libraries, Cryptographic Hash Functions							

Ethereum's Cryptographic Hash Function: Keccak-256, Ethereum Address and Formats, Inter-Exchange Client Address Protocol				
Module 3	Transaction Model	Assignment	Programming	9 sessions
Topics: Blockchain Level Transaction Models : UTXO, Account-Based Online Transaction Model, CAP Properties in Blockchain, Security and Privacy Requirements of Online Transactions, Basic Security Properties: Consistency, Tamper-Resistance, Resistance to DDoS attacks, Resistance to Double-Spending attacks, Resistance to the Consensus attacks, Pseudonymity; Additional Security and Privacy Properties of Blockchain: Unlinkability, Confidentiality of Transactions and Data Privacy, Consensus Algorithms, BFT based Consensus Algorithms, Sleepy Consensus, Proof of Elapsed Time, Proof of Authority, Proof of Reputation, Comparison of Consensus Algorithms				
List of Laboratory Tasks:				
Targeted Application & Tools that can be used:				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
After completion of each module a programming based Assignment/Assessment will be conducted. On completion of Module 3, student will be asked to develop a Project.				
Textbook(s): T1. Antonopoulos, Andreas M., and Gavin Wood. <i>Mastering ethereum: building smart contracts and dapps</i> . O'reilly Media, 2018. T2. Howard E. Poston, Blockchain Security from the Bottom Up: Securing and Preventing Attacks on Cryptocurrencies, Decentralized Applications, NFTs, and Smart Contracts, John Wiley & Sons, 2022.				
References R1. Parisi, Alessandro. <i>Securing Blockchain Networks like Ethereum and Hyperledger Fabric: Learn advanced security configurations and design principles to safeguard Blockchain networks</i> . Packt Publishing Ltd, 2020. Web Based Resources and E-books: Digital Learning Resources (Library Resources) W1: NPTEL : https://nptel.ac.in/courses/106/104/106104220/# W2: UDEMY : https://www.udemy.com/course/build-your-blockchain-az/ W3 : Book https://www.google.co.in/books/edition/Blockchain_By_Example/ci59DwAAQBAJ?hl=en&gbpv=1 W4 : Book https://www.insiderintelligence.com/insights/blockchain-technology-applications-use-cases/ W6: https://www.analyticsinsight.net/real-world-applications-of-blockchain-technologies/ W7:PU Library Link : https://puniversity.informaticsglobal.com/login Or : http://182.72.188.193/				
Topics relevant to “SKILL DEVELOPMENT”: Real time data analysis used for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE3023	Course Title: Distributed Ledger Technology Type of Course: Discipline Elective		L-T-P-C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		Foundations of Blockchain Technology					
Anti-requisites		NIL					
Course Description		<p>The purpose of the course is to provide the fundamental concepts of distributed ledger technologies as well as to explore various aspects of distributed ledger techniques like Ethereum, Hyper ledger and smart contract.</p> <p>With a good knowledge in the fundamental concepts of block chain and distributed ledger technologies, the student can gain practical experience in implementing them, enabling the student to be an effective chain code creator.</p>					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Distributed Ledger Technology and attain Skill Development through Experiential Learning techniques .					
Course Out Comes		<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Understand and explore the working of distributed ledger technology (Knowledge) 2. Understand the working of Smart Contracts (Knowledge) 3. Apply the learning of solidity and de-centralized apps on Ethereum (Application). 					
Course Content:							
Version No.		1.0					
Module 1	Introduction to Distributed Ledger Technologies	Assignment	Data Collection			No. of Sessions: 09	
<p>Topics: What is Distributed Ledger Technology (DLT) and How Does it work? Key Features of DLT, Distributed Nature of the Ledger, Consensus Mechanism, Open/Permissionless Distributed Ledgers : Bitcoin , Ethereum ; Permissioned Distributed Ledgers :, Ripple, Fabric (Hyperledger Project) , Corda, Key Advantages of DLT, Challenges and Risks related to DLT, Applications of DLT. Assignment: Permissionless Distributed Ledgers/ Permissioned Distributed Ledgers</p>							
Module 2	Introduction to Hyperledger	Assignment	Writing Task			No. of Sessions: 09	
<p>Topics: What is Hyperledger? Hyper ledger frameworks, Hyperledger Fabric- Components design, principles of Hyperledger design, reference architecture, run time architecture, the journey of sample transaction, Hyperledger Composer. Assignment: Hyperledger Fabric Design</p>							

Module 3	Designing a Data and Transaction Model	Assignment	Programming Task	No. of Sessions: 10
<p>Topics: Starting the chaincode development, Compiling and running chaincode, Installing and instantiating chaincode, Invoking chaincode, Creating a chaincode, The chaincode interface, setting up chaincode file, Access control – ABAC- Registering a user, Enrolling a user, Retrieving user identities and attributes in chaincode, Implementing chaincode functions, Defining chaincode assets, Coding chaincode functions Creating an asset, Testing. Assignment: Creating Chaincode and interfacing among them.</p>				
Module 4	Applications of DLT	Case Study	Discussion	No. of Sessions: 08
<p>Topics: Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins. Case study: Managing the Metal and Mining Industry's Supply Chain with Hyperledger Fabric</p>				
<p>List of Laboratory Tasks:</p> <ol style="list-style-type: none"> Level 1: Create a Simple Blockchain in any suitable programming language. Level 2: Create a complex Blockchain in any suitable programming language Level 1: Deposit oneEther in your MetaMask accounts. Level 2: Deposit 10 Ether in your MetaMask accounts Level 1: Create Single account. Level 2: Create multiple accounts and make a transaction between these accounts Level 1: Test any one property of cryptographic hashing Level 2: Test all the properties of cryptographic hashing Level 1: Add a transaction to a blockchain Level 2: Add multiple transaction to a blockchain Level 1: Create a new file 'WorkingWithVariables.sol' in Solidity Level 2: Program to write a solidity program with required variables Level 1: Create a new file 'SendMoney.sol' in solidity Level 2: Create new transaction with signing Level 1: Single Error Handling using solidity Level 2: Complex exception Handling using solidity Level 1: Use Geth to Implement Private Ethereum Block Chain. Level 2: Use Geth to Implement public Ethereum Block Chain. Level 1: Build Hyperledger Fabric Client Application. Level 2: Build Hyperledger Fabric Server/network Application. Level 1: Build Hyperledger Fabric with Smart Contract. Level 2: Case study on Hyperledger Fabric Level 1: Create Case study of Block Chain being used in illegal activities in real world. Level 2: Using Golang to develop Block Chain Application 				

<p>Targeted Application & Tools that can be used: Meta mask, Docker and Docker compose, Go Programming language</p>
<p>Project work/Assignment:</p>
<p>Topics:</p> <ol style="list-style-type: none"> 1. Permissioned Distributed Ledgers 2. Chaincode- Creation and interface
<p>Textbook(s): T1. Nitin Gaur, Hands-on blockchain with Hyperledger_ Building decentralized applications with Hyperledger Fabric and Composer, Packt,2020.</p>
<p>References</p> <ol style="list-style-type: none"> R1. Andreas M. Antonopoulos, “Mastering Bitcoin- Programming” - The Open Blockchain,Oreilly,2017 R2. hyperledger-fabricdocs Documentation, Release Master, 2021. R3. D. Drescher, Blockchain Basics. Apress, 2017. R4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
<p>Other Resources</p> <ul style="list-style-type: none"> • Distributed Ledger Technology (DLT) and Blockchain, Fintech • NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/ • Udemy: https://www.udemy.com/course/build-your-blockchain-az/ • EDUXLABS Online training :https://eduxlabs.com/courses/blockchain-technologytraining/?tab=tab-curriculum <p>E-Book Links:</p> <p>T1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EXc_hRKtg1dOu6GuNvv0MZMBQ_Zo0lpNJyXsJ4IANfcJdQ?e=YAvywC</p> <p>R1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EUMg4-zAc3dGgl1RWEDDJR8B4SCqMMcO0Izun51qbDITw?e=ObRwKr</p> <p>R2. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EWrs6M9zaYpJhvf9RI2jRaUB9PIJhXmQfZC5vdg284oVlg?e=aD9RgX</p>
<p>Topics relevant to “Skill Development”: Applications of DLT is used for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 3020	Course Title: Smart Contract and Solidity Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1					
Course Pre-requisites	Basics of Mathematics and any Programming Language					
Anti-requisites	NONE					
Course Description	Solidity is an object-oriented, high-level language for implementing smart contracts. Smart contracts are programs which govern the behaviour of accounts within the Ethereum state. Solidity is a curly-bracket language designed to target the Ethereum Virtual Machine (EVM). It is influenced by C++, Python and JavaScript. The Ethereum Virtual Machine (EVM) and assembly (low level language), events and logging blockchain emissions, send vs transfer methods, scoping and more					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Smart Contract and Solidity and attain <u>EMPLOYABILITY</u> through <u>Experiential Learning Techniques.</u>					
Course Out Comes	On successful completion of the course the students shall be able to: CO 1 : Understand the fundamentals of computational Element of the Blockchain Technology C.O 2: Implement user-defined operations of arbitrary complexity that are not possible through plain cryptocurrency protocols C.O 3: Exhibit best practices for designing solutions with smart contracts using Solidity and Remix IDE					
Course Content:	Module: 1: Introduction to Smart Contract [14 Hrs - L[14] + T[00]] [Knowledge] A Simple Smart Contract, Blockchain Basics, The Ethereum Virtual Machine, Versioning, Remix, npm / Node.js, Docker, Binary Packages, Building from Source, CMake options. Module: 2: Solidity in Depth [22 Hrs – L[08] + T[02] + P[12]] [Application] Layout of a Solidity Source File, Structure of a Contract, Types, Units and Globally Available Variables, Expressions and Control Structures, Contracts, Solidity Assembly, Miscellaneous, Solidity v0.5.0 Breaking Changes Module 3: Contract Metadata & Contract ABI Specification [22 Hrs – L[08] + T[02] + P[12]] [Comprehension] Encoding of the Metadata Hash in the Bytecode, Usage for Automatic Interface Generation and NatSpec, Usage for Source Code Verification, Basic Design, Function Selector, Argument Encoding, Types, Design Criteria for the Encoding, Formal Specification of the Encoding, Function					

	Selector and Argument Encoding, Examples, Use of Dynamic Types, Events, JSON, Strict Encoding Mode, Non-standard Packed Mode				
Module 1	Introduction to Smart Contract	TEST-1		Fundamentals of Smart Contract and Solidity	12Sessions
	Topics:				
Module 2	Solidity in Depth	TEST-1		Case studies / Case let	12 Sessions
	Topics:				
Module 3	Contract Metadata & Contract ABI Specification	Endterm lab Exam		Implementing Applications	14 Sessions
	Topics:				
	List of Laboratory Tasks: Develop a complex voting application Build blind auction App Create safe remote purchase Develop micropayment channel Creating Decentralized Apps with Solidity Store Patient Health Records using Solidity Implement Supply Chain Management App using Solidity				
	Targeted Application & Tools that can be used NetBeans				
	Project work/Assignment:				
	Assignment: Quiz and Group Project				
	Text Book T1 Solidity Smart Contracts: Build DApps In Ethereum Blockchain- Rangel Stoilov T2 Mastering Blockchain Programming with Solidity- Jitendra Chittoda .				

	<p>References</p> <p>R1 Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain</p> <p>R2 Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment- Book by David H. Hoover, Kevin Solorio, and Randall Kanna</p> <p>Book link R1: NA</p> <p>E book link R2: NA</p> <p>Web resources: Udemy course –https://www.udemy.com/course/the-complete-solidity-course-blockchain-zero-to-expert/ Coursera Course ---- https://www.coursera.org/learn/smarter-contracts/</p>
	<p>Topics relevant to “SKILL DEVELOPMENT”: Encoding of the Metadata Hash in the Bytecode, Usage for Automatic Interface Generation and NatSpec, Usage for Source Code Verification, Basic Design, Function Selector, Argument Encoding, Types, Design Criteria for the Encoding, Formal Specification of the Encoding, Function Selector and Argument Encoding for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3020	Course Title: Blockchain Technology and Applications Type of Course: Program Core			L-T-P-C	3	0	0	3
Version No.		1.0						
Course Pre-requisites		Fundamentals of Blockchain Technology						
Anti-requisites		NIL						
Course Description		The purpose of the course is to provide an introduction to Blockchain technology with specific focus on industrial applications like Blockchain in Financial system, trade/supply chain management, agriculture industry, Healthcare sectors and Insurance system. With the knowledge of blockchain technology, Students will learn how these system are built, how to interact with them.						
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Blockchain Technology and Applications and attain Skill Development through Participative Learning techniques.						
Course Outcomes		On successful completion of this course the student shall be able to: 1. Understand the concepts of Blockchain technology (Knowledge). 2. Explain the methods for verification and validation of Bitcoin transactions (Comprehension). 3. Explore the use of the Ethereum programming (Application). 4. Illustrate the role of blockchain in various domains (Comprehension).						
Course Content:								
Module 1		Introduction to Blockchain	Quiz		Knowledge based quiz on Cryptographic Hash Functions		No. of Classes: 8	
	Topics: Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Online Wallets and Exchanges, Payment Services, Transaction Fees, Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures.							
Module 2		Bitcoin	Assignment		Bitcoin mining pools		No. of Classes: 10	
	Bitcoin Mechanics: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements. Bitcoin mining: The task of Bitcoin miners, Mining Hardware, Energy consumption, Mining pools, Mining incentives and strategies.							
Module 3		Ethereum	Create a smart contract using solidity language		Components of Ethereum Ecosystem		No. of Classes: 10	
	The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.							
Module 4		Blockchains in Business	Case Study		Conduct a case study on how		No. of Classes: 10	

				BaaS is adopted in industries.	
	Topics: Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare- Blockchain in Financial Industry				
	List of Laboratory Tasks: NA				
	Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • Ethereum Remix online& Ganache • Solidity programming language 				
	Project work/Assignment:				
	<ol style="list-style-type: none"> 1. Calculate the ‘number of ethers’ for the transaction of gas limit for the scenario in which the sender sets the gas limit to 50,000 and a gas price to 20 gwei. 2. Represent the EthereumMerkley Tree for the given list of Transactions. 3. Create Survey report of various types of Blockchain and its real time use cases. 				
	Textbook(s): <ol style="list-style-type: none"> 1. BellajBadr, Richard Horrocks, Xun (Brian) Wu, “BlockchainBy Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2018. 				
	References: <ol style="list-style-type: none"> 1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2nd Edition, Packt Publishing Ltd, March 2018. Weblinks: <ul style="list-style-type: none"> • Udemy: https://www.udemy.com/course/build-your-blockchain-az/ • NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/# Textbook(s): <ol style="list-style-type: none"> 1. BellajBadr, Richard Horrocks, Xun (Brian) Wu, “BlockchainBy Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger”, Packt Publishing Limited, 2018. https://www.google.co.in/books/edition/Blockchain_By_Example/ci59DwAAQBAJ?hl=en&gbpv=1				
	Topics relevant to “SKILL DEVELOPMENT”: Ethereum, Blockchain in Manufacturing for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE2019	Course Title: Foundations of Blockchain Technology Type of Course: Program Core & Theory only			L-T-P-C	3	0	0	3
Version No.		1.1						
Course Pre-requisites		Networks						
Anti-requisites		NIL						
Course Description		The purpose of the course is to provide the fundamental knowledge on Blockchain technology and explore various aspects of Blockchain technology like types of Blockchain, Bitcoin and Ethereum Blockchain platform. With a good knowledge of block chain technology, the student can understand the mechanism of Bitcoin and able to write simple smart contracts						
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Foundations of Blockchain Technology and attain Skill Development through Participative Learning techniques.						
Course Out Comes		On successful completion of this course the student shall be able to: 1. Understand the concepts of an emerging blockchain technology (Knowledge). 2. Infer the knowledge about consensus protocols (comprehension). 3. Explore Bitcoin payment methods (comprehension). 4. Develop simple smart contract (comprehension).						
Course Content:								
Module 1	Blockchain Basics	Quiz		Knowledge based quiz on distributed ledger	10 Sessions			
	Topics: The history of Blockchain: Blockchain, Generic elements of a blockchain, Benefits and limitations of Blockchain, Tiers of Blockchain technology, Features of Blockchain. Types of Blockchain: Distributed ledgers, Public Blockchain, private Blockchain, shared ledger. Quiz: Knowledge based quiz on distributed ledger							
Module 2	Distributed Consensus	Assignment		PoW	08 Sessions			
	Topics: Consensus: Consensus mechanism, Types of consensus mechanisms, Consensus in Blockchain. Assignment: Write an assignment on PoW consensus mechanism							
Module 3	Introducing Bitcoin	Case study		Bitcoin network wallets	10 Sessions			
	Topics: Bitcoin definition, Digital keys and addresses, Transactions, mining, Bitcoin network wallets, Bitcoin payments.							

	Case Study: Conduct a study about hot bitcoin wallets				
Module 4	Smart contracts	Case study		how to execute smart contract	10 Sessions
	<p>Topics:History, Definition, Introduction to Ethereum,Ethereum network,Components of Ethereum ecosystem, Smart contracts.</p> <p>Case Study: Create a simple smart contract for User identity management using Solidity language and show how to execute.</p>				
	<p>Targeted Application & Tools that can be used:</p> <ul style="list-style-type: none"> • Ethereum Remix • MetaMask • Truffle • Ganache 				
	<p>Textbook</p> <p>T1.Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained”, 2nd Edition, Packt Publishing Ltd, March 2018.</p> <p>Weblinks:Mastering Blockchain - Google Books</p>				
	<p>References</p> <p>R1.Andreas M. Antonopoulos , “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly Media Inc, 2015.</p> <p>R2.Blockchain by Melanie Swa, O’Reilly .</p> <p>Weblinks:</p> <ol style="list-style-type: none"> 1. Blockchain A-Z™: Learn How To Build Your First Blockchain Udemy 2. https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency 3. https://www.coursera.org/specializations/introduction-to-blockchain 4. https://presiuniv.knimbus.com/user <p>Text book of Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained, 2nd Edition, Packt Publishing Ltd, March 2018.</p> <p>https://www.google.co.in/books/edition/Mastering_Blockchain/3ZIUDwAAQBAJ?hl=en&gbpv=1</p>				
	<p>Topics relevant to “SKILL DEVELOPMENT”:</p> <p>Bitcoin and Smart Contracts for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>				

Course Code:	Course Title: Machine Learning Techniques		L-T- P- C	2	0	2	3
CSE3008	Type of Course: 1] Discipline Elective 2] Laboratory integrated						
Version No.		1.0					
Course Pre-requisites		CSE3001 Artificial Intelligence and Machine Learning					
Anti-requisites		[List the Anti -requisites of the course]					
Course Description		Machine Learning algorithms are the key to develop intelligent systems such as Apple’s Siri, Google’s self-driving cars etc. This course introduces the concepts of the core machine learning techniques such as Regression learning, Bayesian learning, Ensemble learning, Perceptron learning, Unsupervised learning, Competitive learning, learning from Gaussian mixture models and learning to detect outliers. Course lectures covers both the theoretical foundations as well as the essential algorithms for the various learning methods. Lab sessions complement the lectures and enable the students in developing intelligent systems for real life problems.					
Course Objectives		The objective of the course is to familiarize the learners with the concepts of Machine Learning Techniques and attain Skill Development through experiential Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1] Apply advanced supervised machine learning methods for predictive modeling. [Application] 2] Produce machine learning models with better predictive performance using meta learning algorithms [Application] 3] Create predictive models using Perceptron learning algorithms[Application] 4] Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection[Application] 5] Implement machine learning based intelligent models using Python libraries. [Application]					
Course Content:							
Module 1	Supervised Learning	Assignment		Programming using Keras/Sklearn	No. of Classes L – 7 P – 12		
	Topics: An overview of Machine Learning(ML); ML workflow; types of ML; Types of features, Feature Engineering -Data Imputation Methods; Regression – introduction; simple linear regression, loss functions; Polynomial Regression; Logistic Regression; Softmax Regression with cross entropy as cost function; Bayesian Learning – Bayes Theorem, estimating conditional probabilities for categorical and continuous features, Naïve Bayes for supervised learning; Bayesian Belief networks; Support Vector Machines – soft margin and kernel tricks.						
Module 2	Ensemble Learning	Assignment		Programming using Keras/Sklearn	No. of Classes L-3 P-4		

	Topics: Ensemble Learning – using subset of instances – Bagging, Pasting, using subset of features –random patches and random subspaces method; Voting Classifier, Random Forest; Boosting – AdaBoost, Gradient Boosting, Extremely Randomized Trees, Stacking.				
Module 3	Perceptron Learning	Assignment /Quiz		Programming using Keras/Sklearn	No. of Classes L-7 P -2
	Topics: Perceptron Learning – from biological to artificial neurons, Perceptrons, Linear Threshold Units, logical computations with Perceptrons, common activation functions – sigmoid, tanh, relu and softmax, common loss functions, multi-layer Perceptrons and the Backpropagation algorithm using Gradient Descent.				
Module 4	Unsupervised Learning	Assignment		Programming using Keras/Sklearn	No. of Classes L-6 P -6
	Topics: Unsupervised Learning – simple k Means clustering- simple and mini-batch; updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhouette coefficient, drawbacks of kMeans, kMeans++ ; Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) Competitive Learning - Clustering using Kohonen's Self Organising Maps (SOM), Density Based Spatial Clustering – DBSCAN ; clustering using Gaussian Mixture Models (GMM) with EM algorithm ; Outlier Detection methods – Isolation Forest, Local Outlier Factor(LOF)				
	<p>List of Laboratory Tasks:</p> <p>Experiment N0 1: Methods for handling missing values Level 1: Given a data set from UCI repository, implement the different ways of handling missing values in it using Scikit-learn library of Python Level 2: Implement one of these methods using a custom defined function in Python.</p> <p>Experiment No. 2: Data Visualization Level 1 Perform Exploratory Data Analysis for a given data set by creating Scatter Plot, Pair Plot, Count Plot using Matplotlib and Seaborn Level 2 Create Heat Maps, WordCloud</p> <p>Experiment No. 3: Regression learning Level 1 Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the models parameters and the performance metrics. Plot the learning curves. Level 2 Implement the polynomial regression algorithm. Compare the learning curves of Polynomial and Linear Regression.</p> <p>Experiment No.4: Logistic regression Level 1 Write custom code for generating the logistic/sigmoid plot for a given input Level 2 Given a data set from UCI repository, implement the Logistic regression algorithm. Estimate the class probabilities for a given test data set. Plot and analyze the decision boundaries.</p> <p>Experiment No.5: Bayesian Learning Level 1 Given a data set from UCI repository, implement a classification model using the Bayesian algorithm</p>				

	<p>Experiment No.6: Support Vector Machine(SVM) Level 1 Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.</p> <p>Experiment No. 7: Ensemble Learning Level 1 : Implement Ensemble Learning algorithms such as Bagging, Pasting and Out-of Bag Evaluation Level 2 : Random Patches and Random Subspace Method</p> <p>Experiment No. 8: Ensemble Learning Level 1 : AdaBoost and Gradient Boosting, Stacking</p> <p>Experiment No. 9: Perceptron Learning Level 1 : Implement the Perceptron Classifier Level 2 : – An Image Classifier Using the Sequential API of Keras</p> <p>Experiment No. 10: Unsupervised Learning Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhouette Coefficient . Compare the inertia of both as k increases. Tuning the hyperparameter ‘k’ using GridSearchCV. Level 2 : – Using clustering for Image segmentation and Preprocessing. Kmeans++</p> <p>Experiment No. 11: Density Based Clustering Level 1 Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.</p> <p>Experiment No. 12: Outlier Detection Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor</p>
	<p>Targeted Application & Tools that can be used :</p> <ol style="list-style-type: none"> 1. Execution of the ML algorithms will be done using the Google’s cloud service namely “Colab”, available at https://colab.research.google.com/ or Jupyter Notebook. 2. The data sets will be from the bench marking repositories such as UCI machine learning repository available at : https://archive.ics.uci.edu/ml/index.php 3. Laboratory tasks will be implemented using the libraries available in Python such as Scikit learn, matplotlib, seaborn, perceptron and the deep learning framework namely Keras.
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
	<p>Students can be assigned a mini project to develop a machine learning application for real-life problems in various domains such as health care, business intelligence, environmental modeling, etc.</p>
	<p>Text Book</p> <p>There are a number of useful textbooks for the course, but each cover only a part of the course syllabus. Following is an indicative list of textbooks.</p> <ol style="list-style-type: none"> 1. Aurélien Géron, “Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow”, Oreilly, Second Edition, 2019.

	<ol style="list-style-type: none"> 2. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2018 3. Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017.
	<p>References In references apart from the books and web links, mention a few standards & Hand books relevant to the Laboratory tasks used by the professionals.</p> <ol style="list-style-type: none"> 1. Tan P. N., Steinbach M & Kumar V. “<i>Introduction to Data Mining</i>”, Pearson Education, 2016. 2. https://towardsdatascience.com/machine-learning/home 3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/ 4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview
	<p>Topics relevant to “Skill Development ”: Assignment implementations in software, batch wise presentations are used for developing Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3016	Course Title: CSE3016 Neural Networks and Fuzzy Logic Type of Course: Discipline Elective in AI & ML Basket Theory Course			L-T-P-C	3	0	0	3
Version No.		1.0						
Course Pre-requisites		NIL						
Anti-requisites		NIL						
Course Description		This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Neural Networks and Fuzzy Logic and attain Skill Development through Participative Learning techniques.						
Course Outcomes		On successful completion of this course the students shall be able to: 1. Define the concept of Neural Networks. [Knowledge] 2. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge] 3. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 4. Demonstrate the Fuzzy logic concepts and its applications.[Application]						
Course Content:								
Module 1	Introduction to Neural Network	Quiz		Single Layer Perceptron	9Classes			
	Topics: Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks. Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.							
Module 2	Multilayer Perceptron	Quiz		Multilayer Perceptron	10 Classes			
	Topics: Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples. Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies. Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.							

Module 3	Fuzzy Sets, Operations and Relations	Quiz		Fuzzy Operations	10Classes
	Topics: Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets. Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations. Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.				
Module 4	Fuzzy Logic and Fuzzy Logic Controller	Assignment		Developing Fuzzy Logic Controller	10Classes
	Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions. Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.				
	Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.) 2. Matlab (Neural Network Toolbox, Fuzzy Logic Toolbox) 				
	Project work/Assignment:				
	Students will have to do group assignments for Modules 2 & 4. As a part of their assignments, they will have to implement the solution to particular problems.				
	Textbook(s): <ol style="list-style-type: none"> 1. Haykin, Simon. “<i>Neural networks and learning machines</i>”, 3/E. Pearson Education India, 2011. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553 2. George J. Klir and Bo Yuan, “<i>Fuzzy Sets and Fuzzy Logic- Theory and Applications</i>”, Prentice Hall of India, 2015. https://www.worldcat.org/title/fuzzy-sets-and-fuzzy-logic-theory-and-applications/oclc/505215200 				
	References: <ol style="list-style-type: none"> 1. Shivanandam, Deepa S, “<i>Principles of Soft computing</i>”, N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html 2. Timothy J. Ross, “<i>Fuzzy Logic with Engineering Applications</i>”, Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374 3. Kumar S., “<i>Neural Networks - A Classroom Approach</i>”, Tata McGraw Hill, 2nd Edition 2017.https://www.worldcat.org/title/neural-networks-a-classroom-approach/oclc/56955342 4. Fakhreddine O. Karray, and Clarence W. De Silva. “<i>Soft computing and intelligent systems design: theory, tools, and applications</i>”. Pearson Education, 2009. Weblinks https://www.pearson.com/en-gb/search.html?q=Karray%20Soft-Computing-and-Intelligent-Systems-Design-Theory-Tools-and-Applications				

	<p>Topics relevant to “Skill Development ”: Assignment implementations in software, batch wise presentations are used for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.</p>
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Course Code: CSE 3005	Course Title: APPLIED ARTIFICIAL INTELLIGENCE Type of Course: Integrated			L- T- P- C	2	0	2	3
Version No.		1.0						
Course Pre-requisites		CSE 3001: Artificial Intelligence and Machine Learning						
Anti-requisites		NIL						
Course Description		This course covers some of the applications in artificial intelligence, such as logic, searching, adversarial search, constraint satisfaction, Bayesian networks, etc. Topic include: AI methodology, Logic in AI, Resolution Principle, Graphical Search techniques, Adversarial Search techniques, Game playing, Uncertainty and Probability, Reasoning in AI, Bayesian Networks and Statistical Learning.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of APPLIED ARTIFICIAL INTELLIGENCE and attain Skill Development through Experiential Learning techniques.						
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> • Explain different methods of searching, proving, and analysis in AI. [Knowledge] • Prove by Resolution, different situations in First-order logic. [Application] • Implement various graphical and adversarial search algorithms. [Application] • Solve sequence-labeling problems using HMM. [Application] 						
Course Content:								
Module 2	Logic in AI							12Sessions
	Topics: Propositional Logic, Predicate Logic, First order Logic, Properties of well-formed formulas (Wffs), Conversion to Clausal Form, The Resolution Principle, Inference in First Order Logic (FOL).							
Module 1	Problem Solving by Searching	Case studies / Case let		Case studies / Case let				12 Sessions
	Topics: Introduction to Problem space and state space, State space search techniques solving problems by searching: Classical Search, Adversarial Search, Game playing, and Constraint Satisfaction Problems.							
Module 3	Learning and Probabilistic Reasoning	Quiz		Case studies / Case let				14 Sessions
	Topics: Introduction to Reasoning, Various types of Reasoning methods, Probabilistic Reasoning in AI, Uncertainty in AI, Bayesian Networks, Hidden Markov Model, Applications of HMM for Part-of-Speech tagging.							
	List of Laboratory Tasks:							

	<ol style="list-style-type: none"> 1. Reading text files in Python (may be needed for some of the later experiments), using IDEs like PyCharm. 2. Evaluation of well-formedness of formulae in propositional logic. 3. Evaluation of well-formedness of formulae in first-order logic. 4. Implementation of graph-based representations - Adjacency List, Adjacency Matrix - Interconversion between Adjacency List and Adjacency Matrix. 5. Implementation of Uninformed Search Algorithms (1) - Breadth-First Search 6. Implementation of Uninformed Search Algorithms (2) - Depth-First Search 7. Implementation of Heuristic Search Algorithms (1) - Greedy Best First Search 8. Implementation of Heuristic Search Algorithms (2) - A* Search 9. Implementation of Adversarial Search Algorithms (1) - Minimax Tree Construction 10. Implementation of Adversarial Search Algorithms (2) - Alpha Beta Pruning and Ideal Ordering Algorithms 11. Implementation of Constraint Satisfaction Problems (1) - Sudoku 12. Implementation of Constraint Satisfaction Problems (2) - Map Colouring 13. Implementation of Constraint Satisfaction Problems (3) - Timetable Scheduling 14. Implementation of Decision-Making - Minesweeper 15. Implementation of Probabilistic Decision-Making - Battleship 16. Implementation of HMM 17. Building a PoS Tagger using HMM.
	Targeted Application & Tools that can be used <ol style="list-style-type: none"> 1. Google Colab 2. Java (any online or desktop IDE)
	Project work/Assignment:
	Assignment: Students will have to do a course assignment as designed by the Instructor-in-charge. The assignment can be a programming-based assignment, or solving a number of problems, etc.
	Text Book T1. Stuart J. Russell and Peter Norvig, 2021. <i>Artificial intelligence: A Modern Approach</i>, 4th Edition. Pearson.
	References R1. Elaine Rich, Kevin Knight and Shivashankar B Nair. 2009. <i>Artificial Intelligence</i>, 3rd Edition. Tata McGraw-Hill. book link T1: https://ia803402.us.archive.org/35/items/artificial-intelligence-a-modern-approach-4th-edition/Artificial%20Intelligence%20A%20Modern%20Approach%20%284th%20Edition%29.pdf b resources: W1. http://aima.cs.berkeley.edu/global-index.html W2. https://presiuniv.knimbus.com/user#/
	Topics relevant to “Skill Development”: Probabilities for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2053	Course Title: Enterprise Network Design	L- T- P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE-2011-Data communication and Computer Networks Computer Networks: OSI Reference Model and TCP/IP Protocol Suite 2 Routing IP Addresses 3. Internetworking Devices				
Anti-requisites		NIL				
Course Description		In Enterprise Network Design, students will investigate and design a variety of enterprise network configurations. They will enhance their consulting skills through the process of customer requirement analysis, network design, product specifications. Methodologies for Analysis of network performance and traffic for established complex networks.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of ENTERPRISE NETWORK DESIGN and attain Skill Development through Problem Solving Methodologies.				
Course Outcomes		On successful completion of the course the students shall be able to: 1. Understand the customer requirements, Structure and Modularize the Network. [KNOWLEDGE] 2. Compare Openflow controllers and switches with other enterprise networks. [COMPREHENSION] 3. Design Basic Campus and Data Center Network, Remote Connectivity, IP Addressing and Select suitable Routing Protocols for the Network. [APPLICATION] 4. Apply a Methodology to Network Design [APPLICATION]				
Course Content:						
Module 1	Applying a Methodology to Network Design:	Assignment	Theory		No. of Classes:09	
Applying a Methodology to Network Design: The Cisco Service Oriented Network Architecture, Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites, Using the Top Down Approach to Network Design, The Design Implementation Process. Network Design Demonstration through CISCO Packet Tracer.						
Module 2	Structuring, Modularizing the Network, and Designing Basic Campus and Data Center Networks	Assignment	Theory		No. of Classes:12	

Network Hierarchy, Using a Modular Approach to Network Design, Services Within Modular Networks, Network Management Protocols and Features, Campus Design Considerations, Enterprise Campus Design, Enterprise Data Center Design Considerations.					
Module 3	Remote Connectivity, Designing IP Addressing in the Network & Selecting Routing Protocols	Assignment	Theory		No. of Classes:12
Enterprise Edge WAN Technologies, WAN Design, Using WAN Technologies, Enterprise Edge WAN and MAN Architecture, Selecting Enterprise Edge Components, Designing an IP Addressing Plan, Introduction to IPv6, Routing Protocol Features, Routing Protocols for the Enterprise, Routing Protocol Deployment, Route Redistribution, Route Summarization					
Module 4	Software Defined Network	Assignment	Case Study		No. of Classes:12
Understanding SDN and Open Flow : SDN – SDN Building Blocks, OpenFlow messages – Controller to Switch, Symmetric and Asynchronous messages, Implementing OpenFlow Switch, OpenFlow controllers , POX and NOX, Open Flow in Cloud Computing, Case study: how SDN changed Traditional Enterprise network Design					
Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. CISCO Packet Tracer. 2. SDN Open flow 					
Suggested List of Hands-on Activities self study <ol style="list-style-type: none"> 1. Perform a case study on VLSM 2. Using CISCO Packet Tracer design a LAN with 50 PCV and configure it with suitable IP addressing and routing protocols for an Enterprise Network. 3. DO a case study on an SDN for an Enterprise. 					
Text Book <ol style="list-style-type: none"> 1. Authorized Self-Study Guide, Designing for Cisco Internetwork Solutions (DESGN), Second Edition, Cisco Press-Diane Teare. 2. Network Analysis, Architecture, and Design 3rd Edition, Morgan Kaufman, James D. 3. CCDA Cisco official Guide 4. Software Defined Networking with Open Flow : PACKT Publishing Siamak Azodolmolky 					
References <ol style="list-style-type: none"> 1. Top-Down Network Design (Networking Technology) 3rd Edition, Priscilla Oppenheimer ,Cisco Press Book 2. Network Planning and Design Guide Paperback – 2000, Shaun Hummel Web Resources and Research Articles links; 					

3. Network Planning and Design Guide Paperback – 2000, Shaun Hummel

Weblinks:

1. https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-live%26ebv%3dEB%26ppid%3dpp_xiii
2. https://www.youtube.com/watch?v=ITsezBQU_Co
3. http://www.teraits.com/pitagoras/marcio/gpi/b_POppenheimer_TopDownNetworkDesign_3rd_ed.pdf
4. https://www.cisco.com/c/dam/en/us/td/docs/solutions/Enterprise/Medium_Enterprise_Design_Profile/chap2sba.pdf
5. <https://nptel.ac.in/courses/106105184>

Topics relevant to development of “ EMPLOYABILITY SKILLS”: Network Design Methodology, Identifying Customer Requirements, Characterizing the Existing Network and Sites.

Course Code: CSE 6001	Course Title:Deep Learning		L-T-P-C	2	0	2	3
	Type of Course:Program Core Theory and Laboratory Integrated						
Version No.		1.0					
Course Pre-requisites	<ul style="list-style-type: none">•	<ul style="list-style-type: none">• Data Mining and Machine Learning fundamentals• Basic working knowledge of Statistics and Probability• Familiarity with programming languages and hands on coding					
Anti-requisites		NIL					
Course Description		The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.					
Course Object		The objective of the course is to familiarize the learners with the concepts of Deep Learning and attain Skill Development through Experiential Learning techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Apply basic concepts of Deep Learning to develop feed forward models 2. Apply Supervised and Unsupervised Deep Learning techniques to build effective modelsfor prediction or classification tasks 3. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. 4. Analyze performance of implemented Deep Neural models					
Course Content:							
Module 1	Introduction to Deep Learning		Assignment		Programming		No. of Classes:10
	Topics: Machine Learning in a nutshell, Fundamentals of deep learning and neural networks,Deep Neural Network,Feedforward Neural Network, , Perceptron, MLP Structures, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, Deep Neural Network for Classification.						
Module 2	Improving Deep Neural Networks		Assignment		Programming		No. of Classes:09

	Topics: Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization				
Module 3	Deep Supervised Learning Models	Assignment		Programming	No. of Classes:10
	Topics: Convolutional neural network, Prediction of image using Convolutional Neural Networks, Deep learning in Sequential Data, RNN & LSTM, GRU, Sentiment Analysis				
Module 4	Deep Unsupervised Learning	Assignment		Programming	No. of Classes:10
	Topics: Basics of Deep unsupervised learning, Auto encoders, Restricted Boltzmann Machine, Recommender systems				
	Text Book 1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017				
	References 1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience, 2nd Edition. 2013 2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015 3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013 4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008. https://sm-nitk.vlabs.ac.in/ https://nptel.ac.in/courses/105105157				
	Topics relevant to “SKILL DEVELOPMENT”: Real time Data Analysis, Naming and coding for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE 3014	Course Title: FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING		L- T-P- C	3	0	0	3
Version No.	1.0						
Course Pre-requisites	[1] CSE 3001 – Artificial Intelligence and Machine Learning						
Anti-requisites	NIL						
Course Description	<p>The purpose of this course is to introduce students to the science of natural language processing (NLP). NLP is the science of extracting information from unstructured text. It is basically how we can teach machines to understand human languages and extract meaning from text. In addition to regular theory, the course also involves:</p> <ol style="list-style-type: none"> 1. Programming Assignments 2. Regular Quiz Tests (once a week and once after every module) 						
Course Objective	<p>The objective of the course is to familiarize the learners with the concepts of Fundamentals of Natural language Processing and attain Skill Development through Participative Learning techniques.</p>						
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ul style="list-style-type: none"> • Understand the fundamental concepts of Natural Language Processing. [Knowledge] • Read corpora and train models for different NLP tasks. [Application] • Use word embeddings for solving an NLP Application. [Application] • Understand sequence to sequence modeling as used in machine translation. [Application] 						
Course Content:							
Module 1	Introduction	Quizzes					7 Sessions
	Topics: Introduction. History. Text Analytics. Various tasks in NLP. Sentence boundary Detection. Edit distance. Introduction to word embeddings, PoS tagging, chunking, parsing, machine translation.						
Module 2	Word and Text Representations	Quizzes			Assignments		8 Sessions
	Topics: Logistic Regression and Naïve Bayes classification. Vector semantics and embeddings. Neural Networks and Neural Language Models. Text representations and classification. Deep learning architectures for sequence processing (CNN and LSTM).						
Module 3	PoS Tagging, NER Tagging and Parsing	Quizzes			Assignments		12 Sessions
	Topics:						

	Part-of-Speech Tagging – using NLTK and spacy. Building a PoS Tagger using existing data and Hidden Markov Model. Named Entity Recognition. Relationship between NER tagging and PoS tagging. Constituency Parsing.				
Module 4	NLP Applications	Quizzes			9 Sessions
	Topics: Lexical Resource Creation. Sentiment Analysis. Machine Translation. Word Sense Disambiguation and WordNet. Question Answering.				
	Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. Python Libraries (Eg. NLTK, Spacy, etc.) 2. Java (Stanford CoreNLP) 3. Google Colab 				
	Project work/Assignment:				
	Assignment: Students will have to do group assignments for Modules 2 & 3. As a part of their assignments, they will have to implement the solution to particular problems.				
	Text Book T1 Daniel Jurafsky, and James Martin. “ <i>Speech and Language Processing</i> ” (3rd edition draft, 2022)				
	References 1 Chris Manning and Hinrich Schütze, “ <i>Foundations of Statistical Natural Language Processing</i> ”, 1st Edition, MIT Press. 1999. 2 Pawan Goyal, “ <i>Natural Language Processing</i> ”. NPTEL. E-Book Link for R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBgAvLd1WscI0RqC/view Web resources: https://web.stanford.edu/~jurafsky/slp3/ NPTEL Course: https://onlinecourses.nptel.ac.in/noc22_cs98/course				
	Topics relevant to “SKILL DEVELOPMENT”: Assignment implementations in software, batch wise presentations for developing Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE3152		Course Title: .NET Full Stack Development			L- T-P- C	2	0	2	3
Version No.		1.0							
Course Pre-requisites		Nil							
Anti-requisites		CSE3151 Java Full Stack Development							
Course Description		This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.							
Course Objectives		The objective of the course is to familiarize the learners with the concepts of DotNET FULL STACK Development and attain Employability Skills through Experiential Learning techniques.							
Course Outcomes		On successful completion of the course the students shall be able to: 1] Practice the use of C# for developing a small application [Application] 2] Show web applications using Entity Framework. [Application] 3]Solve simple web applications that use SQL and ASP.NET [Application] 4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]							
Course Content:									
Module 1		C# Programming for Full Stack Development	Project		Programming	10 Sessions			
	Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework Assignment: Develop a small application for managing library using C#.								
Module 2		Entity Framework Core 2.0	Project		Programming	06 Sessions			
	Topics:								

	Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET Assignment: Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project		Programming	06 Sessions
	Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; Assignment: Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project		Programming	08 Sessions
	Topics: Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application Assignment: Develop a software tool to do inventory management in a warehouse.				
	Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Visual Studio				
	Project work/Assignment:				
1.	2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using .NET. 3. Assignment: Case study on Web sites development				
	Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 T2. Valerio De Sanctis, “ <i>ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11</i> ”, 4th Edition, Packt, 2021.				
	References R1. Benjamin Perkins, Jon D. Reid, “ <i>Beginning C# and .NET</i> ”, Wiley, 2021 Reid, 2021. R2. Piotr Gankiewicz, “ <i>Full Stack .NET Web Development</i> ”, Packt Publishing, 2017. R3. Tamir Dresher, Amir Zuker, Shay Friedman, “ <i>Hands-On Full-Stack Web Development with ASP.NET Core</i> ”, Packt Publishing, 2018. R4. Dustin Metzgar, “ <i>Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core</i> ”, Manning, 2017.				
	Topics relevant to development of “Employability”: C#, ASP.NET & SQL for developing Employability Skill Development through Experiential Learning techniques.. This is attained through assessment component mentioned in course handout.				

Course Code: CSE390	Course Title: Front-end Full Stack Development	L- T-P- C	0	0	4	2
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts Front end Full Stack Development and attain Employability through experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension] Illustrate a basic web design using HTML, CSS, Javascript. [Application] Illustrate development of a responsive web. [Application] Apply concepts of Angular.js to develop a web front-end. [Application]					
Course Content:						
Module 1	Fundamentals of DevOps	Project		Programming		04 Sessions
Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control.						
Module 2	Web Design & Development	Project		Programming		03 Sessions
Topics: HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform; Assignment: Develop a website for managing HR policies of a department.						
Module 3	Responsive web design	Project		Programming		08 Sessions
Topics: Bootstrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society..						

Module 4	Fundamentals of Angular.js	Project	Programming	15 Sessions
Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Overview of React.js Assignment: Develop a software tool to do inventory management in a warehouse.				
Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: GCC compiler.				
Text Book: Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 Northwood, Chris, “ <i>The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer</i> ”, APress, 2018				
References: R1. Flanagan D S, “ <i>Javascript : The Definitive Guide</i> ” 7th Edition. 7th ed. O'Reilly Media; 2020. Alex Libby, Gaurav Gupta, and Asoj Talesra. “ <i>Responsive Web Design with HTML5 and CSS3 Essentials</i> ”, Packt Publishing, 2016 J. Duckett J Rupert G Moore J. “ <i>Javascript & JQuery : Interactive Front-End Web Development.</i> ”; Wiley; 2014. Web Reference: www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxIY_uTWA&index=2 Web Reference: https://www.freecodecamp.org/news/frontend-web-developer-bootcamp/ https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live https://nptel.ac.in/courses/106102064				
Topics relevant to development of “Employability”: DevOps Tools Overview – Jenkins, Docker, Kubernetes for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE 2033	Course Title: Go Programming Type of Course: Theory Only Course		L- T-P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		Computer Programming/ Object Oriented Programming (java)					
Anti-requisites		NIL					
Course Description		Go is an open source programming language created by Google. Go is expressive, concise, clean, and efficient. Its concurrency mechanisms make it easy to write programs that get the most out of multicore and networked machines. Go compiles quickly to machine code yet has the convenience of garbage collection and the power of run-time reflection. It's a fast, statically typed, compiled language that feels like a dynamically typed, interpreted language. It is gaining popularity and it is continuing to grow rapidly in industries such as Dropbox, Uber etc. This course will provide an introduction to the Go programming essentials to students of Engineering through lecture hours with demonstrations. Topics: Topics covered in this course are go program structure; data types and control statements; Composite Types – arrays, slices, strings, runes, bytes, hash maps; functions; methods; garbage collection essentials – pointers, structs, interfaces; error handling; Concurrency – go routines and channels, Packages – import and create custom packages and applications of Go					
Course Objective		The objective of the course is to familiarize the learners with the concepts of GO Programming and attain Employability Skills through Problem Solving techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Identify primitive programming constructs in GO. (Knowledge) CO2: Discuss composite data types with concepts of modular programming. (Comprehension) CO3: Implement garbage collection using pointers, structs, interfaces and modules. (Application) CO4: Apply concurrent programming and test routines with applications. (Application)					
Course Content:							
Module 1	Introduction to Go Programming Language	Assignment	Data Collection/Interpretation			10 Sessions	
	Topics: Knowledge]						

Feature of Go language, Installing and Configuring the development environment- Go tools and playground. Structure of Go program; Basic types-numbers, boolean, strings, runes. Variables- declaration, zero values, naming, rules, conversions, constants, multiple variables. Introduction to packages, functions from other packages, println, reading input, Control Structures - if, switch, for, programming exercises using control statements.					
Module 2	Composite types and functions	Assignment	Data Collection/Interpretation		9 Sessions
Topics: [Comprehension] Composite types - arrays, slices, slices with overlapping storage, Structs. Functions-declaring, parameters, returning multiple values, variadic functions; Programming exercises					
Module 3	Pointers, Structs, Interfaces and modules	Quiz	Case studies / Case let		9 Sessions
Topics: Application] Pointers: *and & operator, types, pointers with functions, garbage collector – history, Methods and Interfaces, Modules,packages – importing and creating custom packages; Programming exercises.					
Module 4	Concurrency and Applications	Quiz	Case studies / Case let		7 Sessions
Topics: Application] Concurrency using Go routines, multiple go routines, channels – channel operations, Testing-writing test, Go test command, Core Packages for – strings, containers and lists, Writing Web Applications, Basic Statistical Computations, histogram plotting, encryption and decryption.					
Targeted Application & Tools that can be used: 1. https://go.dev/play/ 2. https://go.dev/doc/install					
Project work/Assignment:					
Text Book T1 1. John Badner, "Learning Go: An Idiomatic Approach to Real World Go Programming", Oreilly, California,2021.					
References R1. 1. Alan A.A. Donovan and Brian W. Kernighan, "The Go Programming Language", Pearson Education, India,2016. R2. Tsoukalos M. Mastering Go: Create Golang production applications using network libraries, concurrency, machine learning, and advanced data structures. Packt Publishing Ltd; 2019 Aug 29. Web resources: https://www.golangprograms.com/go-language.html EBSCO database of Presidency University: https://puniversity.informaticsglobal.com/login					

	<p>W3. GO document: https://go.dev/doc/</p> <p>Online tool for program execution:</p> <ul style="list-style-type: none"> • GO Play Ground - https://go.dev/play/ • Download and install: https://go.dev/doc/install
	<p>Topics relevant to development of “Employability”: Go Programming basics for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE2015	Course Title: Data Analysis and Visualization Type of Course: 1] Program core 2] Lab Integrated Course		L- T- P- C	2	0	4	4
Version No.	1.0						
Course Pre-requisites	Python Programming						
Anti-requisites	NIL						
Course Description	<p>The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts.</p> <p>The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization.</p> <p>With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.</p>						
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Analysis and Visualization and attain EMPLOYABILITY through Experiential Learning techniques.						
Course Out Comes	<p>On successful completion of this course the students shall be able to:</p> <ol style="list-style-type: none"> Understand the various types of data, apply and evaluate the principles of data visualization. Acquire skills to apply visualization techniques to a problem and its associated dataset. Create interactive visualization for better insight using various visualization tools. Handle data occurring in large volumes Implement the visualization concepts practically using Python 						
Course Content:							
Module 1	Introduction to Data Visualization (Comprehension)	Assignment	Programming activity				10 Hours
	<p>Topics: Data collection, Data Preparation Basic Models- Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Interacting with Databases, Data Cleaning and Preparation, Handling Missing Data, Data Transformation.</p> <p>Python Libraries: NumPy, pandas, matplotlib, GGplot, Introduction to pandas Data Structures</p>						

Module 2	Data Visualization Techniques (Application)	Assignment	Programming activity		10 Hours
	Topics: Scalar and point techniques – vector visualization techniques – matrix visualization, Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data, Visual Variables- Networks and Trees - Map Color and Other Channels- Manipulate View- Heat Map.				
Module 3	Visual Analysis of data from various domain (Application)	Assignment	Programming activity		10 Hours
	Topics: Time-oriented data visualization – Spatial data visualization, Text data visualization – Multivariate data visualization and case studies, Finance- marketing-insurance-healthcare etc.				
Module 4	Visualization of Streaming Data (Application)	Assignment	Programming activity		10 Hours
	Topics: Guidelines for designing successful visualizations, Data visualization dos and don'ts, Best practices of Data Streaming, processing streaming data for visualization, presenting streaming data, streaming visualization techniques, streaming analysis.				
	List of Laboratory Tasks: Labsheet -1 [4 Practical Sessions] Working with Numpy Functions and Pandas functions Acquiring and plotting data. Labsheet -2 [4 Practical Sessions] Practicals based on Data Cleaning and Preparation Practicals based on Data Wrangling Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance Labsheet – 3 [4 Practical Sessions] Practicals based on Data Visualization using matplotlib Visualization of various massive dataset - Finance - Healthcare - Census Labsheet – 4 [4 Practical Sessions] Practical based on Time Series Data Analysis-stock market Market-Basket Data analysis-visualization Text visualization using web analytics Labsheet -5 [4 Practical Sessions] Financial analysis using Clustering, Histogram and HeatMap Visualization on Streaming dataset (Stock market dataset, weather forecasting)				

	Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
2.	<p>3. Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard.</p> <p>3. Programming: Implementation of the chosen dashboard</p>
	<p>Text Book</p> <p>2. McKinney, W.(2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media.</p> <p>3. Tamara Munzer, Visualization Analysis and Design, CRC Press 2014.</p> <p>4. Aragues, Anthony. Visualizing Streaming Data: Interactive Analysis Beyond Static Limits. O'Reilly Media, Inc., 2018</p> <p>5. Dr. OssamaEmbarak,“Data Analysis andVisualization Using Python”, Apress,(2018)</p>
	<p>References</p> <p>R1. Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.</p> <p>R2. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020</p> <p>3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.</p> <p>R3. García Salvador, LuengoJulían, & Herrera, F. “Data preprocessing in Data Mining”, Springer,(2015)</p> <p>R4. Stephen Few, “Information Dashboard Design: the effective visual communication of data”, Oreilly, 2006</p> <p>R5. Belorkar, A, “Interactive Data Visualization with Python” - [S.I.]: Packt Publishing, Second Edition. (2018)</p> <p>Web links</p> <p>R1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/</p> <p>R2. Google Data Analytics Professional Certificate Coursera</p> <p>R3. Learning Python for Data Analysis and Visualization Ver 1 Udemy</p> <p>R4. Data Science, Analytics and Visualization (DS) Courses Chaminade University - PROD [Integrated] Catalog</p> <p>R5. Data Visualization Training and Certification Courses Koenig Solutions (koenig-solutions.com)</p>
	Topics relevant to “Employability”: Visual Analysis and Streaming of Data for Employability through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3085	Course Title: Real Time Operating Systems Type of Course : Theory	L-T-P- C	3	0	0	0
Version No.		1				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		The Real-time Operating Systems program is an educational and methodological document included in the master's educational program, provides for the acquisition of skills and competencies related to the study of the features of embedded operating systems, as well as real-time systems. Real-time Operating Systems is aimed at the formation of competencies aimed at obtaining theoretical knowledge about embedded operating systems, and the acquisition of practical skills and competencies in installing, configuring and debugging operating systems.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Real Time Operating Systems and attain EMPLOYABILITY SKILL through PARTICIPATIVE LEARNING techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Explain the fundamentals of Real time systems and its classifications.• Understand the concepts of computer control and the suitable computer hardware requirements for real-time applications.• Describe the operating system concepts and techniques required for real time systems.• Apply deadlock detection and prevention algorithms to solve the given problem				
Course Content:						
Module 1					8 Sessions	
	Introduction Real Time Operating System Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling					
Module 2					8 Sessions	
	BASICS OF REAL-TIME CONCEPTS Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel					
Module 3					8 Sessions	
	PROCESS MANAGEMENT Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals					
Module 4					8 Sessions	

	<p>INTER-PROCESS COMMUNICATION: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion,</p> <p>PIPES MEMORY MANAGEMENT: - Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection</p>
	<p>Text Book</p> <ol style="list-style-type: none"> 1. J. J Labrosse, “MicroC/OS-II: The Real –Time Kernel”, Newnes, 2002. 2. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000.
	<p>References</p> <ol style="list-style-type: none"> 1. W. Richard Stevens, “Advanced Programming in the UNIX® Environment”, 2nd Edition, Pearson Education India, 2011. 2. Philips A. Laplante, “Real-Time System Design and Analysis”, 3rd Edition, John Wley& Sons, 2004 3. Doug Abbott, “Linux for Embedded and Real-Time Applications”, Newnes, 2nd Edition, 2011. <p>Web resources: http://pu.informatics.global</p>
	<p>Topics relevant to development of “Skill Development”: Threads: Multi-threading models, threading issues, thread libraries, synchronization for developing Employability Skills through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE 3080	Course Title: Quantum Computing Type of Course: Integrated		L- T- P- C	2	0	2	3
Version No.		1					
Course Pre-requisites		Linear Algebra Probability and Statistics					
Anti-requisites							
Course Description		This course provides an introduction to the theory and practice of quantum computation. Topics covered include: quantum mechanics to understand quantum computation. Quantum algorithms. The Shor’s factorization algorithm Grover’s search algorithm Mathematical models of quantum computation, Quantum Machine Learning, and to physical systems.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Quantum Computing and attain EMPLOYABILITY SKILLS through EXPERIENTIAL LEARNING techniques					
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">Understand the basic principles of quantum computation and quantum mechanics.Design quantum circuits using quantum gates.Analyze the behavior of basic quantum algorithms.Understand the difference between classical and quantum machine learning approach.					
Course Content:							
Module 1	INTRODUCTION	Quiz		Quiz	10 sessions (8 T + 2 L)		
Topics: Introduction to quantum computing. Qubits, Bloch sphere, multiple qubits, quantum states and measurements, Postulates of quantum mechanics, Classical computation vs quantum computation.							
Module 2	QUANTUM MODEL OF COMPUTATION	Quiz		Quiz	12 sessions (8 T + 4 L)		
Topics: The model of quantum computation, Quantum circuits: single qubit gates, multiple qubit gates, design of quantum circuits.							
Module 3	QUANTUM ALGORITHMS	Assignment		Case Studies	12 sessions (8 T + 4 L)		
Topics: Deutsch-Jozsa algorithm and Grover’s search algorithm. Shor’s algorithm for factoring, Quantum Fourier transform.							
Module 4	QUANTUM INFORMATION THEORY & QUANTUM MACHINE LEARNING	Assignment		Case Studies	11 sessions (9 T + 2 L)		

Topics: Comparison between classical and quantum information theory, Applications of quantum information, Bell states, Quantum Machine Learning, no cloning theorem.
List of Laboratory Tasks: Lab 1: Use Qiskit Tools [Module 1] Lab 2: Display and Use System Information [Module 1] Lab 3: Construct Visualizations [Module 1] Lab 4: Perform Operations on Quantum Circuits [Module 2] Lab 5: Implement BasicAer: Python-based Simulators [Module 2] Lab 6: Access Aer Provider [Module 3] Lab 7: Implement QASM [Module 3] Lab 8: Executing Experiments [Module 3] Lab 9: Return the Experiment Results [Module 4] Lab 10: Compare and Contrast Quantum Information [Module 4]
Targeted Application & Tools that can be used 1. Framework- Qiskit 2. Language- Python 3. Applications: <ul style="list-style-type: none"> Quantum Circuits Quantum Gates Quantum Machine Learning Algorithms
<p style="text-align: center;">Project work/Assignment:</p>
Assignment: <ul style="list-style-type: none"> Create quantum circuit functions that can compute the XOR, AND, NAND and OR gates using the NOT gate (expressed as x in Qiskit), the CNOT gate (expressed as cx in Qiskit) and the Toffoli gate (expressed as ccx in Qiskit) . Measure the Bloch sphere coordinates of a qubit using the Aer simulator and plot the vector on the Bloch sphere Investigate the relationship between the number of qubits required for the desired accuracy of the phase estimation with high probability. Project Work: <ul style="list-style-type: none"> Create a program that builds an oracle for a given string (e.g. given 01101, will return a QuantumCircuit that inverts the phase of the state 01101) and leaves all other states unchanged. Tackle an open issue in the Qiskit Terra repo. Create a program that builds an oracle circuit from a problem (like the PhaseOracle class does in the previous page). Assess how the size of your circuits grow with the size of the problem.
Text Book 1. Nielsen, M., & Chuang, I. (2010). Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511976667 2. McMahon D. Quantum Computing Explained. Hoboken N.J: Wiley-Interscience : IEEE Computer Society; 2008.
References 1. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. (2004) 2. Pittenger A. O., An Introduction to Quantum Computing Algorithms (2000). E book link R1: http://community.qiskit.org/textbook

E book link R2 https://github.com/Qiskit Web resources: <ul style="list-style-type: none"> Abraham Asfaw and Antonio Corcoles & et al. “Learn Quantum Computation Using Qiskit”, 2020, http://community.qiskit.org/textbook IBM Qiskit Global Summer School 2021: Quantum Machine Learning, https://qiskit.org/events/summer-school/ https://quantum-computing.ibm.com/ https://qiskit.org/ https://presiuniv.knimbus.com/u
Topics relevant to development of “Employability Skills” <ul style="list-style-type: none"> Designing Quantum circuits Visualizing Quantum Circuit outputs Analyzing and Comparing Quantum Algorithm Performance for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3071	Course Title: Computer Vision Type of Course: Program Core Theory and Lab Integrated Course	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Linear algebra, vector calculus, and probability, Data structures					
Anti-requisites	NIL					
Course Description	This course provides an introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. We will develop the intuitions and mathematics of the methods in class, and then learn about the difference between theory and practice in homeworks.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Vision and attain EMPLOYABILITY SKILLS through EXPERIENTIAL LEARNING techniques					

Course Outcomes		<p>On successful completion of the course the students shall be able to:</p> <p>CO1: To apply mathematical modeling methods for low-, intermediate- and high-level image processing tasks.</p> <p>CO2: To perform software experiments on computer vision problems and compare their performance with the state of the art.</p> <p>CO3: To gather a basic understanding about the geometric relationships between 2D images and the 3D world.</p>			
Course Content:					
Module 1	Digital Image Processing	Programming Assignment	Data Collection and Analysis		12 sessions
	Image Formation, Image Filtering, Edge Detection, Principal Component Analysis, Corner Detection SIFT, Applications: Large Scale Image Search.				
Module 2	Geometric Techniques in Computer Vision	Programming Assignment	Data Collection and Analysis		12 sessions
	Image Transformations, Camera Projections, Camera Calibration, Depth from Stereo, Two View Structure from Motion, Object Tracking.				
Module 3	Machine Learning for Computer Vision	Programming Assignment	Data analysis		14 sessions
	Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation.				
	<p>List of Laboratory Tasks:</p> <ol style="list-style-type: none"> 1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale) 2. Implementation of Relationships between Pixels 3. Implementation of Transformations of an Image 4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization 5. Display of bit planes of an Image 6. Display of FFT (1-D & 2-D) of an image 7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image 8. Implementation of Image Smoothing Filters (Mean and Median filtering of an Image) 9. Implementation of image sharpening filters and Edge Detection using Gradient Filters 10. Image Compression by DCT, DPCM, HUFFMAN coding 11. Implementation of image restoring techniques 12. Implementation of Image Intensity slicing technique for image enhancement 				
	Targeted Application & Tools that can be used:				
	<p>Text Book</p> <p>T1 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.</p> <p>T2 Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004.</p>				
	<p>References</p> <p>R1. R. Bishop; Pattern Recognition and Machine Learning, Springer, 2006</p> <p>R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.</p> <p>R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.</p>				

	<p>Web references: https://onlinecourses.swayam2.ac.in/cec20_cs08/preview .</p> <p>Library reference: https://presiuniv.knimbus.com/user#/home</p>
	<p>Topics relevant to development of “Employability”: Image Smoothing Filters, Image sharpening filters for developing Employability Skills through Experiential Learning Techniques. This is attained through assessment component mentioned in course handout.</p>

Course Code: CSE3019	Course Title: Stochastic Decision making	L- T- P- C	3	0	0	3
	Type of Course: Theory					
Version No.	1.0					
Course Pre-requisites	A course in Statistics: STAT-UB 1 or STAT-UB 3 or STAT-UB 103. Basic familiarity with Microsoft Excel: developing and copying formulas with relative and absolute cell addresses, and using the function and chart wizards.					
Anti-requisites						
Course Description	This course introduces the basic concepts, principles, and techniques of decision making under uncertainty. Students will learn how to model complex business problems that involve risk and uncertainty with the help of spreadsheet models. The course covers analytical models such as Decision Tree, Stochastic Optimization, Simulation & Optimization, and Dynamic Optimization. The course is hands-on. The emphasis will be on model formulation and interpretation of results, not on mathematical theory. This course emphasizes optimization models with uncertain parameter values. In contrast, the DMA course focuses on various deterministic optimization models and Monte Carlo simulation.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Stochastic Decision making and attain Employability through Participative Learning techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Gain basic knowledge about stochastic processes in the time domain. The student has acquired more detailed knowledge about Markov processes with a discrete state space, including Markov chains, Poisson processes and birth and death processes. 2. Know about queueing systems and Brownian motion, in addition to mastering the fundamental principles of simulation of stochastic processes and the construction of Markov chain Monte Carlo (MCMC) algorithms. 3. formulate simple stochastic process models in the time domain and provide qualitative and quantitative analyses of such models.					
Course Content:	Use data to model currency exchange rates, stock prices, commodity prices, air travelDemand; Brief introduction to Monte Carlo simulation; Optimal financial hedging strategies; Supply contract selection; Airline booking control. Introduction to decision tree; Value of information; Bayesian updateValue an R&D project: managing technology risk; Value a license agreement; Options to postpone, expand, and contract.					
Module 1	Simple static stochastic optimization models	Assignment	Simulation/Data Analysis		14 Sessions	
Use data to model currency exchange rates, stock prices, commodity prices, air travelDemand; Brief introduction to Monte Carlo simulation; Optimal financial hedging strategies; Supply						

contract selection; Airline booking control. Introduction to decision tree; Value of information; Bayesian updateValue an R&D project: managing technology risk; Value a license agreement; Options to postpone, expand, and contract.				
Module 2	sequential decision making: decision tree	Assignment	Simulation/Data Analysis	14 Sessions
Introduction to dynamic programming; Binomial tree; American option pricing; Targeted marketingInventory management at a retail pharmacy; Optimal timing for market entry; Cash management at a retail bank.Moving average; Trends; Seasonality .Introduction to linear programming; Production planning with forecasted demand; Airline revenue management				
Module 3	Real options and decision tree	Term paper/Assignment	Simulation/Data Analysis	14 Sessions
Capital budgeting: when projects have uncertain NPVs and uncertain capital usage; Production strategy: managing quality risk of raw materials; Value-at-risk Plant location for a multinational firm: hedging currency exchange risk; Process flexibility: hedging demand risk.Inventory transshipment: managing demand risk; Capacity planning for an electric utility.				
List of Laboratory Tasks				
Targeted Application & Tools that can be used: The course is theory based and students will get hands on experience in statistical tools.				
Assignment:				
Text Book 1. J Medhi, “Stochastic Processes”				
References 1. A K Basu, “Introduction to Stochastic process” 2. Ming Liao, “Applied Stochastic Process” 3. Time A Wheeler, Kyle H.Wray, “Algorithms for Decision making”				
E-Resources https://presiuniv.knimbus.com/user#/home				
Topics relevant to the “EMPLOYABILITY SKILLS” : Combing simulation with linear optimazation, for development of Employability skills through Participative Learning Techniques . This is attained through the assessment components mentioned in the course handout.				

Course Code: CSE 3076	Course Title: Artificial Intelligence for Robotics Type of Course: Theory Only Course		L-T-P-C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		Basic Programming Concepts					
Anti-requisites		NIL					
Course Description		The course explores the intelligent system structure, working and various levels of representation. The students learn how to identify, differentiate, and categorize a wide range of intelligent system, as well as to evaluate how AI contribute to the design and development of intelligent system design. Also this course offers comprehensive knowledge and professional-level skills focused on developing and deploying software robots. It starts with the basic concepts of Robotic Process Automation. After successful completion of the qualification the candidates shall be employed in the industries for following occupations: RPA Developer, RPA Engineer, RPA Expert.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence for Robotics and attain Employability through Problem Solving Methodologies.					
Course Out Comes		On successful completion of the course the students shall be able to: CO 1: Define the basic of local search algorithms, various optimization techniques for a given AI algorithm. [Remember] CO 2: Identify the smart intelligent way to represent the knowledge Engineering. [Application] CO 3: Describe RPA, where it can be applied and how it's implemented. [Remember] CO 4: Use different types of variables, Control Flow and data manipulation techniques. [Application]					
Course Content:							
Module 1	Introduction to intelligent systems	Quiz					10 Sessions
Topics: Basic Concepts and definitions of AI. Searching: Searching for solutions, Uniformed Search Strategies, Informed Search Strategies, and Heuristic Functions. Local Search Algorithms and Optimization Problems: Hill climbing, simulated annealing, local beam, Genetic algorithms, Constraint Satisfaction Problems, Backtracking Search for CSPs. searching in solution tree- case study: water jug problem. Adversial Search: Games, Optimal Decision in Games, Alpha Beta Pruning, Evaluation Functions, Cutting off search, Games that include an Element of chance, Game programs.							
Module 2	Knowledge representations	Quiz					10 Sessions

Topics: First Order Logic: Syntax and Semantics, Using First Order Logic, Knowledge Engineering, Inference in First Order Logic: Propositional vs. First Order Inference, Unification and Lifting, Resolution, Forward and Backward Chaining.				
Module 3	Introduction To Robotic Process Automation	Assignment	Design solution to given problem	10 Sessions
Topics: Scope and techniques of automation, Robotic process automation - What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of automation. RPA BASICS: History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document - Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.				
Module 4	Rpa Tool Introduction And Basics	Assignment	Design solution to given problem	08 Sessions
Topics: The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation - Data Manipulation Introduction - Scalar variables, collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data.				
Targeted Application & Tools that can be used: Targeted application: Web Crawler, Email Crawler, etc. Tools: UiPath, Power automate, etc.				
Project work/Assignment:				
Assignment: Create a sequence that asks the user for his first and last name, and give him choices to order from his favorite snacks, and then displays his answers. Design a process to Extract Initial name from full name Design a process to insert integer and decimal value into a string without using + operator. Design a process to read text from multiple word documents				
Text Book T1 E. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill, 2013 T2 Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018				
References R1 E. Charnaik and D.McDermott," Introduction to artificial Intelligence", Pearson Education, 2012.				

R2 Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Independently Published, 1st Edition 2018.

E book link R1:

<https://s3.amazonaws.com/ebooks.syncfusion.com/downloads/robotic-process-automation-succinctly/robotic-process-automation-succinctly.pdf?AWSAccessKeyId=AKIAWH6GYCX3TD2TTP24&Expires=1668334212&Signature=3ysYmpkfW8xJnT1yiSy%2FqTq1q9w%3D>

Web resources: <https://www.uipath.com/rpa/robotic-process-automation>
<https://puniversity.informaticsglobal.com/login>
https://www.fer.unizg.hr/_download/repository/AI-1-Introduction.pdf

Topics relevant to “EMPLOYABILITY SKILLS”: Design of assistant bots, Debugging and Exception Handling, Excel Data Tables & PDF - Data Tables in RPA **for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout**

Course Code: CSA2003	Course Title: Software Metrics and Quality Management Type of Course: Integrated		L- T- P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		NIL					
Anti-requisites		NIL					
Course Description		This course will focus on the processes, principles, and techniques of software testing and analysis. It covers a full spectrum of topics from basic principles and underlying theory of testing to organizational and process issues in real-world applications. The emphasis is on selecting practical techniques to achieve an acceptable level of quality at an acceptable cost. This course will provide software engineering professionals with realistic strategies for reliable and cost-effective software testing.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Software Metrics and Quality Management and attain Employability through Experiential Learning techniques.					
Course Out Comes		On successful completion of this course the students shall be able to: <ul style="list-style-type: none">To understand software testing and quality assurance as a fundamental component of software life cycle [Knowledge]To efficiently perform T & QA activities using modern software tools [Comprehension]To prepare test plans and schedules for a T&QA project [Application]					
Course Content:							
Module 1	Introduction to Quality						12 Hours
	Topics: Introduction to Quality: Historical Perspective of Quality, what is Quality? (Is it a fact or perception?), Definitions of Quality, Core Components of Quality, Quality View, Financial Aspect of Quality, Customers, Suppliers and Processes, Total Quality Management (TQM), Quality Principles of Total Quality Management, Quality Management Through Statistical Process Control, Quality Management Through Cultural Changes, Continual (Continuous) Improvement Cycle, Quality in Different Areas, Benchmarking and Metrics, Problem Solving Techniques, Problem Solving Software Tools.						
Module 2	Software Quality						12 Hours
	Topics: Introduction, Constraints of Software Product Quality Assessment, Customer is a King, Quality and Productivity Relationship, Requirements of a Product, Organisation Culture, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Problematic Areas of Software Development Life Cycle, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.						
Module 3	Software Verification and Validation						14 Hours
	Topics: Introduction, Verification, Verification Workbench, Methods of Verification, Type, Entities involved in verification, Reviews in testing lifecycle, Coverage in Verification, Concerns of Verification,						

	Validation, Validation Workbench, Levels of Validation, Coverage in Validation, Acceptance Testing, Management of Verification and Validation, Software development verification and validation activities. V-test Model: Introduction, V-model for software, Testing during Proposal stage, Testing during requirement stage, Testing during test planning phase, Testing during design phase, Testing during coding, VV Model, Critical Roles and Responsibilities.
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1.	2. Case study on real time software applications like MSTeam 2. Implementation of verification and validation for any realtime software application.
	Text Book T1 Software Testing and Continuous Quality Improvement, William E. Lewis, CRC Press, 3 rd , 2016. T2 Software Testing: A Craftsman's Approach, Paul C. Jorgenson, CRC Press, 4 th , 2017.
	References R1. P. Ammann and J. Offutt. Introduction to Software Testing. Cambridge University Press, 2008. R2. https://www.tutorialspoint.com/software_quality_management/software_quality_management_metrics.htm https://nptel.ac.in/courses/106105150 https://nptel.ac.in/courses/106101163
	Topics relevant to “EMPLOYABILITY SKILLS”: Total quality management, software quality management, for development of Employability Skills through Experiential Learning Techniques. This is attained through assessment components mentioned in the course handout.

Course Code: CSE3098	Course Title: Vulnerability Assessment and Penetration Testing Type of Course: Theory Only Course		L-T-P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		CSE3078					
Anti-requisites		NIL					
Course Description		This course explores the tools that can be used to perform information gathering. This course also covers how vulnerability can be carried out by means of tools or manual investigation, and analysis of common attacks in data, mobile applications and wireless networks					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Vulnerability Assessment and Penetration Testing and attain Employability through Problem Solving Methodologies.					
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">Understand the basic principles for information gathering and detecting vulnerabilities in the system.Determine the security threats and vulnerabilities in SDN networks and web applications.Able to use the exploits in mobile applications and wireless networksUnderstand the metasploit and metrepreter are used to automate the attacks and penetration testing techniques.					
Course Content:							
Module 1	Information Gathering, Host Discovery and Evading Techniques	Assignment		Theory	9 Sessions		
	Topics: Introduction - Terminologies - Categories of Penetration Testing - Phases of Penetration Test - Penetration Testing Reports - Information Gathering Techniques - Active, Passive and Sources of Information Gathering – Approaches, Host discovery - Scanning for open ports and services- Types of Port, Vulnerability Scanner Function, pros and cons - Vulnerability Assessment with NMAP - Testing, SCADA environment with NMAP						
Module 2	Vulnerability Scanner in SDN Networks and Web application	Quiz		Theory	10 Sessions		
	Topics: Nessus Vulnerability Scanner - Safe check – Silent dependencies - Port Range Vulnerability Data Resources, SDN Data plane, Control Plane, Application Plane. SDN security attack vectors and SDN Hardening, Authentication Bypass with Insecure Cookie Handling - XSS Vulnerability - File inclusion vulnerability - Remote file Inclusion -Patching file Inclusions - Testing a website for SSI Injection.						
Module 3	Mobile Application Security and wireless	Quiz		Theory	11 Sessions		

	network Vulnerability analysis				
	Topics: Types of Mobile Application Key challenges in Mobile Application and Mobile application penetration testing methodology, Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention -Handheld Exploitation, WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless – WLAN Penetration Test Methodology.				
Module 4	Exploits	Quiz		Theory	8 Sessions
	Topics: Architecture and Environment- Leveraging Metasploit on Penetration Tests, Understanding - Metasploit Channels, Metasploit Framework and Advanced Environment configurations – Understanding the Soft Architecture, Configuration and Locking, Advanced payloads and add on modules Global datastore, module datastore, saved environment Meterpreter.				
	Targeted Application & Tools that can be used: This course helps the students to understand the threats and vulnerabilities using NMAP.				
	Project work/Assignment:				
	Project Assignment:				
	Text Book <ol style="list-style-type: none"> 1. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2015. ISBN : 78-1-4822-3161-8. 2. Dr. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing made easy , Syngress publications, Elsevier, 2013. ISBN :978-0-12-411644-3. 3. Mayor, K.K.Mookey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0 				
	References <ol style="list-style-type: none"> 1. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 PacktPublishing. 2. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress Publication Web resources: https://onlinecourses.nptel.ac.in/noc19_cs68/preview - IIT Kharagpur, Prof. Indranil Sen Gupta				
	Topics relevant to development of “EMPLOYABILITY SKILLS”: Exploitation, Penetration testing techniques, for development of Employability skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in course handout.				

Course Code: CSE3137	Course Title: Text Mining And Analytics Type of Course: Theory Only Course	L- T- P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		No Prerequisites				
Anti-requisites		Nil				
Course Description						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Text Mining And Analytics and attain Employability through Problem Solving Methodologies.				
Course Out Comes		On successful completion of the course the students shall be able to: 1. Interpret the contribution of text mining to generate new knowledge from natural language text 2. Extract useful information from the textual data using various classifiers and Predictors 3. Identify the various components of a web that can be used for mining process 4. Analyse social media data using appropriate web mining techniques 5. Discover interesting patterns from Social Media Networks using linear methods and models				
Course Content:						
Module 1	Text Mining: Overview, Applications and Issues					14 Sessions
	Topics : Early history, Applications, Introduction to Data Mining, Introduction to text mining, Need for text mining, Challenges in text mining, Areas of text mining, Data Retrieval, Information Retrieval.					
Module 2	TEXT EXTRACTION, CLASSIFICATION, AND CLUSTERING					14 Sessions
	Topics: Automatic keyword extraction from individual documents: Introduction, Rapid automatic keyword extraction, Candidate keywords, Keyword scores, Adjoining keywords, Extracted keywords, Benchmark evaluation, Evaluating precision and recall, Evaluating efficiency.					
Module 3	Content-based spam email classification using machine-learning algorithms					12 Sessions
	Topics: Introduction, Machine-learning algorithms, Naive Bayes, LogitBoost, Support vector machines, Data preprocessing, Feature selection, Message representation.					
	Targeted Application & Tools that can be used:					

	Project work/Assignment:
	Assignment:
	Text Book T1 Text Mining Applications and Theory, Michael W. Berry Jacob Kogan, 2010 T2 Bing Liu, Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data, Springer, Second Edition, 2011. .
	References R1 Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, First Edition, 2009. R3 Web resources: 1. https://www.ibm.com/in-en/topics/text-mining 2. pu.informatics.global, https://sm-nitk.vlabs.ac.in/
	Topics relevant to development of “EMPLOYABILITY SKILLS”: Machine learning algorithms, LogitBoost, for development of Employability Skills through Problem solving Techniques. This is attained through the assessment components as mentioned in course handout.

Course Code: CSE2029	Course Title: Web Data Analytics Type of Course: Discipline Elective in data Science basket Theory & Integrated Laboratory		L- T- P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		Python programming					
Anti-requisites		NIL					
Course Description		<p>The objective of this course is to provide overview and importance of Web analytics and helps to understand role of Web analytic. This course also explores the effective of Web analytic strategies and implementation.</p> <p>The purpose of this course is to introduce the students to the Web data analytics concept. The course is both conceptual and analytical and is understood with practical knowledge. The course develops critical thinking skills by augmenting the student's ability to develop web data analytical models for various data sets which helps to overcome many problems. The course involves quizzes and assignments.</p>					
Course Objective		This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by web analytics and improving business.					
Course Outcomes		<p>Upon successful completion of this course the students shall be able to:</p> <p>1. Understand the concept and importance of Web analytics in an organization and the role of Web analytic in collecting, analyzing and reporting website traffic. [Knowledge level]</p> <p>(2) Identify key tools and diagnostics associated with Web analytics. [Application level]</p> <p>(3) Explore effective Web analytics strategies and implementation and Understand the importance of web analytic as a tool for e-Commerce, business research, and market research. [Application level]</p> <p>(4). Understand web site data optimization.[Application level].</p>					
Course Content:							
Module 1	Introduction to Web Analytics	Quiz		Data Analytics		L-4, P-2	

	Topics: Introduction to Web Analytics: Web Analytics Approach – Data collection methods in Web Analytics -A Model of Analysis – Context matters – Data Contradiction – Working of Web Analytics: Log file analysis – Page tagging – Metrics and Dimensions – Interacting with data in Google Analytics.				
Module 2	Learning about users Through Web Analytics	Assignment	Data Collection, data analysis		L-5,P-2
	Topics: Introduction – Goals and Conversions – Conversion Rate – Goal reports in Google Analytics – Performance Indicators – Analyzing Web Users: Learning about users – Traffic Analysis – Analyzing user content – Click-Path analysis – Segmentation.				
Module 3	Web Search Engine Data Analytics	Quizzes and assignments		Google analytics	L-6 ,P-3
	Topics: Different analytical tools - Key features and capabilities of Google analytics- How Google analytics works - Implementing Google analytics - Getting up and running with Google analytics -Navigating Google analytics – Using Google analytics reports -Google metrics - Using visitor data to drive website improvement- Focusing on key performance indicators- Integrating Google analytics with third-Party applications				
Module 4	Qualitative Analysis	Project-based assignment		Reports and analytics	L-9 , P-4
	Topics: Lab Usability Testing- Heuristic Evaluations- Site Visits- Surveys (Questionnaires) - Testing and Experimentation: A/B Testing and Multivariate Testing-Competitive Intelligence - Analysis Search Analytics: Performing Internal Site Search Analytics, Search Engine Optimization (SEO) and Pay per Click (PPC)-Website Optimization against KPIs- Content optimization- Funnel/Goal optimization - Text Analytics: Natural Language Processing (NLP)- Supervised Machine Learning (ML) Algorithms-API and Web data scarping using R and Python.				
	List of Laboratory Tasks: Lab sheet 1[2 Practical Sessions] Experiment No. 1: Level 1: 1. Working concept of web analytics Level 2: 2. Evaluation with Intermediate metrics, custom metrics, calculated metrics. 3. Collection of web data and other internet data with the help of web analytics Lab Sheet 2[2 Practical Sessions]				

	<p>Experiment No. 2:</p> <p>Level 1:</p> <ol style="list-style-type: none"> 1. Delivering reports based on collected data <p>Level 2:</p> <ol style="list-style-type: none"> 2. Implement the concept of web analytics ecosystem 3. Creation of segmentation in web analytics <p>Lab Sheet 3[4 practical Sessions]</p> <p>Level 1:</p> <ol style="list-style-type: none"> 1. Visualization, acquisition and conversions of web analytics data 2. Performing site search analytics <p>Level 2:</p> <ol style="list-style-type: none"> 3. Analyze the web analytic reports and visualizations <p>Lab Sheet 4[4 practical Sessions]</p> <p>Experiment No. 4:</p> <p>Level 1:</p> <ol style="list-style-type: none"> 1. Performing visual web analytics 2. Assignments and final discussions <p>Level 2:</p> <ol style="list-style-type: none"> 3. Web Analytics case studies .
	Targeted Application & Tools that can be used: Google analytics
	Project work/Assignment:
	Web data analytics for website data
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Beasley M, (2013), Practical web analytics for user experience: How analytics can help you understand your users. Newnes, 1st edition, Morgan Kaufmann.
	<p>References</p> <ol style="list-style-type: none"> 1. Sponder M, (2013), Social media analytics: Effective tools for building, interpreting, and using metrics, 1st edition, McGraw Hill Professional. 2. Clifton B, (2012), Advanced Web Metrics with Google Analytics, 3rd edition, John Wiley & Sons.
	<p>Topics related to development of “FOUNDATION”: Web data Analytics, Google analytics reports.</p> <p>Topics related to development of “EMPLOYABILITY”: performing web data analytics for website data.</p> <p>Topics related to development of “HUMAN VALUES AND PROFESSIONAL ETHICS”: Data collection</p>

Course Code: CSE502	Course Title: Technical Skills in Java Open Elective Type of Course: Lab Integrated Course		L-T-P-C	0	0	6	3
Version No.	1.0						
	Basic knowledge of programming and data structure concepts.						
Course Pre-requisites							
Anti-requisites	NIL						
Course Description	This Course is designed for students who have prior programming experience. It provides assistance to prepare for placements and extensive exposure to object-oriented programming features. It helps to develop robust solutions for real world applications.						
Course Objective	The objective of the course is SKILL DEVELOPMENT and EMPLOYABILITY of students by using participative learning techniques.						
Course Out Comes	On successful completion of this course the students shall be able to: 1. Summarize the Object-oriented concepts with example program. 2. Implement Arrays and Strings to solve real world problems. 3. Apply the concept of polymorphism & inheritance to solve real time problems. 4. Illustrate programs on Interface, Packages 5. Demonstrate runtime errors using Exception handling.						
Course Content:							
Module 1	Introduction to Object-oriented programming	Assignment	Practical Task	14 Hours			
Topics: Introduction to object oriented programming, Java Evolution, How Java differs from C++, Features of Java, Java Environment: Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions, JDK, JVM, JRE. Java Tokens: Datatypes, Variables, Operators, Control Statements, Command Line Arguments. Classes, Objects, and Methods: Defining a class, Access Specifiers, instantiating objects, Reference variable, Accessing class members and methods, constructors, method overloading, static members, static methods, inner class, Wrapper class, Auto-boxing and Unboxing.							
Module 2	Arrays, Strings	Assignment	Practical Task	11 Hours			

Topics: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array Strings: Operation on String, Mutable & Immutable String, Creating Strings using String Buffer or StringBuilder. Assignment: Test 1, Quiz1				
Module 3	Inheritance and Polymorphism	Assignment	Practical Task	12 Hours
Inheritance and Polymorphism: Defining a subclass, Types of Inheritance, Method overriding, super keyword, Dynamic method invocation, Dynamic polymorphism, Final, Abstract, this keyword. Forms of inheritance specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance.				
Module 4	Interface and Package	Assignment	Practical task	8 Hours
Topics: Defining interfaces, extending interfaces, implementing interfaces. Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import, Naming Convention for Packages. Assignment: Test 2				
Module 5	Exception Handling	Assignment	Theory task	6 Hours
Topics: Exception Handling: Introduction to Exceptions, Difference between Exceptions & Errors, Types of Exception, Handling of Exceptions: Use of try, nested try statements, catch, finally, throw, throws, built in exceptions, User Defined Exceptions, Checked and Un-Checked Exceptions				
Text Book Text Books: <ol style="list-style-type: none"> 1. Cay S Horstmann and Cary Gornell, “<i>CORE JAVA volume I-Fundamentals</i>”, Pearson 2016. 2. Cay S Horstmann and Cary Gornell, “<i>CORE JAVA volume II-Advanced Features</i>”, Pearson 2017. 				

References

1. Herbert Schildt, *“The Complete Reference Java 2”*, Tata McGraw Hill Education, 10th Edition 2017.
2. James W. Cooper, *“Java TM Design Patterns – A Tutorial”*, Addison-Wesley Publishers 2000.

Web resources:

1. <https://www.udemy.com/course/object-oriented-programming-oops-concepts-in-english/>
2. <https://archive.nptel.ac.in/courses/106/105/106105191/>

Course Code: CSE503	Course Title: Technical Skills in Python Open Elective Type of Course: Lab Integrated Course		L-T-P-C	0	0	6	3
Version No.	1.0						
Course Pre-requisites	Basic knowledge of programming and data structure concepts.						
Anti-requisites	NIL						
Course Description	This Course is designed for students who have prior programming experience. It provides assistance to prepare for placements and extensive exposure to Programming in Python. It helps to develop robust solutions for real world applications.						
Course Objective	The objective of the course is SKILL DEVELOPMENT and EMPLOYABILITY of students by using participative learning techniques.						
Course Out Comes	On successful completion of this course the students shall be able to: 1. Summarize the Object-oriented concepts using Python with example program. 2. Implement Lists, Tuples, Dictionary and Strings to solve real world problems. 3. Apply the concept of polymorphism & inheritance to solve real time problems. 4. Illustrate programs by using Python Library 5. Demonstrate runtime errors using Exception handling.						
Course Content:							
Module 1	Introduction to Python and Basics	Assignment	Practical Task	11 Hours			
Topics: Introduction to Python programming, Python Evolution, Features of Python, Python Environment: Installing Python, Python Program Development, Python Source File Structure, Interpretation, Executions. Python Data Structures & Data Types Looping, I/O Formatting, Functions, Lambda Functions							
Module 2	Classes, Files and Exception handling	Assignment	Practical Task	8 Hours			

Topics: New Style Classes □ Creating File handling Modes □ Reading Files □ Writing & Appending to Files □ Handling File Exceptions Classes □ Instance Methods □ Inheritance □ Polymorphism □ Exception Classes & Custom Exceptions Assignment: Test 1, Quiz 1				
Module 3	Data Structures, Collections, generators and Iterators	Assignment	Practical Task	11 Hours
List Comprehensions □ Nested List Comprehensions □ Dictionary Comprehensions named tuple() □ deque □ ChainMap □ Counter □ OrderedDict Iterators □ Generators □ The Functions any and all □ With Statement				
Module 4	GUIs, Date and time, Regular expressions	Assignment	Practical task	11 Hours
Topics: Components and Events □ An Example GUI □ The root Component □ Adding a Button □ Entry Widgets □ Text Widgets sleep □ Program execution time □ more methods on date/time Filter □ Map □ Reduce □ Decorators □ Frozen set Split □ Working with special characters, date, emails □ Quantifiers □ Match and find all Assignment: Test 2				
Module 5	Threads, API, Django	Assignment	Theory task	10 Hours
Topics: Class and threads □ Multi-threading □ Synchronization □ Treads Life cycle Introduction □ Facebook Messenger □ Openweather Django Overview □ Django Installation □ Creating a Project □ Usage of Project in depth Discussion □ Creating an Application □ Understanding Folder Structure				
Text Book Text Books: 1. Python Programming – A Modular Approach Pearson 2021. 2. Martin C Brown “The Complete reference Python”, McGraw Hill 2021.				

References

1. Mark Lutz, *“Learning Python”*, OReilly 2021.

Web resources:

- 1 <https://developers.google.com/edu/python/>
- 2 https://www.educative.io/courses/learn-python-3-from-scratch?affiliate_id=5073518643380224

Course Code: CSE3035	Course Title: R Programming for Data Science			L-T- C	P-1	0	4	3
	Type of Course: Program Core Lab Integrated Course							
Version No.		1.0						
Course Pre-requisites		Nil						
Anti-requisites		Nil						
Course Description		R Programming for Data Science is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an intuitive way to analysis the data. This course will help the students to apply the knowledge on Data Analytics to a wide range of applications.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of R Programming for Data Science and attain Employability through Problem Solving Methodologies.						
Course Out Comes		On successful completion of the course the students shall be able to: 1) Describe the R programming for Data Analytics.[Knowledge] 2) Generalize the appropriate visualization methods.[Comprehension] 3) Demonstrate the various statistical testing methods.[Application] 4) Apply the probability and complex distribution functions for the analysis of data.[Application]						
Course Content:								
Module 1	Introduction to R Programming	Case studies	Programming		8 Sessions			
	R Studio: Base R-R Studio IDE-Introduction to R Projects and R Markdown. Basic R: R as a calculator-Scripts and Comments-R Variables. Data I/O: Working Directories-Importing Data-Exporting Data-More ways to save-Data I/O in Base R. Subsetting Data in R: Selecting specific elements-Renaming Columns-Subsetting Columns - Subsetting Rows – Adding/Removing Columns-Ordering Columns - Ordering Rows							
Module 2	Data Analysis	Case studies	Programming		10 Sessions			
	Data Summarization: One Quantitative and Categorical Variable. Data Classes: One Dimensional Data Classes-Data Frames and Matrices-Lists. Data Cleaning: Dealing with Missing Data-Strings and Recoding Variables. Manipulating Data in R: Reshaping Data-Merging Datasets. Data Visualizations: Plotting with ggplot2- Plotting with Base R							

Module 3	Statistical Analysis in R	Case studies	Programming		8 Sessions
	Proportion tests-Chi squared test-Fisher exact test-Correlation-T test-Wilcoxon Rank sum tests-Wilcoxon signed rank test- One Way ANOVA- Kruskal Wallis Test-Linear Regression-Logistic Regression and Generalized Linear Models-Poisson Regression.				
Module 4	Simulations	Case studies	Programming		10 Sessions
	Functions: Writing your own function-Loops. Simulations: Standard Probability Distributions-Sampling from more Complex Distributions-The Accept and Reject Algorithm-The Metropolis Hasting Algorithm. R Markdown: Exploratory Analysis-Multiple Facets-Linear Models- Grabbing coefficients-Pander-Multiple Models-Data Extraction				
	Targeted Applications & Tools that can be used: Tools: R Programming				
	Lab:				
	Exp 1. Level 1: <ol style="list-style-type: none"> create a new variable called my.num that contains 6 numbers multiply my.num by 4 create a second variable called my.char that contains 5 character strings combine the two variables my.num and my.char into a variable called both what is the length of both? what class is both? divide both by 3, what happens? Level 2: <ol style="list-style-type: none"> create a vector with elements 1 2 3 4 5 6 and call it x create another vector with elements 10 20 30 40 50 and call it y what happens if you try to add x and y together? why? append the value 60 onto the vector y (hint: you can use the c() function) add x and y together multiply x and y together. pay attention to how R performs operations on vectors of the same length. Exp 2. Level 1: <ol style="list-style-type: none"> Read in the Youth Tobacco study, Youth_Tobacco_Survey_YTS_Data.csv and name it youth. Install and invoke the readxl package. RStudio > Tools > Install Packages. Type readxl into the Package search and click install. Load the installed library with library(readxl). Level 2: <ol style="list-style-type: none"> Download an Excel version of the Monuments dataset, Monuments.xlsx, from CANVAS. Use the read_excel() function in the readxl package to read in the dataset and call the output mon. Write out the mon R object as a CSV file using readr::write_csv and call the file "monuments.csv". 				

	<p>c. Write out the mon R object as an RDS file using <code>readr::write_rds</code> and call it “monuments.rds”.</p> <p>Exp 3:</p> <p>Level 1:</p> <ol style="list-style-type: none"> Check to see if you have the <code>mtcars</code> dataset by entering the command <code>mtcars</code>. What class is <code>mtcars</code>? How many observations (rows) and variables (columns) are in the <code>mtcars</code> dataset? Copy <code>mtcars</code> into an object called <code>cars</code> and rename <code>mpg</code> in <code>cars</code> to <code>MPG</code>. Use <code>rename()</code>. Convert the column names of <code>cars</code> to all upper case. Use <code>rename_all</code>, and the <code>toupper</code> command (or <code>colnames</code>). Convert the rownames of <code>cars</code> to a column called <code>car</code> using <code>rownames_to_column</code>. Subset the columns from <code>cars</code> that end in "p" and call it <code>pvars</code> using <code>ends_with()</code>. Create a subset <code>cars</code> that only contains the columns: <code>wt</code>, <code>qsec</code>, and <code>hp</code> and assign this object to <code>carsSub</code>. What are the dimensions of <code>carsSub</code>? (Use <code>select()</code> and <code>dim()</code>.) <p>Level 2:</p> <ol style="list-style-type: none"> Convert the column names of <code>carsSub</code> to all upper case. Use <code>rename_all()</code>, and <code>toupper()</code> (or <code>colnames()</code>). Subset the rows of <code>cars</code> that get more than 20 miles per gallon (<code>mpg</code>) of fuel efficiency. How many are there? (Use <code>filter()</code>.) Subset the rows that get less than 16 miles per gallon (<code>mpg</code>) of fuel efficiency and have more than 100 horsepower (<code>hp</code>). How many are there? (Use <code>filter()</code>.) Create a subset of the <code>cars</code> data that only contains the columns: <code>wt</code>, <code>qsec</code>, and <code>hp</code> for cars with 8 cylinders (<code>cyl</code>) and reassign this object to <code>carsSub</code>. What are the dimensions of this dataset? Re-order the rows of <code>carsSub</code> by weight (<code>wt</code>) in increasing order. (Use <code>arrange()</code>.) Create a new variable in <code>carsSub</code> called <code>wt2</code>, which is equal to <code>wt^2</code>, using <code>mutate()</code> and piping <code>%>%</code>. <p>Exp 4:</p> <p>Level 1:</p> <ol style="list-style-type: none"> How many bike lanes are currently in Baltimore? You can assume that each observation/row is a different bike lane. How many (a) feet and (b) miles of total bike lanes are currently in Baltimore? (The <code>length</code> variable provides the length in feet.) How many types (<code>type</code>) bike lanes are there? Which type (a) occurs the most and (b) has the longest average bike lane length? <p>Level 2:</p>
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	<p>a. How many different projects (project) do the bike lanes fall into? Which project category has the longest average bike lane length?</p> <p>b. What was the average bike lane length per year that they were installed? (Be sure to first set <code>dateInstalled</code> to NA if it is equal to zero.)</p> <p>c. Numerically and graphically describe the distribution of bike lane lengths (length).</p> <p>d. Describe the distribution of bike lane lengths numerically and graphically after stratifying them by (a) type and then by (b) number of lanes (numLanes).</p> <p>Exp 5:</p> <p>Level 1:</p> <p>a. Get all the different types of bike lanes from the type column. Use <code>sort(unique())</code>. Assign this to an object <code>btypes</code>. Type <code>dput(btypes)</code>.</p> <p>b. By rearranging vector <code>btypes</code> and using <code>dput</code>, recode type as a factor that has <code>SIDEPATH</code> as the first level. Print <code>head(bike\$type)</code>. Note what you see. Run <code>table(bike\$type)</code> afterwards and note the order.</p> <p>c. Make a column called <code>type2</code>, which is a factor of the type column, with the levels: <code>c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE")</code>. Run <code>table(bike\$type2)</code>, with the options <code>useNA = "always"</code>. Note, we do not have to make type a character again before doing this.</p> <p>Level 2:</p> <p>a. • Reassign <code>dateInstalled</code> into a character using <code>as.character</code>. Run <code>head(bike\$dateInstalled)</code>.</p> <p>b. Reassign <code>dateInstalled</code> as a factor, using the default levels. Run <code>head(bike\$dateInstalled)</code>.</p> <p>c. Do not reassign <code>dateInstalled</code>, but simply run <code>head(as.numeric(bike\$dateInstalled))</code>. We are looking to see what happens when we try to go from factor to numeric.</p> <p>d. Do not reassign <code>dateInstalled</code>, but simply run <code>head(as.numeric(as.character(bike\$dateInstalled)))</code>. This is how you get a “numeric” value back if they were incorrectly converted to factors.</p> <p>• Convert type back to a character vector. Make a column <code>type2</code> (replacing the old one), where if the type is one of these categories <code>c("CONTRAFLOW", "SHARED BUS BIKE", "SHARROW", "SIGNED ROUTE")</code> call it "OTHER". Use <code>%in%</code> and <code>ifelse</code>. Make <code>type2</code> a factor with the levels <code>c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE", "OTHER")</code>.</p> <p>• Parse the following dates using the correct lubridate functions:</p> <p>a. “2014/02-14”</p> <p>b. “04/22/14 03:20” assume <code>mdy</code></p> <p>c. “4/5/2016 03:2:22” assume <code>mdy</code></p> <p>Exp 6:</p> <p>Level 1:</p> <p>a. Count the number of rows of the bike data and count the number of complete cases of the bike data. Use <code>sum</code> and <code>complete.cases</code>.</p> <p>b. Create a data set called <code>namat</code> which is equal to <code>is.na(bike)</code>. What is the class of <code>namat</code>? Run <code>rowSums</code> and <code>colSums</code> on <code>namat</code>. These represent the number of missing values in the rows and columns of <code>bike</code>. Don’t print <code>rowSums</code>, but do a table of the <code>rowSums</code>.</p> <p>c. Filter rows of <code>bike</code> that are NOT missing the route variable, assign this to the object <code>have_route</code>. Do a table of the <code>subType</code> variable using <code>table</code>, including the missing <code>subTypes</code>. Get the same frequency distribution using <code>group_by(subType)</code> and <code>tally()</code> or <code>count()</code>.</p>
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- d. Filter rows of bike that have the type SIDEPATH or BIKE LANE using %in%. Call it side_bike. Confirm this gives you the same number of results using the | and ==.
- e. Do a cross tabulation of the bike type and the number of lanes (numLanes). Call it tab. Do a prop.table on the rows and columns margins. Try as.data.frame(tab) or broom::tidy(tab).
- f. Read the Property Tax data into R and call it the variable tax.
- g. How many addresses pay property taxes? (Assume each row is a different address.)
- h. What is the total (a) city (CityTax) and (b) state (SateTax) tax paid? You need to remove the \$ from the CityTax variable, then you need to make it numeric. Try str_replace, but remember \$ is “special” and you need fixed() around it.
- i. Using table() or group_by and summarize(n()) or tally().
 - a. How many observations/properties are in each ward (Ward)?
 - b. What is the mean state tax per ward? Use group_by and summarize.
 - c. What is the maximum amount still due (AmountDue) in each ward? Use group_by and summarize with 'max'.
 - d. What is the 75th percentile of city and state tax paid by Ward? (quantile)
- j. Make boxplots showing CityTax (y-variable) by whether the property is a principal residence (x = ResCode) or not. You will need to trim some leading/trailing white space from ResCode.

Level 2:

- a. Subset the data to only retain those houses that are principal residences. Which command subsets rows? Filter or select?
 - a. How many such houses are there?
 - b. Describe the distribution of property taxes on these residences. Use hist/qplot with certain breaks or plot(density(variable)).
- b. Make an object called health.sal using the salaries data set, with only agencies (JobTitle) of those with “fire” (anywhere in the job title), if any, in the name remember fixed("string_match", ignore_case = TRUE) will ignore cases.
- c. Make a data set called trans which contains only agencies that contain “TRANS”.
- d. What is/are the profession(s) of people who have “abra” in their name for Baltimore’s Salaries? Case should be ignored.
- e. What does the distribution of annual salaries look like? (use hist, 20 breaks) What is the IQR? Hint: first convert to numeric. Try str_replace, but remember \$ is “special” and you need fixed() around it.
- f. Convert HireDate to the Date class - plot Annual Salary vs Hire Date. Use AnnualSalary ~ HireDate with a data = sal argument in plot or use x, y notation in scatter.smooth. Use the lubridate package. Is it mdy(date) or dmy(date) for this data - look at HireDate.
- g. Create a smaller dataset that only includes the Police Department, Fire Department and Sheriff’s Office. Use the Agency variable with string matching. Call this emer. How many employees are in this new dataset?
- h. Create a variable called dept in the emer data set, dept = str_extract(Agency, ".*(ment|ice)"). E.g. we want to extract all characters up until ment or ice (we can group in regex using parentheses) and then discard the rest. Replot annual salary versus hire date and color by dept (not yet - using ggplot). Use the argument col = factor(dept) in plot.

- i. (Bonus). Convert the 'LotSize' variable to a numeric square feet variable in the tax data set. Some tips: a) 1 acre = 43560 square feet b) The hyphens represent a decimals. (This will take a lot of searching to find all the string changes needed before you can convert to numeric.)

Exp 7:

Level 1:

- a. Read in the Bike_Lanes_Wide.csv dataset and call it wide.
- b. Reshape wide using pivot_longer. Call this data long. Make the key lanetype, and the value the_length. Make sure we gather all columns but name, using -name. Note the NAs here.
- c. Read in the roads and crashes .csv files and call them road and crash.
- d. Replace (using str_replace) any hyphens (-) with a space in crash\$Road. Call this data crash2. Table the Road variable.
- e. How many observations are in each dataset?
- f. Separate the Road column (using separate) into (type and number) in crash2. Reassign this to crash2. Table crash2\$type. Then create a new variable calling it road_hyphen using the unite function. Unite the type and number columns using a hyphen (-) and then table road_hyphen.
- g. Which and how many years were data collected in the crash dataset?
- h. Read in the dataset Bike_Lanes.csv and call it bike.

Level 2:

- a. Keep rows where the record is not missing type and not missing name and re-assign the output to bike.
- b. Summarize and group the data by grouping name and type (i.e for each type within each name) and take the sum of the length (reassign the sum of the lengths to the length variable). Call this data set sub.
- c. Reshape sub using pivot_wider. Spread the data where the key is type and we want the value in the new columns to be length - the bike lane length. Call this wide2. Look at the column names of wide2 - what are they? (they also have spaces).
- d. Join data in the crash and road datasets to retain only complete data, (using an inner join) e.g. those observations with road lengths and districts. Merge without using by argument, then merge using by = "Road". call the output merged. How many observations are there?
- e. Join data using a full_join. Call the output full. How many observations are there?
- f. Do a left join of the road and crash. ORDER matters here! How many observations are there?
- g. Repeat above with a right_join with the same order of the arguments. How many observations are there?

Exp 8

Level 1:

- a. Plot average ridership (avg data set) by date using a scatterplot.
 - a. Color the points by route (orange, purple, green, banner)
 - b. Add black smoothed curves for each route
 - c. Color the points by day of the week
- b. Replot 1a where the colors of the points are the name of the route (with banner → blue)
`pal = c("blue", "darkgreen", "orange", "purple")`
- c. Plot average ridership by date with one panel per route

Level 2:

- a. Plot average ridership by date with separate panels by day of the week, colored by route
- b. Plot average ridership (avg) by date, colored by route (same as 1a). (do not take an average, use the average column for each route). Make the x-label "Year". Make the y-label "Number of People". Use the black and white theme `theme_bw()`. Change the text_size to `(text = element_text(size = 20))` in theme.
- c. Plot average ridership on the orange route versus date as a solid line, and add dashed "error" lines based on the boardings and alightings. The line colors should be orange. (hint `linetype` is an aesthetic for lines - see also `scale_linetype` and `scale_linetype_manual`. Use `Alightings = "dashed", Boardings = "dashed", Average = "solid"`)

Exp 9

Level 1:

- a. Compute the correlation between the 1980, 1990, 2000, and 2010 mortality data. No need to save this in an object. Just display the result to the screen. Note any NAs. Then compute using `use = "complete.obs"`.
- b.
 - a. Compute the correlation between the Myanmar, China, and United States mortality data. Store this correlation matrix in an object called `country_cor`
 - b. Extract the Myanmar-US correlation from the correlation matrix.
- c. Is there a difference between mortality information from 1990 and 2000? Run a paired t-test and a Wilcoxon signed rank test to assess this. Hint: to extract the column of information for 1990, use `mort$"1990"`

Level 2:

- a. Using the cars dataset, fit a linear regression model with vehicle cost (`VehBCost`) as the outcome and vehicle age (`VehicleAge`) and whether it's an online sale (`IsOnlineSale`) as predictors as well as their interaction. Save the model fit in an object called `lmfit_cars` and display the summary table.
- b. Create a variable called `expensive` in the cars data that indicates if the vehicle cost is over \$10,000. Use a chi-squared test to assess if there is a relationship between a car being expensive and it being labeled as a "bad buy" (`IsBadBuy`).

	<p>c. Fit a logistic regression model where the outcome is “bad buy” status and predictors are the expensive status and vehicle age (VehicleAge). Save the model fit in an object called <code>logfit_cars</code> and display the summary table. Use <code>summary</code> or <code>tidy(logfit_cars, conf.int = TRUE, exponentiate = TRUE)</code> or <code>tidy(logfit_cars, conf.int = TRUE, exponentiate = FALSE)</code> for log odds ratios</p> <p>Exp 10</p> <p>Level 1:</p> <ul style="list-style-type: none"> • Write a function, <code>sqdif</code>, that does the following: <ul style="list-style-type: none"> a. takes two numbers <code>x</code> and <code>y</code> with default values of 2 and 3. b. takes the difference c. squares this difference d. then returns the final value e. checks that <code>x</code> and <code>y</code> are numeric and stops with an error message otherwise <p>Level 2:</p> <ul style="list-style-type: none"> • Try to write a function called <code>top()</code> that takes a matrix or <code>data.frame</code> and a number <code>n</code>, and returns the first <code>n</code> rows and columns, with the default value of <code>n=5</code>. • Write a function that will calculate a 95% one sample <code>t</code> interval. The results will be stored in a list to be returned containing sample mean and the confidence interval. The input to the functions is the numeric vector containing our data. For review, the formula for a 95% one sample <code>t</code> interval is $\bar{x} \pm 1.96 * s / \sqrt{n}$. <p>Exp 11</p> <p>Level 1:</p> <p>Simulate a random sample of size <code>n=100</code></p> <ul style="list-style-type: none"> • from <ul style="list-style-type: none"> a. a normal distribution with mean 0 and variance 1. (see <code>rnorm</code>) b. a normal distribution with mean 1 and variance 1. (see <code>rnorm</code>) c. a uniform distribution over the interval <code>[-2, 2]</code>. (see <code>runif</code>) • Run a simulation experiment to see how the type I error rate behaves for a two sided one sample <code>t</code>-test when the true population follows a Uniform distribution over <code>[-10,10]</code>. Modify the function <code>t.test.sim</code> that we wrote to run this simulation by <ul style="list-style-type: none"> • changing our random samples of size <code>n</code> to come from a uniform distribution over <code>[-10,10]</code> (see <code>runif</code>). • performing a two sided <code>t</code>-test instead of a one sided <code>t</code>-test. • performing the test at the 0.01 significance level. • choosing an appropriate value for the null value in the <code>t</code>-test. Note that the true mean in this case is 0 for a <code>Uniform(-10,10)</code> population. Try this experiment for
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	<p>$n=10,30,50,100,500$. What happens the estimated type I error rate as n changes? Is the type I error rate maintained for any of these sample sizes?</p> <p>Level 2:</p> <ul style="list-style-type: none"> From introductory statistics, we know that the sampling distribution of a sample mean will be approximately normal with mean μ and standard error σ/\sqrt{n} if we have a random sample from a population with mean μ and standard deviation σ and the sample size is “large” (usually at least 30). In this problem, we will build a simulation that will show when the sample size is large enough. <ul style="list-style-type: none"> Generate $N=500$ samples of size $n=50$ from a Uniform$[-5,5]$ distribution. For each of the $N=500$ samples, calculate the sample mean, so that you now have a vector of 500 sample means. Plot a histogram of these 500 sample means. Does it look normally distributed and centered at 0? Turn this simulation into a function that takes arguments N the number of simulated samples to make and n the sample size of each simulated sample. Run this function for $n=10,15,30,50$. What do you notice about the histogram of the sample means (the sampling distribution of the sample mean) as the sample size increases.
	<p>Text Book</p> <ol style="list-style-type: none"> Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020
	<p>References</p> <ol style="list-style-type: none"> Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback, Glenn J. Myatt and Wayne P. Johnson, Import, 22 July 2014. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Lique, Springer 2013.
	<p>Topics relevant to Development skills</p> <p>Topics relevant to development of “Employability”: Real time application development using R Programming Tools.</p> <p>Topics relevant to “Human Values & Professional Ethics”</p>

Course Code:	Course Title: Applied Machine Learning		L- T- P- C	2	0	2	3
CSE3087	Type of Course: 1] Program Core 2] Laboratory integrated						
Version No.		1.0					
Course Pre-requisites		CSE3001 Artificial Intelligence and Machine Learning					
Anti-requisites		NIL					
Course Description		Machine Learning algorithms are the key to develop intelligent systems such as Apple’s Siri, Google’s self-driving cars etc. This course introduces the concepts of the core machine learning techniques such as Regression learning, Bayesian learning, Ensemble learning, Perceptron learning, Unsupervised learning, Competitive learning, learning from Gaussian mixture models and learning to detect outliers. Course lectures covers both the theoretical foundations as well as the essential algorithms for the various learning methods. Lab sessions complement the lectures and enable the students in developing intelligent systems for real life problems.					
Course Objectives		This course is designed to improve the learners ‘ <u>EMPLOYABILITY SKILLS</u> ’ by using <u>EXPERIENTIAL LEARNING</u> techniques. The supervised hands-on laboratory exercises, assessments and the group projects facilitate this learning process.					
Course Out Comes		On successful completion of the course the students shall be able to: 1] Apply advanced supervised machine learning methods for predictive modeling. [Application] 2] Produce machine learning models with better predictive performance using meta learning algorithms [Application] 3] Create predictive models using Perceptron learning algorithms[Application] 4] Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection[Application] 5] Implement machine learning based intelligent models using Python libraries. [Application]					
Course Content:							
Module 1	Supervised Learning	Assignment		Programming using Keras/Sklearn		No. of Classes L – 7 P – 12	
	Topics: An overview of Machine Learning(ML); ML workflow; types of ML; Types of features, Feature Engineering -Data Imputation Methods; Regression – introduction; simple linear regression, loss functions; Polynomial Regression; Logistic Regression; Softmax Regression with cross entropy as cost function; Bayesian Learning – Bayes Theorem, estimating conditional probabilities for categorical and continuous features, Naïve Bayes for supervised learning; Bayesian Belief networks; Support Vector Machines – soft margin and kernel tricks.						

Module 2	Ensemble Learning	Assignment		Programming using Keras/Sklearn	No. of Classes L-3 P-4
	Topics: Ensemble Learning – using subset of instances – Bagging, Pasting, using subset of features –random patches and random subspaces method; Voting Classifier, Random Forest; Boosting – AdaBoost, Gradient Boosting, Extremely Randomized Trees, Stacking.				
Module 3	Perceptron Learning	Assignment /Quiz		Programming using Keras/Sklearn	No. of Classes L-7 P -2
	Topics: Perceptron Learning – from biological to artificial neurons, Perceptrons, Linear Threshold Units, logical computations with Perceptrons, common activation functions – sigmoid, tanh, relu and softmax, common loss functions, multi-layer Perceptrons and the Backpropagation algorithm using Gradient Descent.				
Module 4	Unsupervised Learning	Assignment		Programming using Keras/Sklearn	No. of Classes L-6 P -6
	Topics: Unsupervised Learning – simple k Means clustering- simple and mini-batch; updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhouette coefficient, drawbacks of kMeans, kMeans++ ; Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) Competitive Learning - Clustering using Kohonen's Self Organising Maps (SOM), Density Based Spatial Clustering – DBSCAN ; clustering using Gaussian Mixture Models (GMM) with EM algorithm ; Outlier Detection methods – Isolation Forest, Local Outlier Factor(LOF)				
	<p>List of Laboratory Tasks:</p> <p>Experiment N0 1: Methods for handling missing values Level 1: Given a data set from UCI repository, implement the different ways of handling missing values in it using Scikit-learn library of Python Level 2: Implement one of these methods using a custom defined function in Python.</p> <p>Experiment No. 2: Data Visualization Level 1 Perform Exploratory Data Analysis for a given data set by creating Scatter Plot, Pair Plot, Count Plot using Matplotlib and Seaborn Level 2 Create Heat Maps, WordCloud</p> <p>Experiment No. 3: Regression learning Level 1 Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the models parameters and the performance metrics. Plot the learning curves. Level 2 Implement the polynomial regression algorithm. Compare the learning curves of Polynomial and Linear Regression.</p> <p>Experiment No.4: Logistic regression Level 1 Write custom code for generating the logistic/sigmoid plot for a given input Level 2 Given a data set from UCI repository, implement the Logistic regression algorithm. Estimate the class probabilities for a given test data set. Plot and analyze the decision boundaries.</p> <p>Experiment No.5: Bayesian Learning</p>				

	<p>Level 1 Given a data set from UCI repository, implement a classification model using the Bayesian algorithm</p> <p>Experiment No.6: Support Vector Machine(SVM) Level 1 Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.</p> <p>Experiment No. 7: Ensemble Learning Level 1 : Implement Ensemble Learning algorithms such as Bagging, Pasting and Out-of Bag Evaluation Level 2 : Random Patches and Random Subspace Method</p> <p>Experiment No. 8: Ensemble Learning Level 1 : AdaBoost and Gradient Boosting, Stacking</p> <p>Experiment No. 9: Perceptron Learning Level 1 : Implement the Perceptron Classifier Level 2 : – An Image Classifier Using the Sequential API of Keras</p> <p>Experiment No. 10: Unsupervised Learning Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhouette Coefficient . Compare the inertia of both as k increases. Tuning the hyperparameter ‘k’ using GridSearchCV. Level 2 : – Using clustering for Image segmentation and Preprocessing. Kmeans++</p> <p>Experiment No. 11: Density Based Clustering Level 1 Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.</p> <p>Experiment No. 12: Outlier Detection Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor</p>
	<p>Targeted Application & Tools that can be used :</p> <ol style="list-style-type: none"> 1. Execution of the ML algorithms will be done using the Google’s cloud service namely “Colab”, available at https://colab.research.google.com/ or Jupyter Notebook. 2. The data sets will be from the bench marking repositories such as UCI machine learning repository available at : https://archive.ics.uci.edu/ml/index.php 3. Laboratory tasks will be implemented using the libraries available in Python such as Scikit learn, matplotlib, seaborn, perceptron and the deep learning framework namely Keras.
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
	<p>Students can be assigned a mini project to develop a machine learning application for real-life problems in various domains such as health care, business intelligence, environmental modeling, etc.</p>
	<p>Text Book</p> <p>There are a number of useful textbooks for the course, but each cover only a part of the course syllabus. Following is an indicative list of textbooks.</p>

	<ol style="list-style-type: none"> 1. Aurélien Géron, “Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow”, Oreilly, Second Edition, 2019. 2. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2018 3. Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017.
	<p>References In references apart from the books and web links, mention a few standards & Hand books relevant to the Laboratory tasks used by the professionals.</p> <ol style="list-style-type: none"> 1. Tan P. N., Steinbach M & Kumar V. “<i>Introduction to Data Mining</i>”, Pearson Education, 2016. 2. https://towardsdatascience.com/machine-learning/home 3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/ 4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Course Code: UG COURSE: CSE3107		Course Title: Robotic Vision Type of Course: Program Core Theory with embedded lab		L-T-P-C	2	0	2	3
Version No.		1.0						
Course Pre-requisites		MAT1001- Calculus and Linear Algebra, MAT1002 - Transform Techniques, Partial Differential Equations and their Applications						
Anti-requisites		NIL						
Course Description		This Course is an introduction to Robotic vision and image analysis techniques and concepts. Robotic vision has found much wider applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, law enforcement, defense, intelligence. With the progress made AI Robotics these days, Robotic vision has become an indispensable part of our digital age. This course includes Fundamentals, Applications, Human Visual Perception, Image Formation, Sampling and Quantization, Binary Image, Three-Dimensional Imaging, Image file formats. Color and Color Imagery: Perception of Colors, Image Transformation: Fourier Transforms, Image Enhancement and Restoration, Image Reconstruction, Image Segmentation, Visual based Servoing, Object detection.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of Robotic Vision Employability through Problem Solving Methodologies.						
Course Out Comes		On successful completion of the course the students shall be able to: 1. Explain the fundamentals of Robotic vision and its processing. [Understanding] 2. Utilize image enhancement techniques in spatial and frequency domain. [Application] 3. Apply the mathematical modeling of image degradation and restoration. [Application] 4. Apply the concept of image segmentation. [Application]						
Course Content:								
Module 1		Introduction to Robotic Vision	Assignment		Practical		No. of Classes:8	
	Overview of computer vision and its applications in robotics, Introduction to robotic perception and the role of vision sensors ,Challenges and limitations of robotic vision systems Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Classification of images, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.							
Module 2		Image Transformation:	Assignment		Practical		No. of Classes:8	

	Image enhancement in spatial domain: Some basic gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters. Image enhancement in frequency domain: 1D FFT, 2D FFT, Smoothing and Sharpening frequency domain filters, Homomorphic filtering.				
Module 3	Image Restoration	Assignment		Practical	No. of Classes:8
	A model of the image restoration and degradation process, Noise models – spatial and frequency properties of noise, some important probability density functions: Gaussian noise, Rayleigh noise, Gamma noise, exponential, uniform, impulse noise, Periodic noise Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering.				
Module 4	Image Segmentation and Ethics	Assignment		Practical	No. of Classes:6
	Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Color image processing: Color Fundamentals, Color Models, Pseudo color Image Processing. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, Some Basic Morphological Algorithms. Ethical and Social Implications: Ethical considerations in robotic vision applications, Privacy concerns and data protection, Social impact and implications of robotic vision technologies				
	<p>Lab Experiments are to be conducted on the following topics:-</p> <p>Lab Sheet 1:</p> <p>1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale._____(One Lab Session)</p> <p>a) Red Blue and Green and Gray Components _____(Level 1)</p> <p>b) Display color Image, find its complement and convert to gray scale _____(Level 1)</p> <p>c) Simulation of an Image (Arithmetic & Logic Operation)._____(Level 2)</p> <p>2. Implementation of Relationships between Pixels._____(One Lab Session)</p> <p>a. find Neighbour of a given Pixel _____(Level 1)</p> <p>b. 4 Point Neighbour _____(Level 1)</p> <p>c. 8 Point Neighbour _____(Level 2)</p> <p>d. Diagonal Neighbour _____(Level 2)</p> <p>Lab Sheet 2:</p> <p>3. Implementation of Transformations of an Image._____(One Lab Session)</p> <p>a. Scaling & Rotation _____(Level 1)</p>				

	<p>b. Gray level transformations, power law, logarithmic, negative. _____ (Level 2)</p> <p>4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization. _____ (One Lab Session)(Level 2)</p> <p>5. Display of bit planes of an Image. _____ (One Lab Session) (Level 2)</p> <p>6. Implementation of Image Intensity slicing technique for image enhancement. _____ (One Lab Session) (Level 2)</p> <p><u>Lab Sheet 3:</u></p> <p>7. Display of FFT (1-D & 2-D) of an image. _____ (One Lab Session)(Level 2)</p> <p>8. Computation of mean, Standard Deviation, Correlation coefficient of the given Image. _____ (One Lab Session)(Level 2)</p> <p>9. Implementation of Image Smoothing Filters(Mean, Median and MinMax filtering of an Image) _____ (One Lab Session)(Level 2)</p> <p>10. Implementation of image sharpening filters and Edge Detection using Gradient Filters. _____ (One Lab Session)(Level 2)</p> <p><u>Lab Sheet 4:</u></p> <p>11. Canny edge detection Algorithm. _____ (One Lab Session)(Level 2)</p> <p>12. Image morphological operations opening closing erosion dilation. _____ (Two Lab Sessions)(Level 2)</p> <p>13. Image segmentation by region growing split and merge algorithm. _____ (Two Lab Sessions)(Level 2)</p>
	<p>Tools/Software Required:</p> <ol style="list-style-type: none"> 1. OpenCV 4 2. Python 3.7 3. MATLAB
	<p>Text Books</p> <ol style="list-style-type: none"> 1. Rafael C. Gonzalez and Richard E. Woods' "Digital Image Processing", Fourth Edition, Global Edition 2018.
	<p>References</p> <ol style="list-style-type: none"> 1. Perter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", 2nd Edition, Springer, 2017 2. Ravishankar Chityala, Sridevi Pudipeddi, "Image Processing and Acquisition Using Python", Taylor & Francis, 2020. 3. Jason M. Kinser, "Image Operators: Image Processing in Python", CRC Press, 2018. 4. TinkuAcharya and Ajoy K. Ray, "Image Processing Principles and Applications", John Wiley and Sons publishers.

Course Code: CSE 5020	Course Title: Medical Image Processing Type of Course: Discipline Elective Theory and Lab Integrated			L- T-P- C	2	0	2	3
Version No.	2.0							
Course Pre-requisites	<ul style="list-style-type: none">• Python programming language• OpenCV library• Basics of digital image processing							
Anti-requisites	NIL							
Course Description	The course introduces the basics to advance the implementation of biomedical images such as MRI, CT, X-ray, etc. Here we will be studying about complete basics of theical image processing and then moving forward we will be learning about the various filters and feature extraction techniques. This course also teaches the segmentation and restoration techniques in depth along with the practical implementation.							
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques.							
Course Outcomes	On successful completion of the course, the students shall be able to: CO 1: understand digital image processing using OpenCV and Python programming language. CO 2: Demonstrate image enhancements for Filter and feature extraction of statistical measurement. CO 3: Implement deep learning techniques for image restoration and segmentation. CO 4: Experiment with soft computing techniques for content-based medical image retrieval							
Course Content:								
Module 1	Digital image processing	Assignment	Image processing	10 Sessions				
Introduction: What is an image, Digital image, Image resolution, and aspect ratio, components of digital image processing, sampling, and quantization, applications areas, vision fundamentals, CAD systems, research areas of digital image processing. Biomedical image processing: various modalities of medical imaging: breast cancer imaging, mammographic imaging, ultrasound imaging, magnetic resonance imaging(MRI), and breast thermography imaging. Problems with medical images, image enhancement, and other modalities of medical imaging.								
Module 2	Filters and feature extraction	Use case study	Feature extraction	10 Sessions				

Noise reduction filters for medical imaging: sources of noise and filters used for noise reduction, spatial domain filters, frequency domain filters, practical results. Feature extraction and statistical measurement: selection of features, shape-related features, Fourier descriptors, text analysis.				
Module 3	Image restoration and segmentation	Assignment	Segmentation	8 Sessions
Medical Image restoration: Image resolution, degradation model, estimation of degradation function, blur model, medical image restoration, blur identification, super-resolution method. Biomedical image segmentation: Broad classification and applications, point detection, line detection, edge detection methods, histogram-based image segmentation, segmentation using split and merge method, region growing method, watershed method, k-means clustering method, self-similar fractal method, topological derivative-based segmentation, comparison of segmentation methods.				
Module 4	Soft computing techniques and content-based image retrieval	use case study	Content based image retrieval	10 Sessions
Soft computing techniques: Fuzzy-based techniques, Neural network-based techniques ,genetic algorithm-based techniques. Content-based image retrieval (CBIR): Visual connect descriptors, shape similarity measure, relevance feedback, distance measureand s, challenges. Content-based medical image retrieval (CBMIR): Challenges in implementation of CBMIR, Practical approaches of CBMIR.				
Targeted Application & Tools that can be used: <ul style="list-style-type: none"> • Google Collab Pro • Jupyter Notebook with GPU 				
Project work/Assignment:				
Mini project on feature extraction using deep learning algorithm such as CNN.				
Text Book T1. G.R Sinha, Bhagwati Charan Patel,” Medical Image Processing Concepts and Applications”, Eastern Economy Edition.2020				
References R1. Geoff Dougherty California State University, Channel Islands” Digital Image Processing for Medical Applications”, Cambridge University Press.2019				
Weblinks W1. https://onlinecourses.nptel.ac.in/noc22_bt34/preview W2. https://www.slideshare.net/AboulEllaHassanien/medical-image-analysis-27297012				
Topics relevant to development of “SKILL DEVELOPMENT”: Design and development of feature extraction and segmentation algorithm using python programming language. Topic relevant to HUMAN VALUES & PROFESSIONAL ETHICS”: Naming and coding convention for Project Development.				

Course Code: CSE3068	Course Title:Advanced DBMS Type of Course: Core Theory &Integrated Laboratory		L-P-C	2	2	3
Version No.	1.0					
Course Pre-requisites	[1] Database Management System (CSE2074) Basics of DBMS, like, File System and its drawbacks, Database Approach, 3-Schema Architecture and its concepts, Relational Algebra, Normalization, Transactions and its concepts, Backup and Recovery. In laboratory MySQL database skills are learnt.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to make the students revisit RDBMS transactions first. Then introduce them with Distributed, Parallel, and NoSQL database concepts. They include the main characteristics, advantages, and disadvantages of each one of them. Importance and differences among them are noted. Need to transit from RBMS to NoSQL is discussed. The striking features of distributed, parallel and NoSQL are considered and studied. The associated laboratory provides a chance to have hands-on concepts learned during this course.					
Course Objective	This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by learning the working on Database using MySQL.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Recall the transactions in RDMS (2) Explain advanced features of distributed, parallel, and NoSQL databases. (3) Illustrate the features in Distributed database (4) Employ Parallel database concepts in real life applications.					
Course Content:						
Module 1	Transactions in RDBMS	Quiz	Comprehension based Quizzes and assignments.	06Classes		
Topics: RDBMS -Transaction control state diagram, ACID properties of transaction, Schedules in transactions - Serial, Non-Serial and Serializable, Serializability-Conflict and View, Conflict Serializability check by Precedency Graph, Concurrency Control – Lock Based and Time Stamp Based.						
Module 2	NoSQL Databases	Programming and Mini Project	Laboratory experiments and Mini Projects on NoSQL Topics using MongoDB/ Casandra.	06Classes		
Topics: NoSQL Introduction – Scale Out, Commodity Hardware, Brief History, Features – Non-Relational, Schema Free, Simple API, and Distributed. NoSQL Architectures/Data Models - Document, Columnar, Key-Value, and Graph. Transaction in NoSQL- BASE for reliable database transactions, Achieving Horizontal Scalability with Database Sharding, CAP theorem. Case Study: MongoDB/Casandra/ AWS/ HBase						
Module 3	Distributed Databases	Assignment	Assignment on main topics of Distributed Databases	06Classes		
Topics:						

Loosely Coupled, Characteristics of Distributed Databases, Local and Global view of applications, Distributed Processing, Types – Homogeneous and Heterogeneous, Distributed Data Storage – Replication and Fragmentation, Fragmentation – Horizontal and Vertical Type, Difference between Centralized and Distributed Databases.

Module 4	Parallel Databases	Assignment	Assignment on main topics of Parallel Databases	06 Classes
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Topics:
Tightly Coupled, Features of parallel databases, Shared Memory, Shared Disk, Shared Nothing Systems. Advantages of each of these schemes, Advantages and Disadvantages of Parallel Databases, Differences between Parallel and Distributed Databases.

Install MONGODB

<https://www.javatpoint.com/mongodb-create-database>

Create any one of the following databases.

Employee, Student, University, Banking, or Online Shopping

Drop database

Create Collection: In MongoDB db.createCollection(name,option) is used to create collection.

Drop Collection

List of Laboratory Tasks:(7 X 2= 14 Sessions)

Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on ‘Student’ Database.

Level 2: Do MongoDB text search on ‘Employee’ Database.

Experiment No. 2: Try experiments on MongoDB Operators

Level 1: Perform queries involving MongoDB Query and Projection Operators using ‘Student’ Database.

Level 2: Do queries involving MongoDB update operator on ‘Employee’ Database.

Experiment No. 3: Explore different query modifiers.

Level 1: Perform different query modifiers on ‘Student’ Database.

Level 2: Try various query modifiers on ‘Employee’ Database.

Experiment No. 4: Explore Aggregation commands.

Level 1: Implement different aggregation commands on ‘Student’ Database.

Level2: Perform various aggregation commands on ‘Employee’ Database.

Experiment No. 5: Explore Authentication commands.

Level 1: Try authentication commands on ‘Student’ Database.

Level 2: NA

Experiment No. 6: Explore Replication Commands

Level 1: Try all replication commands on ‘Student’ Database.

Level2: Implement replication commands on ‘Employee’ Database.

Experiment No.7: Try Sharding Commands.

Level1: Explore Sharding Commands on ‘Student’ Database.

Level 2: Implement Sharding Commands on ‘Employee’ Database.

<p>Targeted Application & Tools that can be used: MongoDB is to be installed and used.</p>
<p>Project work/Assignment:</p> <p>Each batch of students (self-selected batch mates) will identify projects, such as, Library, Banking, and Reservation etc.,and do it. Concepts of NoSQL, like, CRUD operations, supporting ad hoc queries, indexing flexibility, assisting replication, creating capped collections, and Retrieving data from multiple documents.</p> <p>Sample Mini Projects:</p> <p>1. Content Management System Clubbing the content assets like text and HTML into a single database helps provide a better user experience. MongoDB has an excellent toolset not only for storing and indexing but also for controlling the structure of a content management system. You can easily design a web-based CMS by using the model proposed by “Metadata and Asset Management” in MongoDB. Additionally, you can use “Storing Comments” to model user comments on blog posts.</p> <p>2. Gaming Project Data is an essential part of making video games work. Some typical examples of gaming data include player profiles, matchmaking, telemetry, and leaderboards. The common thread between all games is that they all have a specific goal. And you have to achieve multiple objectives or pay your way out to reach the end goal. This may involve steps like watering your plants, growing vegetables, serving food in a restaurant, and so on.</p>
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2019(Wiley Publications). 2. Stefano Ceri, Giuseppe Pelagatti , Distributed Databases: Principles and Systems,, 2017(McGraw Hill Education).
<p>References</p> <ol style="list-style-type: none"> 1. Elmasri R and Navathe S B, “Fundamentals of Database System”,7th Edition, 2017(Pearson Publication). 2. Pivert. <i>NoSQL Data Models: Trends and Challenges</i>, 1st edition(Wiley).
<p>Topics related to development of “FOUNDATION”:Transaction, CRUD Operations, Replication, and Sharding</p> <p>Topics related to development of “EMPLOYABILITY”: Project implementations in software, batch wise presentations</p> <p>Topics related to development of “HUMAN VALUES AND PROFESSIONAL ETHICS”: Team Dynamics during Mini Project Development.</p>

Course Code: CSE3070	Course Title: Advanced Computer Networks		L-T-P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		CSE-2011-Data communication and Computer Networks- TCP/IP Protocol Suite, IEEE 802.x, VLAN, Ipv4 Addresses, IPv6 address					
Anti-requisites		NIL					
Course Description		This course emphasizes the advanced concepts of computer networks and their design aspects. This course will explore the design aspects of physical and network layers, switching basics, logical design and management aspects, network traffic and scheduling, performance of WIFI AND WIMAX network along with current internet technology like 5G and Software Defined Network.					
Course Objective		This course goal is to provide an advanced background on relevant and recent computer networking topics and to have a comprehensive and deep knowledge in computer networks.					
Course Outcomes		Upon successful completion of the course the students shall be able to: 1. Understand the physical network technology and design of WAN. 2. Understand switching networks, routing in packet switching networks with different routing algorithms. 3. Demonstrate the Modeling of network traffic and networking protocols. 4. Understand the principles of new generation of computer networks, alternative Infrastructures and SDN.					
	Course Content:						
Module 1	PHYSICAL NETWORK DESIGN	Assignment	Theory		No. of Classes:10		
	Topics: Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks						
Module 2	SWITCHING BASICS	Assignment	Theory		No. of Classes:12		
	Topics: Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals						
Module 3	LOGICAL DESIGN AND MANAGEMENT	Assignment	Theory		No. of Classes:10		
	Topics: VLSM, OSPF and BGP – VPN –RMON and SNMP, Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.						

Module 4	NETWORK TRAFFIC, SCHEDULING and Alternative Infrastructures	Assignment	Case Study		No. of Classes:12
	Topics: Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis Alternative Infrastructures (Active networks, Software defined network. Network Security and wireless and Mobile networks, 5G cloudification.				
	Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. CISCO Packet Tracer, 2. Wireshark 				
	Project work/Assignment:				
	<ol style="list-style-type: none"> 1. Design LAN WAN and assign IP Address. 2. Configure the WAN topology using routing protocols 3. Design Wireless network in college campus. 				
	Suggested List of Hands-on Activities: <ol style="list-style-type: none"> 1. Perform a case study on VLSM 2. Using CISCO Packet Tracer design a LAN with 50 PCV and configure it with suitable IP addressing and routing protocols 3. DO a case study on an SDN for an Enterprise. 4. Perform a case study on 5G Cloudification. 				
	Text Book <ol style="list-style-type: none"> 1. Larry L. Peterson & Bruce S. Davie, “Computer Network: A System Approach”, Morgan Kaufmann, 5/e, 2012. 2. Jochen Schiller, “Mobile Communications”, Pearson Addison-Wesley, 2/e, 2010. 				
	References <ol style="list-style-type: none"> 1. Behrouz A. Forouzan , “TCP/IP Protocol Suite”, McGraw- Hill, 4/e, 2015. 2. James F. Kurose, Keith W. Ross, “Computer Networking”, Pearson, 2016. 3. Charles M. Kozierok, “The TCP/IP Guide”, No starch press, 2018. 4. Computer Networking: A Top-Down Approach, James F. Kuros and Keith W. Ross,Pearson, 6th Edition,2012 5. A Practical Guide to Advanced Networking , Jeffrey S. Beasley and PiyasatNilkaew,Pearson, 3rd Edition,2012 6. Computer Networks , Andrew S. Tanenbaum, David J. Wetherall,Prentice, 5th Edition,201 Web Resources and Research Articles links:				

	1. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer-applications
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Course Code: CSE 3071	Course Title: Computer Vision Type of Course: Program Core Theory and Lab Integrated Course			L- T-P- C	2	0	2	3
Version No.	1.0							
Course Pre-requisites	Linear algebra, vector calculus, and probability, Data structures							
Anti-requisites	NIL							
Course Description	This course introduces computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. We will develop the intuitions and mathematics of the methods in class, and then learn about the difference between theory and practice in HomeWorks.							
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING TECHNIQUES.							
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <p>CO1: Apply mathematical modeling methods for low-, intermediate- and high-level image processing tasks.</p> <p>CO2: Perform software experiments on computer vision problems and compare their performance with the state of the art.</p> <p>CO3: Describe the geometric relationships between 2D images and the 3D world.</p>							
Course Content:								
Module 1	Digital Image Processing	Programming Assignment	Data Collection and Analysis					12 sessions
	Image Formation, Image Filtering, Edge Detection, Principal Component Analysis, Corner Detection SIFT, Applications: Large Scale Image Search.							
Module 2	Geometric Techniques in Computer Vision	Programming Assignment	Data Collection and Analysis					12 sessions
	Image Transformations, Camera Projections, Camera Calibration, Depth from Stereo, Two View Structure from Motion, Object Tracking.							
Module 3	Machine Learning for Computer Vision	Programming Assignment	Data analysis					14 sessions
	Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation.							
	List of Laboratory Tasks: 1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)[Text Wrapping Break]2. Implementation of Relationships between Pixels[Text Wrapping Break]3. Implementation of							

	<p>Transformations of an Image[Text Wrapping Break]4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization[Text Wrapping Break]5. Display of bit planes of an Image[Text Wrapping Break]6. Display of FFT (1-D & 2-D) of an image[Text Wrapping Break]7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image[Text Wrapping Break]8. Implementation of Image Smoothing Filters (Mean and Median filtering of an Image)[Text Wrapping Break]9. Implementation of image sharpening filters and Edge Detection using Gradient Filters[Text Wrapping Break]10. Image Compression by DCT, DPCM, HUFFMAN coding[Text Wrapping Break]11. Implementation of image restoring techniques[Text Wrapping Break]12. Implementation of Image Intensity slicing technique for image enhancement</p>
	Targeted Application & Tools that can be used: Matlab
	Project work/Assignment:
	<p>Text Book</p> <p>T1 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.</p> <p>T2 Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004.</p>
	<p>References</p> <p>R1. R. Bishop; Pattern Recognition and Machine Learning, Springer, 2006</p> <p>R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.</p> <p>R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.</p> <p>Web references:</p> <p>https://onlinecourses.swayam2.ac.in/cec20_cs08/preview</p> <p>.</p> <p>Library reference: https://presiuniv.knimbus.com/user#/home</p>
	<p>Topics relevant to development of “Employability”:</p> <p>Topics relevant to “HUMAN VALUES & PROFESSIONAL ETHICS”:</p>

Course Code: CSE3009	Course Title: Optimization Techniques for Machine Learning Type of Course: Program Core& Theory Only	L-T-P-C	3	0	0	3
Version No.		1.1				
Course Pre-requisites		Fluency with reasoning and analysis using linear algebra and probability is required. Familiarity with Python is preferable.				
Anti-requisites		NIL				
Course Description		<p>The course aims to equip students with advanced techniques and methods in optimization that are tailored to large-scale statistics and machine learning problems. A number of prominent developments in first-order optimization methods in the convex, nonconvex, stochastic, and distributed settings are explored in this course. Upon completing the course, students are expected to be able to better formulate an optimization problem by exploiting desired structural properties (for example, convexity, smoothness, and sparsity), and to select an efficient optimization method under problem constraints (for example, online, distributed, and memory cost).</p> <p>The course aims to equip students with advanced techniques and methods in optimization that are tailored to large-scale statistics and machine learning problems. A number of prominent developments in first-order optimization methods in the convex, nonconvex, stochastic, and distributed settings are explored in this course. Upon completing the course, students are expected to be able to better formulate an optimization problem by exploiting desired structural properties (for example, convexity, smoothness, and sparsity), and to select an efficient optimization method under problem constraints (for example, online, distributed, and memory cost).</p>				
Course Objective		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.				
Course Out Comes		<p>On successful completion of the course the students shall be able to:</p> <p>1] Understand standard supervised and unsupervised machine learning tasks as optimization problems [Understand] 2] Understand key definitions relating to convex functions, convex sets, and convex optimization [Understand] 3] Implement first-order and stochastic first-order solvers for convex optimization problems. [Application] 4] Apply machine learning techniques to real world problems. [Application]</p>				
Course Content:						

Module 1	Fundamentals of Convex Analysis	Assignment		Programming Task	8 Sessions
	Topics: Review of basic linear algebra and probability, convex sets and functions – Strong and weak duality, constraint qualifications, Optimality conditions for machine learning problems (regressions, SVM, etc.)				
	Assignment: Quiz on optimality conditions for machine learning problems.				
Module 2	First order and Higher Order Methods	Assignment		Data Collection/Excel	14 Sessions
	Topics: First Order Methods : Gradient descent convergence analysis – Convergence analysis for momentum-based acceleration methods: Heavy-ball, multistep, Nesterov, FISTA, etc. – Convergence speedup with conjugacy – Convergence analysis for sub-gradient methods – Stochastic (sub) gradient descent (convergences in probability and distribution, almost sure convergence, parallelism, applications in deep learning, etc.) Higher-Order Methods – Newton’s method: convergence analysis (exact/inexact step-sizes, self-concordance), applications in regressions – Quasi-Newton Theory (Secant methods), convergence proofs for BFGS/DFP, L-BFGS in machine learning Assignment: Different first order methods and their types with examples.				
Module 3	Regularized Optimization & Proximal and Operator Splitting	Assignment		Programming/Data analysis Task	10 Sessions
	Topics: ℓ_1 -regularized sparse optimization for machine/statistical learning: compressed sensing, LASSO, logistic regression, etc. – Structured sparsity optimization for machine/statistical learning: low-rank matrix completion, nuclear norm regularization, inverse covariance inference, atomic norm regularization, etc. Dual decomposition and decentralization – Method of multipliers and ADMM methods: convergence analysis and proofs – Proximal operators and proximal methods – Design and analysis of distributed algorithms Assignment: Design of distributed algorithms with examples.				
Module 4	Nonconvex Optimization in Machine Learning	Assignment	Programming/Data analysis Task		8 Sessions

	<p>Topics: Coordinate descent methods and convergence analysis – Special structured nonconvex optimization – Optimization landscape – Saddle point escape Assignment: Design of nonconvex optimization algorithms and their usage.</p>
	<p>Targeted Application & Tools that can be used: Google Colab</p>
	<p>Project work/Assignment:</p>
	<p>Creating a classification system using Machine Learning methods (Stochastic Gradient Descent, Naïve bayes Classifier, etc.) using standard datasets like Iris Recognition Dataset etc.</p>
	<p>Text Book T1. A. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017. T2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015. T3. F. Bach, “Learning with Submodular Functions: A Convex Optimization Perspective”, Foundations and Trends in Machine Learning, Now Publishers Inc., 2013.</p>
	<p>References R1. S. Boyd, N. Parikh, and E. Chu, “Distributed optimization and statistical learning via the alternating direction method of multipliers”, Foundations and Trends in Machine Learning, Now Publishers Inc. R2. Y. Nesterov, “Introductory Lectures on Convex Optimization: A Basic Course,” Springer, 2004. R3. M. Bazarra, H.D. Sherali, and C.M. Shetty, “Nonlinear Programming: Theory and Algorithms,” John Wiley & Sons, 2006.</p>
	<p>http://192.168.1.10/cgi-bin/koha/opac-detail.pl?biblionumber=11708&query_desc=ti%2Cwrdl%3A%20MACHINE%20LEARNING</p>
	<p>Topics relevant to development of “SKILL”: Gradient descent convergence analysis, Quasi-Newton Theory (Secant methods), LASSO, Logistic Regression, Coordinate descent methods and convergence analysis Topics relevant to development of “ENVIRONMENT AND SUSTAINABILITY SKILLS”: NIL</p>

Course Code:	Course Title: Reinforcement Learning		L- T- P- C	2	0	2	3
CSE3011	Type of Course: 1] Program Core 2] Laboratory integrated						
Version No.		1.0					
Course Pre-requisites		CSE3001: Artificial Intelligence and Machine Learning					
Anti-requisites		NIL					
Course Description		For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. It is of utmost importance to come up with innovative solutions for scenarios that are highly stochastic. The objective of this course, is to introduce different reinforcement learning techniques which is a promising paradigm for stochastic decision making in the forthcoming era. Starting from the basics of stochastic processes, this course introduces several RL techniques that are as per the industry standard. With a good knowledge in RL, the students will be able to develop efficient solutions for complex and challenging real-life problems that are highly stochastic in nature.					
Course Objectives		This course is designed to improve the learners ‘EMPLOYABILITY SKILLS’ by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Apply dynamic programming concepts to find an optimal policy in a gaming environment [Applying] 2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy in a reinforcement learning environment. [Applying] 3. Utilize Temporal Difference learning techniques in the Frozen Lake RL environment [Applying] 4. Solve the Multi-Armed Bandit (MAB) problem using various exploration-exploitation strategies [Applying]					
Course Content:							
Module 1	Introduction to Reinforcement Learning	Assignment		Programming using the OpenAI Gym environment	No. of Classes L – 5 P – 6		
	Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types, episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope						

Module 2	Monte-Carlo(MC) methods	Assignment		Programming using the OpenAI Gym environment	No. of Classes L-5 P-6
	Topics: Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method.				
Module 3	Temporal Difference(TD) Learning	Assignment /Quiz		Programming using the OpenAI Gym environment	No. of Classes L-7 P -6
	Topics: Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing the optimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods.				
Module 4	Multi-Armed Bandit (MAB) problem	Assignment		Programming using the OpenAI Gym environment	No. of Classes L-6 P -4
	Topics: Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits, introduction to Deep Reinforcement Learning(DRL) Algorithm – Deep Q Network (DQN)				
	List of Laboratory Tasks: <ol style="list-style-type: none"> Software Setup : installalling Anaconda, OpenAI Gym and Universe. Basic simulations of some gaming environments in Gym Working with Gym environments to create agents with random policy <ol style="list-style-type: none"> Create the Frozen Lake GYM environment and explore the states, action, transition probability, reward functions and generating episodes. Create an agent for the Cart-Pole environment using a random policy and record the game Finding the optimal policy for the agent using Dynamic Programming <ol style="list-style-type: none"> Compute the optimal policy for the Frozen Lake Environment using value iteration method Compute the optimal policy for the Frozen Lake Environment using policy iteration method Implementing Monte Carlo prediction method using blackjack game <ol style="list-style-type: none"> Every-visit MC prediction First-visit MC prediction Implementing on-policy MC control method using the epsilon-greedy policy for the blackjack game Implementing Temporal Difference prediction for the Frozen lake environment for a random policy Computing the optimal policy using on-policy TD control – SARSA Computing the optimal policy using off-policy TD control – Q-learning Multi-Armed Bandit problem <ol style="list-style-type: none"> Creating a MAB in Gym Compute the best arm using various exploration strategies such as epsilon-greedy and softmax exploration method. 				

	10. Application of MAB – Finding the best advertisement banner for a web site using MAB
	Targeted Application & Tools that can be used : <ol style="list-style-type: none"> 1. Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or Jupyter Notebook. 2. Laboratory tasks will be implemented using the necessary libraries available in Python
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	Students can be given group assignments to develop different gaming environments and implement the RL algorithms
	Text Book <ol style="list-style-type: none"> 1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018. 2. Sudharshan Ravichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020
	References <ol style="list-style-type: none"> 1. Laurra Graesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022 2. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

Course Code: CSE 3012	Course Title: Time Series Analysis Type of Course: Laboratory Integrated			L- T-P- C	2	0	2	3
Version No.		1						
Course Pre-requisites		CSE 3001 Artificial Intelligence and Machine Learning						
Anti-requisites		--						
Course Description		The course will provide a basic introduction to modern time series analysis. This course teaches time-series analysis and the methods used to predict, process, and recognize sequential data. The objective of the course is to give students a better understanding of the concepts and the tools in time series analysis. The course develops a comprehensive set of tools and techniques for analyzing various forms of time series and for understanding the current literature in applied time series econometrics. This course covers time series regression and exploratory data analysis, ARMA/ARIMA models, model identification/estimation/linear operators, Fourier analysis, spectral estimation, and state space models.						
Course Objective		This course is designed to improve the learners “EMPLOYIBILITY SKILLS” by using EXPERIENTIAL LEARNING techniques. Lecturers on the Time Series Analysis facilitates the Peer Learning and group projects on real time applications.						
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Understand basic concepts in time series analysis and forecasting. [Understand]• Understand the use of time series models for forecasting and the limitations of the methods. [Understand]• Develop time series regression models. [Application]• Compare with multivariate times series and other applications. [Comprehension]						
Course Content:								
Module 1	INTRODUCTION OF TIMESERIES ANALYSIS	Assignment		Data Collection/Interpretation		L[6] +P[2] Sessions		
	Topics: Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting. Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.							

Module 2	TIME SERIES REGRESSION MODEL	Assignment/Quiz		Case studies	L[6] +P[3] Sessions
Topics: Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.					
Module 3	AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS	Quiz		Case studies	L[10] +P[2] Sessions
Topics: Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the “BEST” Model - Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models .					
Module 4	MULTIVARIATE TIME SERIES MODELS AND FORECASTING	Assignment		Case studies	L[8] +P[1] Sessions
Topics: Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting.					
List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Loading, Preprocessing and Handling Time series data. 2. Fitting and plotting by Modified Exponential Curve. 3. Estimating and eliminating trend using Aggregation, Smoothing and Polynomial Fitting. 4. Eliminating Trend and Seasonality via Differencing and Decomposition. 5. Fitting of Trend using Moving Average Method. 6. Forecasting by Exponential Smoothing, ARIMA. 7. Forecasting by Seasonal autoregressive integrated moving average model (SARIMA). 8. Develop Time series model using Multivariate Analysis models via Canonical Correlation 9. Develop Time series model using Multivariate Analysis models via Structural Equation Modeling. 10. Develop Time series model using Inter Dependence Techniques via Factor Analysis. 11. Develop Time series model using Inter Dependence Techniques via Cluster Analysis. 					
Targeted Application & Tools that can be used Target Applications: <ul style="list-style-type: none"> • HealthCare Industries. • Manufacturing Industries. • Cyber Security. • Smart Intelligent systems. Tools:					

	<ul style="list-style-type: none"> • Python • R • MATLAB • XLSTAT • Tableau • Qlik Sense
	Project work/Assignment:
	Assignment: <ul style="list-style-type: none"> • Predicting changes in the thickness of Ozone layer based on its time-series data from 1926 – 2016. • Examine the South African GDP on a period from 1960 to 2016. Our data contains 226 observations and has been obtained from OECD Statistics. • Developing an ARIMA model to forecast the monthly Australian gas production level for the next 12 months.
	Text Book <p>T1 Douglas C. Montgomery, Cheryl L. Jen , Introduction To Time Series Analysis And Forecasting, 4th Edition, Wiley Series In Probability And Statistics, 2019. https://b-ok.cc/book/2542456/2fa941</p> <p>T2 Dr. Avishek Pal , Dr. Pks Prakash , Master Time Series Data Processing, Visualization, And Modeling Using Python, 2019. https://b-ok.cc/book/3413340/2eb247</p> <p>T3 John Wiley & Sons , Time Series Analysis And Forecasting By Example ,Technical University Of Denmark, 2021. https://b-ok.cc/book/1183901/9be7ed</p>

	<p>References</p> <p>R1 Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).</p> <p>R2 Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd.</p> <p>R3 Time Series Analysis by James D Hamilton Copyright © 2020 by prince town university press.</p> <p>E book link R1: https://b-ok.cc/book/2802612/149485</p> <p>E book link R2: https://b-ok.cc/book/3704316/872fbf</p> <p>E book link R3: https://b-ok.cc/book/3685042/275c71</p> <p>Web resources:</p> <ol style="list-style-type: none"> https://www.coursera.org/learn/practical-time-series-analysis https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/ https://swayam.gov.in/nd1_noc19_mg46/preview
	<p>Topics relevant to development of “Skill Development”:</p> <ol style="list-style-type: none"> Systematic variation in time series data Autoregressive Models Exponential smoothing models or esms Generating forecasts on time series <p>Topics relevant to development of “Employability Skills”</p> <ol style="list-style-type: none"> Time series analysis to Monitor and access water resources. Remote Sensing time series analysis for Crop Monitoring. Satellite Image Time series Analysis. Waste Monitoring and Analysis.

Course Code: CSE3017	Course Title: Autonomous Navigation and Vehicles Type of Course : Theory	L- T-P- C	3	0	0	3
Version No.	1.1	<ul style="list-style-type: none"> Real-time embedded programming Optimal estimation and control Linear algebra 				
Course Pre-requisites	•					
Anti-requisites	NIL					

Course Description	<p>Overview of technologies vehicles including sensors, sensing algorithms, machine learning, localization, mapping, object detection, tracking, communication and security. Hands-on implementation of robotic sensing and navigation algorithms on both simulated and physical mobile platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for vision-based navigation of autonomous vehicles (e.g., mobile robots, self-driving cars, drones). It culminates in a critical review of recent advances in the field and a team project aimed at advancing the state-of-the-art.</p> <p>Topics include: Autonomous driving technologies overview, Object Recognition and Tracking, Localization with GNSS, Visual Odometry, Perceptions In Autonomous driving, Deep learning in Autonomous Driving Perception, Prediction and Routing, Decision planning and control</p>
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Understand the Autonomous system's and its requirements. Explain algorithm, sensing, object recognition and tracking of an Autonomous system. [Understand] 2. Do the error analysis of Localization systems and use the tools and techniques,[Analyze] 3. Explain, plan and control the traffic behavior, and shall be able to do lane level routing and create simple algorithms. [Application] 4. Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform.[Application]
Course Content:	
Module 1	
	12 Sessions
<p>Introduction to autonomous driving: Autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception. Object Recognition and Tracking: Autonomous driving client system, driving cloud platform, Robot Operating System, HD Map Production, Deep learning Model Training, Localization with GNSS: GNSS overview, GNSS error analysis, satellite based augmentation systems, real time kinematic and differential GPS, precise point positioning, Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry.</p>	
Module 2	
	8 Sessions

	Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Stereo, Optical flow and Scene flow. Deep learning in Autonomous Driving Perception: Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow.
Module 3	10 Sessions
	Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost.
Module 4	08 Sessions
	Decision planning and control: Behavioral decisions, Motion planning, Feedback control Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating systems and computing platform Cloud platform for Autonomous driving: Introduction, infrastructure, simulation.
	Targeted Application & Tools that can be used: Applications: Obstacle Avoidance, Path Planning, Autonomous Vehicles. Tools: MIDGUARD A Simulation platform for Autonomous Vehicle navigation.
	Project Work/Assignment: 1. Develop a system that avoids obstacles in the path. 2. To develop a cloud based autonomous navigation, what are the parameters should be considered, draw a framework for the navigation system.
	Text Book T1: Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 2 nd Edition, 2019 T2: Ronald K. Jurgen Autonomous Vehicles for Safer Driving SAE International Edition , 2019
	References R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 1st Edition, 2016 R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 1st Edition, 2016 R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 1st Edition, 2018 Web Resources: http://pu.informatics.global
	Topics relevant to development of “Employability”: Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

Course Code: CSE3018	Course Title: Digital Health and Imaging Type of Course: Program Core& Theory Only	L-T- P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE3008: Machine Learning Techniques				
Anti-requisites		-				
Course Description		This course will give an overview of digital health and its impact on healthcare, Image enhancement techniques, filtering, and restoration. Medical Imaging, health informatics, Health data analytics and predictive modeling.				
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.				
Course Out Comes		On successful completion of the course the students shall be able to: 1.Understand the role of digital health’s impact in ethical and legal considerations. [Understand] 2. Apply Machine learning techniques for medical image analysis. [Application] 3. Apply Computer-aided detection and diagnosis in medical imaging. [Application] 4. Apply Health data analytics and predictive modeling. [Application]				
Course Content:						
Module 1	Introduction to Digital Health and Digital Image	Assignment		Theory	L : 8	
	Introduction to Digital Health Overview of digital health and its impact on healthcare, Introduction to telemedicine, wearables, and health monitoring devices, Ethical and legal considerations in digital health. Digital Image Processing Fundamentals: Digital image representation and properties, Image enhancement techniques, Image filtering and restoration, Image segmentation and feature extraction					
Module 2	Medical Imaging Modalities	Assignment		Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions	L: 10	
	Medical Imaging Modalities: Principles and applications of various medical imaging modalities. X-ray imaging, computed tomography (CT), and magnetic resonance imaging (MRI) , Ultrasound imaging and nuclear medicine imaging, Imaging modalities for specific healthcare domains (e.g., radiology, cardiology)					

Module 3	Image Analysis in Healthcare	Assignment /Quiz	Researching and reviewing academic papers or industry publications on specific AI applications	L:12
	Image registration and fusion techniques, Quantitative image analysis for disease diagnosis and treatment planning, Computer-aided detection and diagnosis in medical imaging, Machine learning in medical image analysis. Health Informatics and Electronic Health Records, Introduction to health informatics and electronic health records (EHR), EHR systems and interoperability, Data privacy, security, and regulatory considerations in health informatics.			
Module 4	Digital Health Applications and Innovations	Assignment	Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.	L: 10
	Mobile health (mHealth) applications and remote patient monitoring, Health data analytics and predictive modeling. Artificial intelligence and machine learning in digital health. Emerging technologies and trends in digital health.			
	Targeted Application & Tools that can be used: Applications: Quantitative image analysis for disease diagnosis, Mobile health (mHealth) Tools: TensorFlow, PyTorch, Computer-aided detection			
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
	Assignments can involve researching and reviewing academic papers or industry publications on specific AI applications in engineering / Students may be given programming assignments to implement AI algorithms / Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions / Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.			
	Text Book 1. "Digital Health: Scaling Healthcare to the World" by Paul Sonnier-2020 2. "Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods 3. "Biomedical Signal and Image Processing" by Kayvan Najarian and Robert Splinter			
	References 1. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley , 2021.. 2. "Introduction to Health Informatics" by Mark S. Braunstein 3. https://talentsprint.com/course/ai-digital-health 4. https://www.udemy.com/topic/medical-imaging/			

Course Code:	Course Title: Stochastic Decision Making		L- T-P- C	3	0	0	3
CSE3019	Type of Course: Program Core& Theory Only						
Version No.		1.0					
Course Pre-requisites		MAT1003: Applied Statistics					
Anti-requisites		-					
Course Description		Stochastic Decision Making is an advanced-level course designed to build upon the foundational knowledge of artificial intelligence (AI) and its applications in engineering. This course aims to provide engineering students with an in-depth understanding of Stochastic techniques, algorithms, and emerging trends that are shaping the future of Agent-driven engineering systems. Through theoretical concepts, live examples, and case studies, students will explore cutting-edge building intelligent agents methodologies and their application in solving complex partially observable environment.					
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Understand the role of knowledge-based agents and Apply logic in problem-solving [Understanding] 2. Apply dynamic System concepts to find an optimal policy in partially observable environment. [Application] 3. Implementation of various detection techniques and hypothesis for taking the decision in the real time environment [Application] 4. Apply various Project Scheduling strategies to solve the decision problem. [Application]					
Course Content:							
Module 1	Intelligent Agents and Searching Techniques	Assignment		Theory	L : 10		
	Introduction - Structure of Intelligent Agents - Agent programs - Simple reflex agents - Goal-based agents - Utility-based agents - Agents and Environments - Properties of task environments - fully observable vs. partially observable - Deterministic vs. stochastic. Static vs, dynamic, Discrete vs. continuous, Single agent vs. multiagent Searching Techniques: Solving Problems by Searching - Problem-Solving Agents - Formulating Problems - Real-world problems - Searching for Solutions - Search Strategies - Breadth-first search - Uniform cost search - Depth-first search - Depth-limited search -						
Module 2	Dynamic Systems	Assignment		Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions	L: 10		

	<p>Dynamic Programming - Decision Trees - Deterministic Decision Trees , Stochastic Decision Trees scenario tree , Stochastic Dynamic Programming, Markowitz' model Comparing the Deterministic and Stochastic Objective values.</p> <p>Recourse Problems - Outline of Structure - Knowledge Engineering - The Electronic Circuits Domain - General Ontology - The Grocery Shopping World.</p> <p>Problem Reduction: Finding a Frame, Removing Unnecessary Columns, Removing Unnecessary Rows, Reducing the Complexity of Feasibility Tests</p>				
Module 3	Detection and decisions	Assignment /Quiz		Researching and reviewing academic papers or industry publications on specific AI applications	L:10
	<p>Detection and decisions : Decision criteria and the maximum a posteriori probability criterion, Binary MAP detection, Binary detection with a minimum-cost criterion, The error curve and the Neyman–Pearson rule, The min–max detection rule</p> <p>Hypothesis testing : Sufficient statistics with $M \geq 2$ hypotheses, More general minimum-cost tests, Binary hypotheses with IID observations,</p> <p>Feasibility in Networks: The un-capacitated case, Generating Relatively Complete Recourse, An Investment Example</p>				
Module 4	Project Estimation and Scheduling	Assignment		Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.	L: 10
	<p>Project Estimation : Introduction - The squared-cost function, Other cost functions. MMSE estimation for Gaussian random vectors- Scalar iterative estimation, The vector space of random variables; orthogonality MAP estimation and sufficient statistics</p> <p>Project Scheduling : PERT as a Decision Problem , Introduction of Randomness, Bounds on the Expected Project Duration, Series reductions, Parallel reductions, Disregarding path dependences, Arc duplications ,Using Jensen's inequality,</p>				
	<p>Targeted Application & Tools that can be used:</p> <p>Applications: Object detection, image classification, Sentiment analysis, language translation, Speech recognition, speaker identification, emotion recognition, Personalized product recommendations etc.</p> <p>Tools: OpenCV, TensorFlow, PyTorch, NLTK (Natural Language Toolkit), OpenAI Gym</p>				
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
	<p>Assignments can involve researching and reviewing academic papers or industry publications on specific AI applications in engineering / Students may be given programming assignments to implement AI algorithms / Case studies can be assigned to students, where they analyze real-world</p>				

	scenarios and propose AI-based solutions / Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.
	Text Book <ol style="list-style-type: none"> 1. Peter Kall, Stein W. Wallace, “Stochastic Programming,” Springer 2020 2. Robert G. Gallager, “Stochastic Processes Theory for Applications”, Cambridge University Press 2019
	References <ol style="list-style-type: none"> 1. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley , 2021.. 2. Laurra Graesser and Wan Loon Keng, “Foundations of Deep Reinforcement Learning”, Pearson, 2022 3. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

Course Code: CSE3088	Course Title: Business Intelligence and Analytics Type of Course:1] Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE1002: Programming using Python CSE2012: Database Management Systems					
Anti-requisites	NIL					
Course Description	The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective. Business Intelligence (BI) is a set of architectures, theories, methodologies and technologies that transform structured, semi-structured and unstructured data into meaningful and useful information. Students will analyze enterprise data requirements to develop queries, reports and build OLAP cubes that use business analytics to answer complex business questions.					
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Out Comes	On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Discuss the impact of Business Intelligence (BI) theories, architectures, and methodologies on the organizational decision making process.[Comprehension] 2. Analyse the differences between the structured, semi-structured and unstructured data types to leverage the best technologies.[Application] 3. Develop Ad hoc queries, reports, spread sheets, dashboards and mobile BI applications.[Application] 4. Using business analytics to answer complex business questions using data from a variety of sources, such as data files and relational/NoSQL databases.[Knowledge] 					
Course Content:						

Module 1	An Overview of Business Intelligence, Analytics (Comprehension)	Assignment			10 Hours
	Topics: A Framework for Business Intelligence (BI). Intelligence Creation Use and BI Governance. Transaction Processing Versus Analytic Processing. Successful BI Implementation. Analytics Overview. Brief introduction to Big Data Analytics.				
Module 2	Business Reporting, Visual Analytics and Business Performance (Knowledge)	Assignment			10 Hours
	Topics: Management Business Reporting Definitions and Concepts. Data and Information Visualization. Different Types of Charts and Graphs. The Emergence of Data Visualization and Visual Analytics. Performance Dashboards. Business Performance Management. Performance Measurement. Balanced Scorecards. Six Sigma as a Performance Measurement System.				
Module 3	Big Data and Analytics (Application)	Assignment			10 Hours
	Topics: Definition of Big Data. Fundamentals of Big Data Analytics. Big Data Technologies. Data Scientist. Big Data and Data Warehousing. Big Data Vendors. Big Data and Stream Analytics. Applications of Stream Analytics.				
Module 4	Emerging Trends and Future Impacts (Application)	Assignment			10 Hours
	Topics: Location-Based Analytics for Organizations. Analytics for Consumers. Recommendation Engines. The Web 2.0 Revolution and Online Social Networking. Cloud Computing and BI. Impacts of Analytics in Organizations: An Overview. Issues of Legality, Privacy, and Ethics. The Analytics Ecosystem.				
	Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note				
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
2.	3. Gain an immersive understanding of the practices and processes used by a junior or associate data analyst in their day-to-day job 3. Learn key analytical skills (data cleaning, analysis, & visualization) and tools (spread sheets, SQL, R programming, Tableau)				
	Text Book 3. C. Albright and W. L. Winston “ Business Analytics: Data Analysis & Decision Making ”, Cengage Learning India Pvt. Ltd ; Sixth Edition , September 2019 2. S. Christian, and L.Wayne, “Business Analytics: Data Analysis and Decision Making with MindTap”. Second Edition , September 2022				

	<p>References</p> <p>R1. Ramesh Sharda, Dursun Delen, Efraim Turban “ Analytics, Data Science, & Artificial Intelligence (10th ed.). Upper Saddle River, NJ: Pearson. ISBN- 9781292341552, Second Edition 6 March 2020</p> <p>R2. Jose, J. and Lal, S.P. :Introduction to Computing & problem solving with Python, Khanna Book Publishing First edition 2019</p> <p>R3. B. Mt Wan “ Data Analytics using Python ”, 9th Edition, published by Pearson Education 2020.</p> <p>R4. Ramesh Sharda “Business Intelligence Analytics And Data Science A Managerial Perspective” 4Th Edition , Pearson India, April 2019.</p> <p>Web links</p> <p>R1. http://owl.english.purdue.edu/owl/resource/560/01/</p> <p>R2. http://myregisapp.regis.edu/Citrix/StoreWeb/</p> <p>R3. https://in.coursera.org/courses?query=business%20intelligence</p> <p>R4. https://www.coursera.org/learn/business-intelligence-data-analytics</p> <p>R5. https://www.udemy.com/course/business-intelligence-and-data-analytics/</p>
	<p>Topics relevant to development of “Employability”: Business Intelligence, Big Data Analytics, Data Scientist.</p>

Course Code: CSE3103	Course Title: Cognitive Science & Analytics Type of Course : Theory	L- T-P- C	3	0	0	3
Version No.	1.1					
Course Pre-requisites	CSE3008: Machine Learning Techniques					
Anti-requisites	NIL					
Course Description	Overview of biological structure and artificial network, sensing algorithms, machine learning, localization. Hands-on implementation of cognitive recognition algorithms on both simulated and physical platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for cognitive analysis. It culminates in a critical review of recent advances in the field and a team project aimed at advancing the Reasoning.					
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the different neural network models. [Understand] 2. Understand cognition systems and its requirements. [Understand] 3. Apply dynamic System concepts in Cognitive Science and Neuroeconomics. [Application] 4. Apply Cognitive Science in Learning and Reasoning. [Application]					
Course Content:						
Module 1				8 Sessions		
	Introduction to Biological Neuron: Structure of Neuron, Action Potential, Process of Action Potential, Process of Synaptic Transmission, Stimulate the synaptic vesicle, <i>Depolarization of the neuron</i> , Memory (Biological Basis): Theories of Memory Formation, System Consolidation Theory, Multiple-Trace Theory, Reconsolidation Theory, Artificial Neural Network: Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron. Bayesian Network, Degree of Belief, Conditional Probability, Bayes’s Rule					
Module 2				12 Sessions		
	Cognitive Architecture: Fundamental Concepts, Cognitive View, Computers in Cognitive Science, Applied Cognitive Science, Interdisciplinary Nature of Cognitive Science, Nature of Cognitive Psychology, Notion of Cognitive Architecture, Global View of the Cognitive Architecture, Cognitive Processes, Working Memory, and Attention. Neuroscience: Brain and Cognition, Introduction to the Study of the Nervous System, Organization of the Central Nervous System, Neural Representation, Neuropsychology, Computational Neuroscience,					
Module 3				10 Sessions		
	MO D E L S A N D T O O L S : The Physical Symbol System Hypothesis :Intelligent Action and the Physical Symbol System, Neural based Models of Information Processing. Cognitive Science and Dynamical Systems, Applying Dynamical Systems. Neuroeconomics: Perception as a Bayesian Problem. Neuroeconomics: Bayes in the Brain					

	Strategies for Brain Mapping, Studying Cognitive Functioning: Techniques from Neuroscience
Module 4	08 Sessions
	Application: Models of Language Learning- Language Learning in Neural Networks, Bayesian Language Learning, Language Acquisition, Natural Language Processing, Semantics. Neural Network Models of Children's Physical Reasoning, Cognitive Science and the Law, Autonomous Vehicles: Combining Deep Learning and Intuitive Knowledge,
	Targeted Application & Tools that can be used: Applications: Behavior-Based Robotics Tools: SHAKEY's Software, Logic Programming in STRIPS and PLANEX
	Project Work/Assignment: 1. Develop a Model for Cognition and Knowledge Representation 2. Develop a Model for Biorobotics- Insects and Morphological Computation
	Text Book T2: José Luis Bermúdez, COGNITIVE SCIENCE I Publishers 3 rd Edition, Cambridge University Press, 2020 T2: Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, COGNITIVE SCIENCE Publishers 3 rd Edition, Cambridge University Press, 2020
	References R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 2 nd Edition, 2019 R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 12 ⁿ Edition, 2020 R3. Hannah Yee Fen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 2 nd Edition, 2019 Web Resources: https://www.cambridge.org/highereducation/books/cognitive-science/
	Topics relevant to development of "Employability": Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

Course Code: CSE3108		Course Title: Expert Systems Type of Course: Program Core& Theory Only		L-T-P-C	3	0	0	3
Version No.			1.1					
Course Pre-requisites			CSE3008: Machine Learning Techniques					
Anti-requisites			NIL					
Course Description			This course is an introduction to expert systems, which is an integral part of the computer science curriculum. In this course, we learn how theory and applications complement each other. Both theory and application are presented. Students are provided with the various tools language which they can use to develop systems of their own. By integrating theory with a fully functional means of applying that theory to real-world situations, students will gain an appreciation for the role played by expert systems in today’s world.					
Course Objective			This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Out Comes			On successful completion of the course the students shall be able to: [1] Understand the various AI programming knowledges. [2] Apply the expert system techniques for specific task completion. [3]Design and Develop expert systems using appropriate knowledge-based tools.					
Course Content:								
Module 1		Introduction to AI programming knowledges	Case study		Programming Task		12 Sessions	
	Introduction to AI programming languages, Blind search strategies, Breadth-first – Depth-first – Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game tress, Min-max algorithms, game playing – Alpha-beta pruning. Knowledge representation issues predicate logic – logic programming Semantic nets- frames and inheritance, constraint propagation; Representing Knowledge using rules, Rules-based deduction systems.							
Module 2		Expert System tools	Assignment		Tools		14 Sessions	

	<p>Introduction to Expert Systems, Architecture of expert system, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.</p> <p>Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems.</p>				
Module 3	Building an expert systems	Assignment		Programming	16 Sessions
	<p>Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process.</p> <p>Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development.</p>				
	<p>Targeted Application & Tools that can be used:</p> <p>AI related tools and knowledge based tools for expert system.</p>				
	Project work/Assignment:				
	<p>Assignment 1: Task on FuzzyCLIPS.</p> <p>Assignment 2: Back-propagation algorithm for training Neural Networks (NN)</p>				
	<p>Text Book</p> <p>T1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi.</p> <p>T2. Introduction to Expert Systems, Jackson P., 3rd edition, Addison Wesley, ISBN 0-201-87686-8</p> <p>T2. Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman</p>				
	<p>References</p> <p>R1. Stuart Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice-Hall,</p> <p>R2. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley,</p> <p>R3. Patterson, Artificial Intelligence & Expert System, Prentice Hall India, 1999.</p> <p>R4. Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley,</p> <p>R5. Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman & Allanheld, New Jersey</p> <p>.</p> <p>Weblinks:</p> <p>https://onlinelibrary.wiley.com/journal/14680394</p> <p>https://www.youtube.com/watch?v=11nznK9D8</p>				

	https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live
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Course Code: CSE3072	Course Title: Wireless Sensor Networks	L- T-P- C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE-236 Principles of Data Communications and Computer Networks				
Anti-requisites		NIL				
Course Description		This course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, uni cast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks.				
Course Objective		The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING TECHNIQUES				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none">• Explain the basics of the Wireless systems.• Describe different protocols being used by wireless networks including ABR and MANETS.• Illustrate the Fundamental Concepts and applications of ad hoc and wireless sensor networks.• Interpret the WSN routing issues by considering related QoS measurements.				
Course Content:						
Module 1	Overview of Wireless Sensor and Adhoc Networks	Assignment		Data Interpretation		08 Sessions
	Topics: Introduction, Sensor Network Technology background, Elements of basic Sensor Network Architecture, Survey of Sensor Networks, Network Characteristics and Challenges, Applications of Wireless Sensor Networks, Range of Applications, Category 2 WSN Applications – Home Control, Industrial Automation, Medical Applications, Category 1 WSN Applications – Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Introduction to Cellular and Adhoc Networks, Issues in Adhoc Networks – Routing, Multicasting, QoS, Security, Scalability.					

Module 2	Wireless Transmission Technology and MAC Protocols for Adhoc	Assignment		Basics and Interpretation	13 Sessions
Topics: Introduction, Radio Technology Primer – Propagation and Modulation, Propagation and Modulation impairments, Available Wireless Technologies, Campus Applications, MAN/WAN Applications, Medium Access Control Protocols – Fundamentals, Performance Requirements, MAC Protocols for WSNs -Schedule based Protocols and Random Access based Protocols, Sensor MAC case study, Issues in Designing MAC Protocol for Adhoc Networks - Bandwidth efficiency, QoS support, Synchronization, error-prone broadcast channel, Mobility of nodes.					
Module 3	Routing Protocols for Adhoc and WSN	Quiz		Questions Set	9Sessions
Topics: Background, Data Dissemination and gathering, Routing challenges, Network Scale and Time-Varying Characteristics, Routing Strategies, characteristics of an ideal Routing Protocol for Adhoc Networks, WSN Routing Techniques, Classifications of Routing Protocols, Table-driven and on-demand Routing Protocols, Routing Protocols with efficient flooding mechanism.					
Module 4	Demonstration of WSN Adhoc Network using Simulators	Quiz		Questions Set	8 Sessions
Topics: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools (MATLAB wireless module, NS2, etc).					
Targeted Application & Tools that can be used: This course helps the students to understand the concepts related to Wireless Sensor and Adhoc and networks.by using simulation tools in several educational associations and research hubs. For this reason, the study of existing experimental tools for analyzing the behavior of WSNs has become essential, with wireless sensor networks that include NS-2, OMNeT++, Prowler, OPNET, and TOSSIM.					
Project work/Assignment:					
Project Assignment: 1. Resource Allocation Robust to Traffic and Channel Variations in Multihop Wireless Networks. 2. Evaluation Models for the Nearest Closer Routing Protocol in Wireless Sensor Networks Assignment: 1]Define Wireless Sensor Networks? Explain in brief about the Applications of Wireless SensorNetworks 2] Discuss the advantages and applications of sensor networks? 3] Discuss the design considerations of physical layer and transceiver?					
Text Book T1: Kazem Soharby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley Publication, 2016, ISBN : 978-81-265-2730-4 T2: C. Siva Ram Murthy and B. S. Manoj, Adhoc Wireless Networks – Architecture and Protocols, Pearson Publication, 2013. ISBN: 978-81-317-0688-6					
References 1: Jagannathan Sarangapani, Wireless Adhoc and Sensor Networks – Protocols, Performance and Control, CRC Press 2017, e-book ISBN: 9781315221441 2: Chai K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall Publisher 2007, ISBN : 0-13-007617-4					

<p>R3: https://networksimulationtools.com/glomosim-simulator-projects/</p> <p>R4 : http://vlabs.iitkgp.ac.in/ant/8/</p> <p>Case study</p> <p>link:https://www.academia.edu/33109763/A_Case_Study_on_Mobile_Adhoc_Network_Security_for_Hostile_Environment</p> <p>E book link : http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w03.pdf</p> <p>E book link : https://referenceglobe.com/CollegeLibrary/library_books/20180301073312adhoc2-ilovepdf-compressed.pdf</p> <p>Web resources: https://archive.nptel.ac.in/courses/106/105/106105160/- IIT KGP, Prof. SUDIP MISHRA</p> <p>Web resources: https://www.digimat.in/nptel/courses/video/106105160/L22.html - IIT KGP, Prof. SUDIP MISHRA</p>
<p>Topics relevant to development of “Skill Development”:Sustainable development tools, Integrity Availability Concepts Policies, procedures,Guidelines, infrastructure-less wireless network that is deployed in a large number of wireless sensors.</p>

Course Code: CSE3073	Course Title: Game design and Development	L-T-P-C	2	0	2	3
Type of Course: Program Core						
Version No.		1.0				
Course Pre-requisites		Nil				
Anti-requisites		NIL				
Course Description		The Game Design and development course is a hands-on learning experience that focuses on teaching students how to design, develop, and test game prototypes. Students will learn game design concepts such as player engagement, game mechanics, and game balance, and the basics of game art, sound, and programming. Throughout the course, students will work in teams to develop and refine their game prototypes, receiving feedback and guidance from the instructor and their peers. Topics covered include prototyping tools, sample game engines, and the creation of simple 2D and 3D game prototypes. The course will culminate in a final project where students will present and demonstrate their completed game prototypes to the class.				
CourseObjective		This course is designed to develop ENTREPRENEURIAL SKILLS by USING EXPERIENTIAL LEARNING Techniques.				
Course OutComes		At the end of the course the student should be able to: CO1 Recall the elements of Game Mechanics. CO2Distinguish between several types of prototypes. CO3 Employ the concepts to create prototypes of games.				
CourseContent:		Game mechanics, emergence and progression, resource mechanics, feedback structures.Uses and importance of prototyping, distinct types of prototypes, stages of prototyping, identifying key features, create functioning prototypes.				
Version No.		1.0				
Module 1	Game Mechanics	Assignment		Evolution of prototyping	No.of Classes:12	
	Topics: Introduction to Game Mechanics, distinct types of game mechanics and applications, concepts of emergence and progression, Resource mechanics and economies, level design and progression in levels, feedback structures and semiotics.					
Module 2	Designing	Case Study		Importance of prototyping	No.of Classes:13	
	Topics: Introduction to prototyping, uses and importance of prototyping. Distinct types of prototypes such as paper, physical, playable, art and sound prototypes, interface, low fidelity and high-fidelity code, core game and complete game prototypes.					

Module 3	Creating and Testing Prototypes	Assignment		Prepare physical prototype of a popular game	No. of Classes:20
	<p>Topics: Documentation, identifying key features, stages of prototyping, testing and feedback, application of different prototyping techniques such as paper, physical, playable, art and sound prototypes, interface, code, low fidelity and high-fidelity prototyping techniques to create functioning prototypes.</p>				
	<p>Targeted Application & Tools that can be used: Algodoo</p>				
	<p>Project work/Assignment:</p>				
3.	<p>4. 2D Platformer Design 3. Game Development 4. UI/UX Design</p>				
	<p>Textbook(s):</p> <p>2. Jeremy G. Bond, “Introduction to Game Design, Prototyping, and Development”, 2nd Edition, Addison-Wesley Professional, 2017.</p>				
	<p>References</p> <p>2. Ennio De Nucci, Adam Kramarzewski, “Practical Game Design : Learn the Art of Game Design Through Applicable Skills and Cutting-edge Insights”, Packt Publishing, 2018.</p> <p>3. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012.</p> <p>Weblinks:</p> <p>https://learn.unity.com/ https://starloopstudios.com/rapid-game-prototyping-why-is-it-important-in-game-development/[Text Wrapping Break]</p>				

Course Code: CSE3083	Course Title: Advanced Computer Architecture			L- T-P- C	3	0	0	3
	Type of Course: Discipline Elective							
Version No.	1.0							
Course Pre-requisites	CSE 2009 Computer Organization and Architecture							
Anti-requisites	NIL							
Course Description	This course introduces the principles and classes of parallelism in computation and architectures of different levels of parallel processing from intermediate to advanced level. This theory-based course emphasizes understanding advanced memory optimization techniques. It equips the students with the intuition behind Instruction level parallelism with pipelining and reducing the cost & hazards using dynamic scheduling. It helps the students to appreciate multiprocessing & thread level parallelism using shared, distributed and directory-based memory models for synchronization and consistency. The course also explores SIMD processors like Graphics Processing Units and Vector processors.							
Course Outcomes	<p>On successful completion of the course the students shall be able to:</p> <p>1] Discuss the concept of parallelism, virtualization, and memory optimization.</p> <p>2] Interpret the practices to explore Instruction level parallelism with pipe lining and reducing the cost & hazards using dynamic scheduling.</p> <p>3] Explain the intuition behind multiprocessing & thread level parallelism using shared, distributed and directory-based memory models for synchronization and consistency.</p> <p>4] Discuss internal architecture of SIMD systems like Vector processors and GPUs.</p>							
Course Content:								
Module 1	Flynn's classification and Memory Hierarchy	Assignment	Data Analysis task					10 Classes
	<p>Topics: Defining Computer Architecture, Flynn's Classification of Computers, Metrics for Performance Measurement, Amdahl's Law, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Virtual Memory and Virtual Machines, The Design of Memory Hierarchy.</p> <p>Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8.</p>							
Module 2	Instruction Level Parallelism	Assignment	Analysis, Data Collection					9 Classes
	<p>Topics: Concepts and Challenges, Superscalar architecture, Hazard Resolution and Timing Constraints, Out of Order Execution and Register Renaming, Reducing Branch Costs with Advanced Branch Prediction, Dynamic Scheduling, Advanced Techniques for Instruction Delivery and Speculation, Limitations of ILP.</p> <p>Case Study: Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8.</p>							

Module 3	Thread Parallelism	Level	Case Study	Data analysis task		9 Classes
	Topics: Introduction, Shared-Memory Multicore Systems, Performance Metrics for Shared-Memory Multicore Systems, Prefetching, Cache Coherence Protocols, Synchronization, Memory Consistency. Case Study: Intel Skylake and IBM Power8.					
Module 4	Data Parallelism	Level	Assignment	Analysis, Collection	Data	9 Classes
	Topics: Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, GPU Memory Hierarchy, Detecting and Enhancing Loop- Level Parallelism Case Study: Nvidia Maxwell.					
	Targeted Application & Tools that can be used: Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc. Tools: <ul style="list-style-type: none"> Virtual Lab, IIT KGP Tejas – Java Based Architectural Simulator, IIT Delhi 					
	Project work/Assignment:					
	Case Study: <ul style="list-style-type: none"> Memory Hierarchies in Intel Core i7 and ARM Cortex-A8 Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8 Term Assignments: <ul style="list-style-type: none"> Comparative analysis of instruction set architecture (ISA) of CISC and RISC processors Carry out a thorough analysis of the internal organization and Instruction set Architecture of state-of the art CISC processors like VAX, PDP-11, Motorola 68k, Intel's x86 and the best in the market RISC architectures including DEC Alpha, ARC, AMD 29k, Atmel AVR, Intel i860, Blackfin, i960, Motorola 88000, MIPS, PA-RISC, Power, SPARC, SuperH, and ARM too. A short survey of the recent trends in advanced Cache memory optimization 					

	Study and analyze few important present day cache memory optimization techniques the levels used, the mapping technique employed, read and write policies, coherency and consistency scenarios etc.
	Text Book 1. J.L. Hennessy and D.A. Patterson, “Computer Architecture: A Quantitative Approach”, 6 th Edition, Morgan Kauffmann Publishers, November 2021.
	References 1. J.P. Shen and M.H. Lipasti, “Modern Processor Design: Fundamentals of Superscalar Processors”, 2 nd Edition paperback imprint, McGraw-Hill Higher Education, 2013. 2. D.B. Kirk and W.W. Hwu, “Programming Massively Parallel Processors”, 3 rd Edition, Morgan Kauffmann Publishers, November 2016.
	Topics relevant to development of “FOUNDATION SKILLS”: Pipelining, CISC and RISC processors, Static and Dynamic scheduling Topics relevant to “HUMAN VALUES & PROFESSIONAL ETHICS”: Collaboration and Data collection for Term assignments and Case Studies.

Course Code: CSE3085	Course Title: Real Time Operating Systems Type of Course: Theory	L- T- P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		The Real-time Operating Systems program is an educational and methodological document included in the master's educational program, provides for the acquisition of skills and competencies related to the study of the features of embedded operating systems, as well as real-time systems. Real-time Operating Systems is aimed at the formation of competencies aimed at obtaining theoretical knowledge about embedded operating systems, and the acquisition of practical skills and competencies in installing, configuring and debugging operating systems.				
Course Objective		This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIAL LEARNING Techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> Explain the fundamentals of Real time systems and their classifications. Understand the concepts of System control and the suitable computer hardware requirements for real-time applications. Describe the operating system concepts and techniques applicable for real time systems. Apply deadlock detection and prevention algorithms to solve the given problem 				

Course Content:		
Module 1		8 Sessions
	Introduction Real Time Operating System Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling	
Module 2		8 Sessions
	BASICS OF REAL-TIME CONCEPTS Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel	
Module 3		8 Sessions
	PROCESS MANAGEMENT Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals	
Module 4		8 Sessions
	INTER-PROCESS COMMUNICATION: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion, PIPES MEMORY MANAGEMENT: - Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection	
	Text Book <ol style="list-style-type: none"> 1. J. J Labrosse, “MicroC/OS-II: The Real –Time Kernel”, Newnes, 2002. 2. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000. 	
	References <ol style="list-style-type: none"> 1. W. Richard Stevens, “Advanced Programming in the UNIX® Environment”, 2nd Edition, Pearson Education India, 2011. 2. Philips A. Laplante, “Real-Time System Design and Analysis”, 3rd Edition, John Wley& Sons, 2004 3. Doug Abbott, “Linux for Embedded and Real-Time Applications”, Newnes, 2nd Edition, 2011. Web resources: http://pu.informatics.global	
	Topics relevant to development of “Skill Development”: Threads: Multi-threading models, threading issues, thread libraries, synchronization	

Course Code: CSE 2028		Course Title: Statistical Foundation of Data Science			Type of Course: Integrated		L-T- P- C	2	0	2	3
Version No.		1									
Course Pre-requisites		Basic knowledge about mathematical operations and statistics, Machine learning.									
Anti-requisites											
Course Description		This course is intended for those developers who are interested in entering the field of data science and are looking for concise information on the topic of statistics with the help of insightful content based exercises, examples and simple explanation. This course gives in depth introduction to statistics and machine learning theory, methods, and algorithms for data science. It covers multiple regression, kernel learning, sparse regression, sure screening, generalized linear models and quasi-likelihood, covariance learning and factor models, principal component analysis and other related topics.									
Course Objective		This course is designed to improve the learner’s <u>EMPLOYABILITY SKILLS</u> by using real-world <u>PROBLEM-SOLVING</u> methodologies.									
Course Out Comes		On successful completion of the course the students shall be able to: 1. Identify the statistical concepts in the field of data science. (Knowledge) 2. Apply logical thinking, solve the problem in context of High Dimensional Inference. (Application) 3. Classify the relevant topics in statistics and supervised learning & unsupervised learning (Comprehension) 4. Demonstrate different types of data classification real -world problems of data science applications. (Application)									
Course Content:											
Module 1		Multiple and Nonparametric Regression		Assignment				Data Collection/Interpretation		10Sessions	
		Topics: Introduction, Multiple Linear Regression - The Gauss-Markov Theorem, Statistical Tests Weighted Least-Squares, Box-Cox Transformation, Model Building and Basis Expansions - Polynomial Regression, Spline Regression, Multiple Covariates, Ridge Regression - Bias-Variance Tradeoff , Penalized Least Squares, Bayesian Interpretation, Ridge Regression Solution Path, Kernel Ridge Regression,									
Module 2		High Dimensional Inference		Case studies				Case studies / Case let		10 Sessions	
		Topics: Inference in linear regression - Debias of regularized regression estimators, Inference in generalized linear models, Test of linear hypotheses, Numerical comparison - Asymptotic efficiency, Statistical efficiency and Fisher information, Linear regression with random									

	design, Partial linear regression, Gaussian graphical models - Inference via penalized least squares, Sample size in regression and graphical models, General solutions.				
Module 3	Mathematics of machine learning	Quiz		Case studies	10 Sessions
	Topics: Bayesian modelling and Gaussian processes, randomized methods, Bayesian neural networks: approximate inference, variational autoencoders, generative models, applications. Recurrent neural networks, backpropagation through time, Long short term memory networks, neural Turing machines, machine translation, Restricted Boltzmann Machine				
Module 4	Advanced Neural Networks	Quiz		Case studies	10 Sessions
	Convolutional neural network, Prediction of data using Convolutional Neural Networks, Generative adversarial networks-Deep learning in Sequential Data, RNN(Recurrent Neural Networks) & LSTM(Long Short Term Memory), GRU(Gated Recurrent Unit), Sentiment Analysis, Recommender systems.				

	<p>List of Laboratory Tasks:</p> <p>Experiment No 1: Working with Numpy arrays Level 1: Basic Statistics, Copying, & Subsetting, Indexing, Flattening, Level 2: Dealing with Missing Values, and filling with missing values</p> <p>Experiment No. 2: Working with Pandas data frames Level 1: Descriptive Statistics, Basic statistical functions Level 2: Statistical functions, Aggregations</p> <p>Experiment No. 3: Develop python program for Basic plots using Matplotlib Level 1: Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots Level 2: Time Series, Categorical Data, and Text Data</p> <p>Experiment No. 4: Develop python program for Frequency distributions Level 1: student dataset , pollution dataset Level 2: stock market dataset</p> <p>Experiment No. 5: Develop python program for Variability Level 1: Statistical values Level 2: Probability Distributions and Pipes</p> <p>Experiment No. 6: Develop python program for Normal Curves</p> <p>Experiment No. 7: Develop python program for Correlation and scatter plots</p> <p>Experiment No. 8: Develop python program for Correlation coefficient</p> <p>Experiment No. 9 : Develop python program for Simple Linear Regression</p> <p>Experiment No. 10 : Apply and explore various plotting functions on UCI data sets, Normal curves, Density and contour plots, Correlation and scatter plots</p>
	<p>Targeted Applications & Tools that can be used:</p> <ul style="list-style-type: none"> • Data Analysis • Data classification • Data Exploration • Data Clustering <p>Tools: Python with statistical packages</p>
	<p>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</p>
•	<ul style="list-style-type: none"> • After completion of each module a programming-based Assignment/Assessment will be conducted. • A scenario will be given to the students to be developed as a series of Program/ Application.

	<ul style="list-style-type: none"> On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using python.
	<p>Text Book</p> <p>T1 Fan, Jianqing, Runze Li, Cun-Hui Zhang, and Hui Zou. <i>Statistical foundations of data science</i>. CRC press, 2020.</p> <p>T2 Alan Agresti, Maria Kateri “Foundations of Statistics for Data Scientists With R and Python” 2021</p>
	<p>References</p> <p>Books</p> <p>R1. James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). <i>An Introduction to Statistical Learning with Applications in R</i> . Springer, New York.</p> <p>R2. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). <i>The elements of Statistical Learning: Data Mining, Inference, and Prediction</i> (2nd ed). Springer, New York.</p> <p>R3. Buehlmann, P. and van de Geer, S. (2011). <i>Statistics for High-Dimensional Data: Methods, Theory and Applications</i>. Springer, New York.</p> <p>E book link</p> <p>1.W. N. Venables, D. M. Smith and the R Core Team, https://www.ebooksdirectory.com/details.php?ebook=1791</p> <p>Web link:</p> <p>1. https://www.udemy.com/course/statistics-for-data-science-and-business-analysis(Udemy)</p> <p>2. https://www.coursera.org/learn/foundations-of-data-science(Coursera)</p>
	<p>Topics relevant to the development of “Foundation Skills”:</p> <ul style="list-style-type: none"> Data Exploration using Python and R Programming. <p>Topics relevant to the development of “Employability Skills”:</p> <p>Statistical Data Analysis and exploration using Python and R Programming.</p>

Course Code: UG COURSE: CSE3013	Course Title: Machine Vision Type of Course: Discipline elective Theory with embedded lab	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	MAT1003 Applied Statistics CSE2048 Robotic Vision					
Anti-requisites	NIL					
Course Description	Machine Vision is a field of study that focuses on the design, development, and implementation of computer vision systems and technologies for visual perception and analysis. This course provides an in-depth understanding of the fundamental principles, algorithms, and applications of machine vision. The Machine Vision course covers a wide range of topics related to computer vision, image processing, and pattern recognition. It combines theoretical concepts with hands-on practical exercises to provide students with a comprehensive understanding of machine vision techniques. Introduction to Machine Vision, Image Acquisition and Preprocessing, Image Segmentation and Feature Extraction, Object Detection and Recognition, Machine Vision Systems and Applications.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Machine Vision and attain Employability through Problem Solving Methodologies.					
Course Out Comes	<p>On successful completion of the course the students shall be able to:</p> <ol style="list-style-type: none"> 1. Gain a solid understanding of the fundamental principles and concepts underlying machine vision systems, including image processing, computer vision algorithms, and pattern recognition techniques. [Knowledge] 2. Acquire knowledge of various machine vision algorithms and techniques used for tasks such as image acquisition, preprocessing, segmentation, feature extraction, object detection, tracking. [Application] 3. Ability to Implement Machine Vision Systems Develop the skills to design, implement, and evaluate machine vision systems using programming languages and libraries commonly used in the field, such as MATLAB, OpenCV, Python, TensorFlow, or PyTorch. [Application] 4. Gain hands-on experience through lab exercises, projects, and assignments that involve implementing and experimenting with machine vision algorithms and systems. [Application] 5. Develop teamwork and communication skills by working on group projects and effectively presenting findings and results related to machine 					

	vision tasks. [Application]				
Course Content:					
Module 1	Introduction to Machine Vision	Assignment		Practical	No. of Classes:8
	Overview of machine vision and its applications, Basic components of a machine vision system, Challenges and limitations in machine vision				
Module 2	Image Acquisition and Preprocessing	Assignment		Practical	No. of Classes:14
	Image formation and acquisition methods, Image enhancement techniques, Noise reduction and image denoising. Image Segmentation and Feature Extraction: Thresholding techniques <ul style="list-style-type: none"> • Edge detection algorithms • Region-based segmentation • Feature extraction methods 				
Module 3	Object Detection and Recognition	Assignment		Practical	No. of Classes:8
	Object detection algorithms (e.g., template matching, Haar cascades), Feature-based object recognition, Machine learning-based object detection and recognition				
Module 4	Machine Vision Systems and Application	Assignment		Practical	No. of Classes:8
•	<ul style="list-style-type: none"> • Industrial machine vision systems • Robotics and autonomous systems • Medical imaging and healthcare applications • Surveillance and security systems • Augmented reality and virtual reality applications 				
	<p>Lab Experiments are to be conducted on the following topics:-</p> <p>Lab Sheet 1:</p> <p>1. Image Loading and Display:</p> <ul style="list-style-type: none"> ○ Load an image from a file using the imread function. ○ Display the loaded image using the imshow function.._____ (One Lab Session) <p>2. Image Arithmetic Operations:</p>				

	<ul style="list-style-type: none"> ○ Perform addition, subtraction, and multiplication of images using basic arithmetic operations. ○ Display the results of each operation using the imshow function ._____(One Lab Session) <p>3. Implementation of Transformations of an Image._____(One Lab Session)</p> <ul style="list-style-type: none"> a. Scaling & Rotation b. Gray level transformations, power law, logarithmic, negative. <p>4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.____(One Lab Session)</p> <p><u>Lab Sheet 2:</u></p> <p>5. Edge Detection:</p> <ul style="list-style-type: none"> a. Apply edge detection algorithms (e.g., Sobel, Canny) to detect edges in the image. b. Display the edge-detected images using imshow and compare them with the original. (One Lab Session) <p>6. Image Restoration:</p> <ul style="list-style-type: none"> a. Introduce noise (e.g., Gaussian, salt and pepper) to the image using functions like imnoise. b. Apply suitable restoration techniques (e.g., median filtering, Wiener filtering) to remove the noise. (One Lab Session) <p>7. Image Segmentation:</p> <ul style="list-style-type: none"> a. Convert the image to grayscale using the rgb2gray function. b. Perform thresholding using a suitable threshold value to segment the image. c. Display the segmented image using imshow and compare it with the original. (One Lab Session) (Level 2) <p><u>Lab Sheet 3:</u></p> <p>8. Feature Extraction:</p> <ul style="list-style-type: none"> a. Texture feature extraction using methods like Gray-Level Co-occurrence Matrix (GLCM) or Local Binary Patterns (LBP). b. Shape feature extraction (e.g., area, perimeter, eccentricity) using region properties. c. Color feature extraction using color histograms or color moments. (Two Lab Session) (Level 2) <p><u>Lab Sheet 4: (Group Project)</u></p> <p>9. Object Detection and Recognition:</p> <ul style="list-style-type: none"> ○ Haar cascade object detection (e.g., face detection or object detection using pre-trained classifiers). ○ Feature-based object detection using techniques like Speeded-Up Robust Features (SURF) or Scale-Invariant Feature Transform (SIFT). ○ Deep learning-based object detection using Convolutional Neural Networks (CNNs) or You Only Look Once (YOLO) algorithm. <p>10. Optical Character Recognition (OCR):</p>
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	<ul style="list-style-type: none"> a. Preprocessing of text images (e.g., binarization, noise removal, or skew correction). b. Text localization using techniques like connected component analysis or Stroke Width Transform (SWT). c. Character recognition using machine learning algorithms like Support Vector Machines (SVM) or Convolutional Neural Networks (CNNs). <p>11. Gesture Recognition:</p> <ul style="list-style-type: none"> a. Hand segmentation using techniques like background subtraction or skin color detection. b. Feature extraction from hand regions (e.g., finger counting, hand shape descriptors). c. Classification of gestures using machine learning algorithms (e.g., k-Nearest Neighbors or Support Vector Machines).
	Tools/Software Required : <ul style="list-style-type: none"> 1. OpenCV 4 2. Python 3.7 3. MATLAB
	Text Books <ul style="list-style-type: none"> 1. "Machine Vision: Theory, Algorithms, Practicalities" by E.R. Davies 4th edition 2005
	References <ul style="list-style-type: none"> 2. "Computer Vision: Algorithms and Applications" by Richard Szeliski 2nd edition 2022. 3. Ravishankar Chityala, Sridevi Pudipeddi, "Image Processing and Acquisition Using Python", Taylor & Francis, 2020.

Course Code: CSE3076	Course Title: Artificial Intelligence for Robotics Type of Course: Theory Only Course	L- T- P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		-				
Anti-requisites		-				
Course Description		The course "Artificial Intelligence for Robotic Theory" aims to provide students with a deep understanding of the theoretical foundations and advanced concepts in artificial intelligence (AI) as they apply to robotics. The course delves into the theoretical underpinnings of AI algorithms, models, and methodologies used in robotic systems, enabling students to analyze and develop novel AI solutions for complex robotic tasks. Through a combination of lectures, discussions, and theoretical exercises, students will explore key AI theories and their applications in robotics. Students will also critically analyze research papers and gain insights into the current state-of-the-art in AI for robotics.				
Course Objective		The objective of the course is skill development of student by using Participative Learning techniques				
Course Out Comes		On successful completion of the course the students shall be able to: 1. Summarize the basics of artificial intelligence and its application in the context of robotics. [Understanding] 2. Infer the fundamental concepts and components of robotics, including robot anatomy and the systems engineering approach. [Understanding] 3. Apply the knowledge of image recognition processes and techniques, including image processing, convolution, artificial neurons, and convolutional neural networks. [Appling] 4. Apply the knowledge about how to build a system which detects objects and speech using driftnet techniques. [Appling]				
Course Content:						
Module 1	Foundation for Robotics and AI				8 Sessions	
Topics: The basic principle of robotics and AI: Introduction to AI, the example problem – clean up this room, OODA (Observe- Orient-Decide- Act) loop, Artificial intelligence and advanced robotics Techniques, Introducing the robot and development environment, Software components (ROS, Python, and Linux), Robot control systems and a decision-making framework, The robot control system – a control loop with soft real-time control.						
Module 2	Robot Design Process				10 Sessions	
Topics: Introduction to what is a robot, Robot anatomy – robots made of A systems engineering-based approach to robotics, Subsumption architecture, Use cases (The Problem Part-1, Problem Part-2), Subsumption architecture: Storyboard – put away the toys, Decomposing hardware needs, Breaking down software needs.						
Module 3	Object Recognition Using Neural Networks				10 Sessions	

Topics: The image recognition process, Technical requirements, The image recognition training and deployment process – step by step, Image processing, Convolution, Artificial neurons, The convolution neural network process, Build the toy/not toy detector			
Module 4	Robot speech recognition		10 Sessions
Topics: Introduction to Teaching a Robot to Listen, teaching a Robot to Listen, Robot speech recognition, Robot speech recognition, Intent, Mycroft, Demo of speech recognition.			
Targeted Application & Tools that can be used: Application Area: Resource Allocation, Finance and Economics (Risk Analysis and Consumption Assessment), Fraud Detection, Image Segmentation, Dimensionality Reduction, Gene Expression Analysis, Recommender System, Image reconstruction, Large Scale Surveillance. Tools: Anaconda Navigator Python Packages			
Project work/Assignment:			
Assignment: Train a system to recognize the speech. Train a system to recognize the object.			
Text Book T1. Artificial Intelligence for Robotics by Francis X. Govers, Released August 2018, Publisher(s): Packt Publishing, ISBN: 9781788835442.			
References R1. Introduction to AI Robotics Robin R. Murph, ISBN 0-262-13383-0 (hc.: alk. paper) R2. Introduction to AI Robotics, Second Edition by Robin R. Murphy, ISBN 9780262348157 E book link R1: https://doc.lagout.org/science/0_Computer%20Science/8_Electronics%20%26%20Robotics/Introduction%20to%20AI%20Robotics%20-%20Murphy%20R.R.pdf			
Topics relevant to development of “Skill Development”: Object Detection, Speech Recognition			

Course Code: CSE3095	Course Title: Cloud Security Type of Course: Discipline Elective in Cloud Computing Basket Theory		L- T- P- C	3	0	0	3
Version No.		1.0					
Course Pre-requisites		[1] Cloud Computing and Services (CSE322)					
Anti-requisites		NIL					
Course Description		This course provides ground-up coverage on the high-level concepts of cloud landscape, architectural principles, and techniques. It describes the Cloud security architecture and explores the guiding security for Infrastructure and Softwares.					
Course Objective		This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.					
Course Outcomes		On successful completion of this course the students shall be able to: 1. Describe fundamentals of cloud computing [Knowledge]. 2. Explain cloud computing security architecture and associated challenges [Comprehension]. 3. Discuss cloud computing software security essentials [Comprehension]. 4. Apply infrastructure security and data security in cloud computing enviroment. [Application].					
Course Content:							
Module 1:	Fundamentals of Cloud Computing	Quiz		Knowledge based Quiz	10 Sessions		
	Topics: Cloud Computing at a Glance, Building Cloud Computing Environments, Computing Platforms and Technologies, Cloud Computing Architecture: Cloud Delivery Models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud Deployment Models, Expected Benefits.						
Module 2:	Cloud Security Challenges and Cloud Security Architecture	Quiz		Comprehension based Quiz	10 Sessions		
	Topics: Security Policy Implementation, Computer Security Incident Response Team, Virtualization Security Management. Architectural Considerations, Identity Management and Access Control, Autonomic Security.						
Module 3	Cloud Computing Software Security Essentials	Assignment		Batch-wise Assignments	9 Sessions		
	Topics: Cloud Information Security Objectives, Cloud Security Services, Secure Cloud Software Requirements, Cloud Security Policy Implementation, Secure Cloud Software Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery.						
Module 4:	Infrastructure Security and Data Security	Assignment and Presentation		Batch-wise Assignment and Presentations	9 Sessions		

	Topics: Infrastructure Security: The Network Level, The Host Level, The Application Level. Data Security : Aspects of Data Security, Data Security Mitigation, Provider Data and its Security.
	Targeted Application & Tools that can be used: Use of CloudSim simulator.
	Project work/Assignment: Survey on Cloud Service Providers
	Text Book <ol style="list-style-type: none"> 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “<i>Mastering Cloud Computing</i>”, McGraw Hill Education, July 2021. 2. Roland L Krutz and Russell Dean Vines, “<i>Cloud Security - A Comprehensive Guide to Secure Cloud Computing</i>”, Wiley Publishing, Inc. 2019.
	References <ol style="list-style-type: none"> 1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, “<i>Secure Cloud Computing</i>”, Springer, ISBN 978-1-4614-9278-8 (eBook). 2. John Rittinghouse and James Ransome, “<i>Cloud Computing, Implementation, Management and Security</i>”, CRC Press, 2010. 3. Tim Mather, Subra Kumaraswamy and Shahed Latif, “Cloud Security and Privacy – An Enterprise Perspective on Risks and Compliance”, Oreily Publication, 2009.
	Topics related to development of “FOUNDATION”: Cloud computing architecture, Security policy implementation. Topics related to development of “EMPLOYABILITY”: Infrastructure security and Data security.

Course Code: CSE3102	Course Title: Malware Analysis Type of Course: Discipline Elective in Cyber Security Basket				L-T-P-C	3	0	0	3
Version No.	1.0								
Course Pre-requisites	Have the knowledge of Cryptography and Network Security								
Anti-requisites	NIL								
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.								
Course Objective	To study the fundamentals of malwares. To know about different malicious programs and their behavior To know how to work on linux systems. To learn, analyze and demonstrate network hacking tools								
Course OutComes	On successful completion of this course the students shall be able to: 1. Understanding the nature of malware, its capabilities, and how it is combated through detection and classification. 2. Apply the methodologies and tools to perform static and dynamic analysis on unknown executables. 3. Analyze scientific and logical limitations on society's ability to combat malware.. 4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.								
Course Content:									
Module 1	Introduction to MALWARE ANALYSIS (Application)		Assignment	Programming activity				12 Hours	
	Topics: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware typesviruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis.								
Module 2	Static Analysis (Application)		Assignment	Programming activity				11 Hours	
	Topics:								

X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, ReverseEngineering-x86 Architecture						
Module 3	Dynamic Analysis (Application)		Assignment	Programming activity		11 Hours
Topics: Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark						
Module 4	Malware Functionality and Detection Techniques (Comprehension)		Assignment	Programming activity		12 Hours
Topics: Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection. Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences						
Targeted Application & Tools that can be used: eCMAP (Certified Malware Analysis Professional)						
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course						
1.	2. Problem Solving: Choose an appropriate data structure and implementation of programs. 2. Programming: Implementation of given scenario using Java					
Text Book 1. Michael Sikorski and Andrew Honig, 2012: “ Practical Malware Analysis”, No Starch Press.						

References

1. Jamie Butler and Greg Hoglund, 2005: "Rootkits: Subverting the Windows Kernel", Addison-Wesley.
2. Dang, Gazet and Bachaalany, 2014: "Practical Reverse Engineering", Wiley.
3. Reverend Bill Blunden, 2012: "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" Second Edition, Jones & Bartlett.

Course Code: CSE3136	Course Title: E-Business and Marketing Analytics Type of Course: Theory Only Course	L-T-P-C	3	0	0	3
Version No.		1.0				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		This course describes the basic principles of e-business technologies. Upon the completion of this course, students should have a good working knowledge of e-business concepts, applications, technologies (e.g. e-business infrastructure, technology required for e-business, e-business marketplace, e-Commerce, B2B e-business, E-business strategy, e-procurement, customer relationship management and service implementation and optimization) and ability to understand any kind of marketing analytics.				
Course Objective		This course is designed to improve the learner’s EMPLOYABILITY SKILLS by using real-world PROBLEM-SOLVING methodologies.				
Course Out Comes		On successful completion of the course, the students shall be able to: 1. Demonstrate the strategy of E-Business and identify the component parts (Knowledge). 2. Identify records according to management policy by maintaining database and processing software (Knowledge). 3. Identify the ethical, social and security issues of information systems (Knowledge). 4. Apply the basic concepts and technologies used in the field of business management information systems (Application).				
	Course Content:					
Module 1: E-BUSINESS – An Introduction					10 Sessions	
	Introduction, E-Commerce – definition, History of E-commerce, types of E-Commerce B to B etc. Comparison of traditional commerce and e-commerce. E-Commerce business models – major B to B, B to C model, Consumer-to-Consumer (C2C), Consumer-to-Business (C2B) model, Peer to-Peer (P2P) model – emerging trends. Advantages/ Disadvantages of e-commerce, web auctions, virtual communities, portals, e-business revenue models.					
Module 2: MARKETING ANALYTICS					10 Sessions	

	Introduction to Marketing Analytics-Marketing Budget and Marketing Performance Measure, Marketing Metrics and its application- Financial Implications of various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis, History and Evolution of social media-Understanding Science of social media, Web analytics, Search analytics. E-Commerce and marketing B to B and B to C marketing and branding strategies.	
Module 3: SECURITY THREATS OF E-BUSINESS		09 Sessions
	Security threats – An area view – implementing E-commerce security – encryption – Decryption, Protecting client computers E-Commerce Communication channels and web servers Encryption, SSL protocol, Firewalls, Cryptography methods, VPNs, protecting, networks, policies and procedures, E-payment systems – An overview. B to C payments, B to B payments. Types of E- payment system, Secure Electronic Transaction (SET) protocol. RFID Concepts.	
Module 4: E-BUSINESS MARKETING TECHNOLOGIES		09 Sessions
	Introduction to R-Programming, Statistical models in R, Simple programs using R. Algorithms using MAP Reduce, Linear and Logistic Regression modelling, Clustering techniques. Case studies: Social network analysis- Text analysis-marketing analysis.	
	Text Book <ol style="list-style-type: none"> 1. Beginner’s Guide for Data Analysis using R Programming, Jeeva Jose Khanna Book Publishing; 1st edition, 2018. 2. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013 	
	References <ol style="list-style-type: none"> 1. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014 2. Bittu Kumar, Social Networking, V & S Publishers, 2013 3. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007 4. TakeshiMoriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016 <p>Web resources: https://onlinecourses.nptel.ac.in/noc19_mg54/preview https://onlinecourses.nptel.ac.in/noc20_mg30/preview https://www.coursera.org/learn/foundations-of-digital-marketing-and-e-commerce</p>	
	Topics relevant to development of “Employability skill Development”: Web auctions, E-Business revenue model, RFID concept, CRM system. Web analytics and search analytics	

Course Code: CSE3137	Course Title: Text Mining and Analytics		L-T-P-C	3	0	0	3
	Type of Course: Discipline Elective						
Version No.		1.0					
Course Pre-requisites		Basic knowledge of Python and machine learning					
Anti-requisites		Nil					
Course Description		This course covers the major techniques for mining and analyzing text data to discover interesting patterns, extract useful knowledge, and support decision-making, with an emphasis on statistical approaches and Machine Learning Methods					
Course Objective		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes		On successful completion of the course the students shall be able to: 1. Apply various pre-processing techniques to clean and prepare text data for analysis. [Application] 2. Demonstrate the fundamental concepts and techniques of natural language processing (NLP) and text mining. [Application] 3. Develop the techniques for document summarization to extract key information from text data. [Application] 4. Apply sentiment analysis to identify and understand the sentiment expressed in the text. [Application] 5. Interpret text mining techniques in interdisciplinary contexts, such as social sciences, healthcare, finance, and marketing. [Application]					
Course Content:							
Module 1	Introduction to Text mining	Assignment		Knowledge, Quizzes		07 Hours	
	Topics: Text mining techniques and their applications Fundamental of text mining and analytics, Introduction to preprocessing techniques, Text normalization including tokenization and lemmatization, Text and character N-grams, Stopword						

	removal, and stemming, Hand-on practice: Text preprocessing, text classification, sentiment analysis, information retrieval.				
Module 2	Natural Language Processing	Assignment		Knowledge, Quizzes	08 Hours
	Topics: Introduction to NLP: Tokenization, part-of-speech tagging, syntactic parsing, named entity recognition, and semantic analysis				
Module 3	Text Classification and Sentiment Analysis	Case study		Application, Quizzes	09 Hours
	Topics: Text classification techniques and sentiment analysis: feature extraction, feature selection, and various classification algorithms using different Machine learning and Deep Learning techniques such as SVM, Decision tree, Random Forest, CNN, LSTM.				
Module 4	Information Retrieval and Search Engines	Case study		Application, Quizzes	09 Hours
	Topics: Information retrieval techniques for text-based search engines: Basic concepts, components of an information retrieval system, retrieval models. Query formulation, query optimization, query expansion techniques. Web Search Engines: Crawling and indexing techniques, web ranking algorithms (e.g., PageRank), search engine architectures. Multimedia Retrieval: Image and video retrieval, content-based and metadata-based approaches. Evaluation Metrics.				
Module 5	Text Analytics for Social Media and Web Data	Case study		Application, Quizzes	07 Hours
	Topics: Text analytics techniques for social media and web data: Mining and analyzing text data from platforms like Twitter, Facebook, and web pages [Blooms 'level selected: Application]				
	Targeted Application & Tools that can be used: Natural Language Processing (NLP) Libraries: NLTK, SpaCy, Stanford NLP				

	Text Classification Tools: Scikit-learn, TensorFlow, Keras Social Media Analytics Tools: Twitter API, Facebook Graph API, YouTube Data API
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1.	2. Develop a project where they collect social media data from platforms like Twitter or Facebook and perform sentiment analysis to determine the overall sentiment (positive, negative, or neutral) of the collected data 2. Develop a text classification model that can automatically categorize news articles into different topics or classes such as sports, politics, entertainment, etc 3. Develop a project where they build a system that can identify named entities (such as person names, locations, organizations) in a given text and extract relations between them
	Text Book 1. C. D. Manning, H. Schütze, and P. Raghavan, "Text Mining and Analytics: From Text Data to Knowledge Graphs," Cambridge University Press, 2021. 2. G. Chakraborty, M. Pagolu, and S. Garla, "Text Mining and Analysis: Practical Methods, Examples, and Case Studies Using SAS," CRC Press, 2014. 3. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin, published by Pearson. The latest edition is the 3rd edition, published in 2020.
	References 1. S. Weiss, N. Indurkha, T. Zhang, and F. Zhang, "Text Mining: Predictive Methods for Analyzing Unstructured Information," Springer, 2015. 2. G. Sholomitsky and Y. Reiter, "Introduction to Text Analytics: Language Technology for Information Access and Management," Morgan & Claypool Publishers, 2019. 3. S. M. Weiss, N. Indurkha, T. Zhang, and F. Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured Information," Springer, 2004. 4. S. Bird, E. Klein, and E. Loper, "Natural Language Processing with Python," O'Reilly Media, 2009 5. D. Sarkar, "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data," Apress, 2020
	Web Resources and Research Articles: 1. https://www.datacamp.com/courses/text-mining-with-r 2. https://www.nltk.org/book/ 3. https://libguides.wellesley.edu/c.php?g=992506&p=7181108 4. http://www.acadmix.com/eBooks_Download

Course Code: CSE3106		Course Title: Robotic Process Automation Systems Type of Course: Theory / Practical			L- T- P- C	2	0	4	4
Version No.		1.0							
Course Pre-requisites		NIL							
Anti-requisites		NIL							
Course Description		The Step into Robotic Process Automation (RPA) course is intended to introduce RPA to students. The course assumes no prior knowledge of RPA. The course takes a use-case approach. It begins by defining a real-world, generic problem and how it's solved in a non-RPA environment. The course goes on to teach skills that enable the students to create a robot using free UiPath software (Academic Alliance Edition) to automate the solution.							
Course Objective		The objective of the course is to provide a knowledge and applications of Robotic Process Automation.							
Course Outcomes		Upon successful completion of the course the students shall be able to: 1. Illustrate the intuition about Robotic Process Automation Technology and the underlying logic/structure related to RPA [Remember]. 2. Demonstrate the RPA Methodologies for Control Flow and data manipulation techniques [Apply]. 3. Apply appropriate RPA Tools for the automation Process [Apply]. 4. Utilize of various automated tools and its modern workflow automations [Apply].							
	Course Content:								
Module 1		RPA Foundations		Remember			8 Sessions		
	Emergence of Robotic Process Automation (RPA), Evolution of RPA, Future of RPA, Differentiating RPA from Automation, Defining Robotic Process Automation & its benefits, What RPA is Not, Types of Bots, Application areas of RPA, How Robotic Process Automation works, RPA development methodology and key considerations. Introduction to Robotic Process Automation Tools, Basic components in an RPA platform, Installation details of RPA tools, Types of Templates, User Interface, Domains in Activities, Workflow Files in the RPA platform.								
Module 2		RPA Methodologies		Apply			7 Sessions		
	Process Components and Activities: User Interface Automation Activities, System Activities, Variables, Arguments, Imports Panel and User Events. App Integration, Recording, Scraping, Selector, Workflow Activities. Example of Automate login to your (web)Email account, recording mouse and keyboard actions to perform an operation, scraping data from website and writing to CSV.								
Module 3		Intelligent Automation		Apply			7 Sessions		
	Data Manipulation, Automation of Virtual Machines, Introduction to Native Citrix Automation, Text and Image Automation, PDF Automation, Computer Vision, Programming, Debugging, Error Handling, Logging, Extensions, Project Organization								
Module 4		DEPLOYING AND MAINTAINING THE BOT		Apply			8 Sessions		

	Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages - Meta Bot Designer – Meta Bot with AI Sense - Bot Insight - Transactional Analytics - Operational Analytics
	<div> <div>Tasks</div> <div>List Of Laboratory (30 Hours)</div> </div>
	Lab Sheet 1: (6 Hrs)
	Setup and Configure a RPA tool and understand the user interface of the tool: <ol style="list-style-type: none"> 1. Create a Sequence to obtain user inputs display them using a message box. 2. Create a Flowchart to navigate to a desired page based on a condition. 3. Create a State Machine workflow to compare user input with a random number.
	Lab Sheet 2: (6 Hrs)
	Build a process in RPA platform using Automation Activities. <ol style="list-style-type: none"> 1. Create an automation process using key System Activities, Variables and Arguments. 2. Also implement Automation using System Trigger
	Lab Sheet 3: (6 Hrs)
	Automate login to (web)Email account.
	Lab Sheet 4: (6 Hrs)
	Recording mouse and keyboard actions to perform an operation Scraping data from website and writing to CSV
	Lab Sheet 5: (6 Hrs)
	Different ways of Error Handling in RPA platform <ol style="list-style-type: none"> 1. Browse through the log files related to a RPA Project
	Suggested List of Hands-on Activities:
	<ol style="list-style-type: none"> 2. Scrape the number of GitHub repositories for the top technologies in today's market. 2. Extract data from an excel file, according to a specific condition and store it in another excel file. 3. Segregate emails based on the email ID in respective folders present in the Outlook folder
	Text Book(s)
	<ol style="list-style-type: none"> 2. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, Mumbai, 2018 2. Tom Taulli , “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020. 3. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9787788470940 4. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Edition.
	References:
	<ol style="list-style-type: none"> 2. Richard Murdoch, “Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant” (1st Edition), Independently published, 2018. ISBN 978-1983036835. 2. A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020. 3. Frank Casale, Rebecca Dilla, Heidi Jaynes and Lauren Livingston, “Introduction to Robotic Process Automation: A Primer. 4. Automation: A Primer.

	<p>5. EMC education services. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, Wiley, 2012.</p> <p>Web Resources and Research Articles links:</p> <ol style="list-style-type: none"> 1. IEEE Transactions on Robotic Process Automation- https://ieeexplore.ieee.org/abstract/document/9114349 2. NPTEL Course on “ Robotics, IIT Bombay by Prof. B. Seth, Prof. C. Amarnath, Prof. K. Kurien Issac, Prof. P.S. Gandhi, Prof. P. Seshu https://nptel.ac.in/courses/112101098 3. https://www.uipath.com/rpa/robotic-process-automation 4. https://www.uipath.com/rpa/robotic-process-automation
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Course Code: CSA2003	Course Title: Software Metrics and Quality Management Type of Course: Integrated	L-T-P- C	2	0	2	3
Version No.		1.0				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		This course will focus on the processes, principles, and techniques of software testing and analysis. It covers a full spectrum of topics from basic principles and underlying theory of testing to organizational and process issues in real-world applications. The emphasis is on selecting practical techniques to achieve an acceptable level of quality at an acceptable cost. This course will provide software engineering professionals with realistic strategies for reliable and cost-effective software testing.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Software Metrics and Quality Management and attain Employability through Experiential Learning techniques.				
Course Out Comes		On successful completion of this course the students shall be able to: <ul style="list-style-type: none"> To understand software testing and quality assurance as a fundamental component of software life cycle [Knowledge] To efficiently perform T & QA activities using modern software tools [Comprehension] To prepare test plans and schedules for a T&QA project [Application] 				
Course Content:						
Module 1	Introduction to Quality					12 Hours
	Topics: Introduction to Quality: Historical Perspective of Quality, what is Quality? (Is it a fact or perception?), Definitions of Quality, Core Components of Quality, Quality View, Financial Aspect of Quality, Customers, Suppliers and Processes, Total Quality Management (TQM), Quality Principles of Total Quality Management, Quality Management Through Statistical Process Control, Quality Management Through Cultural Changes, Continual (Continuous) Improvement Cycle, Quality in Different Areas, Benchmarking and Metrics, Problem Solving Techniques, Problem Solving Software Tools.					
Module 2	Software Quality					12 Hours
	Topics: Introduction, Constraints of Software Product Quality Assessment, Customer is a King, Quality and Productivity Relationship, Requirements of a Product, Organisation Culture, Characteristics of Software, Software Development Process, Types of Products, Schemes of Criticality Definitions, Problematic Areas of Software Development Life Cycle, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects of Quality Management.					
Module 3	Software Verification and Validation					14 Hours
	Topics: Introduction, Verification, Verification Workbench, Methods of Verification, Type, Entities involved in verification, Reviews in testing lifecycle, Coverage in Verification, Concerns of Verification, Validation,					

	Validation Workbench, Levels of Validation, Coverage in Validation, Acceptance Testing, Management of Verification and Validation, Software development verification and validation activities. V-test Model: Introduction, V-model for software, Testing during Proposal stage, Testing during requirement stage, Testing during test planning phase, Testing during design phase, Testing during coding, VV Model, Critical Roles and Responsibilities.
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1.	2. Case study on real time software applications like MSTeam
	2. Implementation of verification and validation for any realtime software application.
	Text Book T1 Software Testing and Continuous Quality Improvement, William E. Lewis, CRC Press, 3 rd ,2016. T2 Software Testing: A Craftsman's Approach, Paul C. Jorgenson, CRC Press, 4 th , 2017.
	References R1. P. Ammann and J. Offutt. Introduction to Software Testing. Cambridge University Press, 2008. R2. https://www.tutorialspoint.com/software_quality_management/software_quality_management_metrics.htm https://nptel.ac.in/courses/106105150 https://nptel.ac.in/courses/106101163
	Topics relevant to “EMPLOYABILITY SKILLS”: Total quality management, software quality management, for development of Employability Skills through Experiential Learning Techniques. This is attained through assessment components mentioned in the course handout.

Course Code: CSE3016	Course Title: CSE3016 Neural Networks and Fuzzy Logic Type of Course: Discipline Elective in AI & ML Basket Theory Course	L-T-P-C	3	0	0	3
Version No.		1.2				
Course Pre-requisites		NIL				
Anti-requisites		NIL				
Course Description		This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory.				
Course Objective		This course is designed to improve the student's EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques.				

Course Outcomes		On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Define the concept of Neural Networks. [Knowledge] 2. Define the ideas behind most common learning algorithms in Neural Network. [Knowledge] 3. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 4. Demonstrate the Fuzzy logic concepts and its applications. [Application] 			
Course Content:					
Module 1	Introduction to Neural Network	Quiz		Single Layer Perceptron	9 Classes
	Topics: Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks. Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.				
Module 2	Multilayer Perceptron	Quiz		Multilayer Perceptron	10 Classes
	Topics: Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples. Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies. Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.				
Module 3	Fuzzy Sets, Operations and Relations	Quiz		Fuzzy Operations	10 Classes
	Topics: Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets. Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations. Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.				
Module 4	Fuzzy Logic and Fuzzy Logic Controller	Assignment		Developing Fuzzy Logic Controller	10 Classes
	Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions. Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.				
	Targeted Application & Tools that can be used: <ol style="list-style-type: none"> 1. Python Libraries and Software (Eg., Tensorflow , Scikit-Learn etc.) 2. Matlab (Neural Network Toolbox, Fuzzy Logic Toolbox) 				
	Project work/Assignment:				

	Students will have to do group assignments for Modules 2 & 4. As a part of their assignments, they will have to implement the solution to particular problems.
	Textbook(s): 1. Haykin, Simon. “ <i>Neural networks and learning machines</i> ”, 3/E. Pearson Education India, 2011. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553 2. George J. Klir and Bo Yuan, “ <i>Fuzzy Sets and Fuzzy Logic- Theory and Applications</i> ”, Prentice Hall of India, 2015. https://www.worldcat.org/title/fuzzy-sets-and-fuzzy-logic-theory-and-applications/oclc/505215200
	References: 1. Shivanandam, Deepa S, “ <i>Principles of Soft computing</i> ”, N Wiley India, 3rd Edition, 2018. https://www.wileyindia.com/principles-of-soft-computing-3ed.html 2. Timothy J. Ross, “ <i>Fuzzy Logic with Engineering Applications</i> ”, Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374 3. Kumar S., “ <i>Neural Networks - A Classroom Approach</i> ”, Tata McGraw Hill, 2nd Edition 2017. https://www.worldcat.org/title/neural-networks-a-classroom-approach/oclc/56955342 4. Fakhreddine O. Karray, and Clarence W. De Silva. “ <i>Soft computing and intelligent systems design: theory, tools, and applications</i> ”. Pearson Education, 2009. Weblinks https://www.pearson.com/en-gb/search.html?q=Karray%20Soft-Computing-and-Intelligent-Systems-Design-Theory-Tools-and-Applications
	Topics related to development of “EMPLOYABILITY”: Assignment implementations in software, batch wise presentations.

Course Code: CSE 3051	Course Title: System Monitoring Type of Course: Theory only	L-T-P- C	3	0	0	3
Version No.		1				
Course Pre-requisites		Agile Structures and Frameworks				
Anti-requisites		NA				
Course Description		This course is intended for understanding the principles of automation and the application of tools for the analysis and testing of software. The automated analysis encompasses both approaches to automatically generate a very large number of tests to check whether programs meet requirements, and also means by which it is possible to prove that software meets requirements and that it is free from certain commonly-occurring defects, such as divide-by-zero, overflow/underflow, deadlock, race-condition freedom, buffer/array overflow, uncaught exceptions, and several other commonly-occurring bugs that can lead to program failures or security problems. The learner will become familiar with the fundamental theory and applications of such approaches, and apply a variety of automated analysis techniques on example programs.				

Course Objective		The objective of the course is skill development of students by using Participative Learning techniques.				
Course Out Comes		On successful completion of the course the students shall be able to: <ul style="list-style-type: none"> Understand testing in DevOps. Learn its approaches to testing. Understand to design test cases. 				
Course Content:						
Module 1	NEED OF SYSTEM MONITORING	Assignment				8 Sessions
	Topics: Predicting system load - Failure prevention – Anomalies					
Module 2	TENETS OF SYSTEM	Assignment				8 Sessions
	Topics: Identifying as many problems as possible - Identifying problems as early as possible - Generating as few false alarms as possible – Automation					
Module 3	CORE COMPONENTS OF MONITORING TOOLS	Assignment				8 Sessions
	Topics: Alerts – Graphs - Logs					
Module 4	INTELLIGENTLY MONITORING THE RIGHT METRICS IN EACH	Assignment				8 Sessions
	Topics : Layer 0: The Application - Layer 1: The Process - Layer 2: The Server - Layer 3: The Hosting Provider - Layer 4: External Dependencies - Layer 5: The User					
Module 5	MONITORING STRATEGIES	Quiz				8 Sessions
	Topics : Monitor potential faulty entities - Monitor existing faulty entities - Tuning and Continuous Improvement					
	Targeted Application & Tools that can be used Jenkins, Docker					
	Project work/Assignment:					
	Assignment:					
	Text Book <ol style="list-style-type: none"> Building a Monitoring Infrastructure with Nagios - by David Josephsen. 2016 Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation - by Jez Humble (Author), David Farley (Author), Martin Fowler (Foreword). 2017 					

	References 1. Instant Nagios Starter - by Michael Guthrie, Packt Publishing Limited (23 May 2016) Web resources: W1. https://presiuniv.knimbus.com/user#/home
	Topics relevant to the development of “Skill Development”: Predicting system load - Failure prevention

Course Code: CSE3073	Course Title: Game Design and Development	L-T-P-C	2	0	2	3
	Type of Course: Discipline Elective					
Version No.		1.0				
Course Pre-requisites		CSE 2001- Data Structures and Algorithms & C# Programming Specific Topics to be included				
Anti-requisites		NIL				
Course Description		The course helps learners to build the necessary skills to design and development games. The Specialization focuses on both the theory and practice of game making. From a technical standpoint, learners will learn about basic operation using latest Unity 2021 game engine. In Game Design process, learners will write a complete game script and proposal of their own design from initial concept up to the first playable prototype.				
Course Object		The course will give a well-rounded knowledge in the Game Development with an emphasis on understanding and applying techniques in video game production. And this course will cover with a solid grasp of the fundamental game art principles, including knowledge of game engine technology and pre-production and production environments.				
Course Out Comes		On successful completion of the course the students shall be able to: 1. Recognize Game Preproduction and Design Process. 2. Identify the UI of Unity Game Engine and its Work Flow. 3. Illustrate GameObject Behaviour using C# Script. 4. Produce Game using Unity Game Engine.				
Course Content:						
Module 1	Essentials of Game Design	Assignment		Memory recall quiz from Introduction to Game and its basics		No. of Classes:8

				and Practical components for Preproduction	
	Topics: Introduction to Game - Basic Elements of Play- Basic elements of games- Basic Game Design Tools- Constraint- Direct and indirect actions- Goals-Challenge- Skill, strategy, chance, and uncertainty- Decision-making and Feedback-Abstraction-Theme-Context of Play- Preproduction -Logo - background				
Module 2	The Kinds of Play & Working with Unity API	Assignment		Quiz based on Play Categories and Lab Experiments on Unity Engine API	No. of Classes: 12
	Topics: The Kinds of Play - Competitive play, Cooperative play, Skill-based play, Experience-based play, Games of chance and uncertainty, Whimsical play, Role-playing, Player Experience -Introduction to fundamentals of game, Storytelling - basic programming using C# , Game Theory, Unity Interface- Tools- Windows – Game Objects, Components, Camera – Lightning -Building Platform and Project Preferences. Unity Editor Interface : Main Menu- Tool bar- Scene View-Game View-Hierarchy Window-Project Window-Inspector Window-Console Window-Status Bar -Game Objects.				
Module 3	Game Design Process and Working with Game Object in Unity	Assignment		Experiments based on Unity API and basic Operation	No. of Classes:12
	Topics: Iterative Game Design Process – Conceptualize- Prototype- Playtest and Evaluate Game Design Values : Experience – Theme - Point of view – Challenge - Skill, strategy, chance, and uncertainty - Introduction to Vectors, Game design - The structure of games, Unity Tools Materials and Textures, Game Objects, Components- Scripting: Unity Mono Behavior Class-Mono Behavior Methods / Messages - Rotations, Translations - Layers, Tags- Colliders, Collisions, Triggers- Physics, Physic Material, Texture, Shader – Lighting.				
Module 4	Game Prototyping, Evaluation and Game Development	Assignment		Game prototyping and Unity Programming	No. of Classes:12
	Topics: Game Prototyping : Paper prototypes - Physical Prototypes Playable prototypes - Art and sound prototypes - Core game prototypes - Complete game prototypes, Evaluation – UI : Working with UI & Menus- - Game development, Asset Management, Advanced Unity Programming				
	<u>Lab Experiments are to be conducted on the following topics: -</u> <ol style="list-style-type: none"> 1. Introduction to Preproduction 2. Introduction to Unity Game Engine API 3. Unity Game Objects its properties 4. Grouping Object in Environment 5. Multiple Game Objects 				

	6. Object Mono Behavior 7. Object Transform 8. Get Component Method 9. Prefabs 10. Translating Game Objects 11. Textures 12. Unity Physics 13. Player Movement 14. Camera Movement 15. Player Control 16. Character Controller 17. UI 18. Game Development
	Mini Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	Building a 2D/3D Game
	Text Books <ol style="list-style-type: none"> 1. Colleen Macklin, John Sharp, Games, Design and Play A Detailed Approach to Iterative Game Design, Pearson Education, Inc. 2016 2. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012 3. Ethan Ham, Tabletop Game Design for Video Game Designers, 2016 Taylor & Francis
	References <ol style="list-style-type: none"> 1. Jeff W Murray, “2D Unity”, William Pollock 2015, 2. Alan Thorn, “Learn Unity for 2D Game Development”, Tia 2017. 3. Unity API, Documentation 2021.

Course Code:	Course Title: E-Commerce	L-T-P-C	2	0	2	3
CSE3126	Type of Course: Program Core					
Version No.	1.0					
Course Pre-requisites	Web Technology					
Anti-requisites	NIL					
Course Description	This course caters the knowledge of real time ecommerce platforms, their architecture, structure and workflow. It also provides sufficient hands on to build a own e commerce platform and host.					

Course objectives		The objective of the course is skill development of student by using Participative Learning techniques.				
Course Out Comes		On successful completion of this course the students shall be able to: <ol style="list-style-type: none"> 1. Understand the concepts of an E-commerce (Knowledge). 2. Acquire the knowledge about existing e-commerce applications (comprehension). 3. Build own e-commerce application (Application) 4. Deploy e-commerce application (Application). 				
Course content:						
Module 1	Introduction to E-Commerce	Assignment		Survey	8 Sessions	
	Topics: Introduction to Electronic Commerce: Meaning, nature and scope; Business application of ecommerce; Global trading environment and adopting of e -commerce, evolution of World Wide Web, future of Web. Assignment: Perform a survey of state-of-art e-commerce platforms					
Module 2	Website design	Assignment		Case Study	9 Sessions	
	Topics: Web sites as market place; Role of web site in B2C e -commerce; Web site strategies; Web site design principles; push and pull approaches; Alternative methods of customer communication such as e -mail, BBA; E-mail etiquette and e-mail security. Assignment: Write a case study of any B2C business application					
Module 3	Business Models of E-Commerce	Assignment		Case Study	10 Sessions	
	Topics: B2B, B2C, B2G and other models of e - commerce; Applications of e-commerce to supply chain management; Product and service digitisation; Remote servicing, procurement and online marketing and advertising; Applications to Customer Relationship Management. Business to Consumer E-Commerce Applications: Cataloging, Order planning and order generation; Cost estimation ad pricing; Order receipt and accounting; Order selection and prioritization; Order scheduling, fulfilling and delivery, Order billing, Post sales services. Assignment: Write a case study of any B2B and B2G business application					
Module 4	E-Payment System	case study		Programming Task	9 Sessions	
	Topics: Types of payment systems –e-cash and currency servers, e-cheques, credit cards, smart cards; electronic purses and debit cards; Operational, credit and legal risk of e - payment, Risk management options for e-payment systems, Set standards. Assignment: Develop one online e-commerce platform for online tutorial					
	List of Laboratory Tasks: <ol style="list-style-type: none"> 1. Level 1: Understand the work flow of various e-commerce applications (Amazon, flipkart, myntra, etc.) Level 2: create a web page of your college. 2. Level 1: Develop a web page for user login 					

	<p>Level 2: Develop a web page for registration</p> <p>3. Level 1: Develop a home page of website consisting of navigation menus. Level 2: Develop a home page of website consisting of navigation menus as links.</p> <p>4. Level 1: Develop a home page of website consisting of vertical navigation panel. Level 2: Develop a page to navigate a page with user credentials and verify.</p> <p>5. Level 1: Build multiple web pages and link them to home page. Level 2: Embed relevant videos of recommended in home page.</p> <p>6. Level 1: Create a small website for online grocery. Level 2: Create a cart of products and navigate to pay portal.</p> <p>7. Level 1: Build a small B2B website (Shopify) Level 2: Build a small B2B website (eBay)</p> <p>8. Level 1: Build a small B2C business transaction (Amazon). Level 2: Build a small B2C business transaction (Flipkart).</p> <p>9. Level 1: Create simple customer to customer (eBay like e-commerce application). Level 2: Create simple customer to customer (big Basket like e-commerce application).</p> <p>10. Level 1: Write a case study on security issues in e-commerce. Level 2: Write a case study on risk management in e-commerce.</p>
	<p>Targeted Application & Tools that can be used: Xamp server, Notepad, Visual studio, MySQL</p>
	<p>Project work/Assignment:</p>
	<p>Design a website to showcase working of 4 types of e-commerce (B2B, B2C, C2B and C2C business transactions).</p>
	<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Sushila Madan (2022), E-Commerce, Scholar Tech Press 2. S.J. P.T. Joseph (2019), E-COMMERCE : An Indian Perspective, PHI 3. Laudon, Kenneth C. and Carol Guercio Traver (2002) E -commerce: business, technology, society. (New Delhi: Pearson Education). 4. Awad, Elias M. (2007), Electronic Commerce: From Vision to Fulfillment (New Delhi: Pearson Education).
	<p>References</p> <ol style="list-style-type: none"> 1. Kalakota, Ravi and Marcia Robinson (2001). Business 2.0: Roadmap for Success (New Delhi: Pearson Education). 2. Smith, P.R. and Dave Chaffey (2005), eMarketingXcellence; The Heart of eBusiness (UK: Elsevier Ltd.)
•	<ul style="list-style-type: none"> • https://onlinecourses.nptel.ac.in • https://onlinecourses.swayam2.ac.in • http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=4125&query_desc=kwl%3A%20e%20commerce • http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14338&query_desc=kwl%3A%20e%20commerce

Course Code: CSE3150	Course Title: Front-end Full Stack Development		L- T-P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		Nil					
Anti-requisites		NIL					
Course Description		This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Outcomes		On successful completion of the course the students shall be able to: 1] Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension] 2] Illustrate development of a responsive web. [Application] 3] Apply concepts of Angular.js to develop a web front-end. [Application] 4] Apply concepts of Angular.js to develop a web front-end. [Application]					
Course Content:							
Module 1	Fundamentals of DevOps and Web Development	Project		Programming		04 Sessions	
	Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control. HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform Assignment: Develop a website for managing HR policies of a department.						
Module 2	Responsive web design	Project		Programming		03 Sessions	
	Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society.						
Module 3	Fundamentals of Angular.js	Project		Programming		08 Sessions	

Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Assignment: Develop a software tool to do inventory management in a warehouse.				
Module 4	Fundamentals of React.js	Project		Programming 15 Sessions
Topics: Overview of React.js.; Reactive Programming; React Components; Render Method; Virtual DOM and Bandwidth Salvation; Two Distinct Ways of Initializing a React Class; States & Life Cycles; Component Mounting; Node.js & NPM; JSX Walkthrough; React Testing. Assignment: Develop a web-based application to book movies/events (like bookmyshow).				
Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: GCC compiler.				
Project work/Assignment:				
2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.				
Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 T2. Northwood, Chris, “ <i>The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer</i> ”, APress, 2018				
References: R1. Flanagan D S, “ <i>Javascript : The Definitive Guide</i> ” 7th Edition. 7th ed. O'Reilly Media; 2020. R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. “ <i>Responsive Web Design with HTML5 and CSS3 Essentials</i> ”, Packt Publishing, 2016 R3. Duckett J Ruppert G Moore J. “ <i>Javascript & JQuery : Interactive Front-End Web Development.</i> ”; Wiley; 2014. R4. Greg Sidelnikov, “ <i>React.js Book_ Learning React JavaScript Library</i> ”, 1 edition, Scratch-River Tigris LLC 2016 R5. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxIY_uTWA&index=2				

Course Code: CSE3151	Course Title: Java Full Stack Development			L- T-P- C	2	0	2	3
Version No.		1.0						
Course Pre-requisites		Nil						
Anti-requisites		CSE3152 .NET Full Stack Development						
Course Description		This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.						
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.						
Course Outcomes		On successful completion of the course the students shall be able to: 1] Practice the use of Java for full stack development [Application] 2] Show web applications using Java EE. [Application] 3] Solve simple applications using Java Persistence and Hibernate [Application] 4] Apply concepts of Spring to develop a Full Stack application. [Application] 5] Employ automation tools like Maven, Selenium for Full Stack development. [Application]						
Course Content:								
Module 1	Introduction	Project		Programming	03 Sessions			
	Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.							
Module 2	Java EE Web Applications	Project		Programming	05 Sessions			
	Topics: Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App Assignment: Develop an application for managing HR policies of a department.							
Module 3	Java Persistence	Project		Programming	06 Sessions			

	using JPA and Hibernate				
	Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society..				
Module 4	Spring Core	Project		Programming	10 Sessions
	Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development Assignment: Develop a software tool to do inventory management in a warehouse.				
Module 5	Automation tools	Project		Programming	06 Sessions
	Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands Assignment: Illustrate the use of automation tools in the development of a small software project.				
	Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.				
	Project work/Assignment:				
1.	2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.				
	Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015				
	References R1. Soni, Ravi Kant. “ <i>Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful.</i> ”, Apress, 2017. R2. Mardan, Azat. “ <i>Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB.</i> ”, Apress, 2015				

Course Code: CSE3152	Course Title: .NET Full Stack Development		L- T-P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		Nil					
Anti-requisites		CSE3151 Java Full Stack Development					
Course Description		This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Outcomes		On successful completion of the course the students shall be able to: 1) Practice the use of C# for developing a small application [Application] 2) Show web applications using Entity Framework. [Application] 3) Solve simple web applications that use SQL and ASP.NET [Application] 4) Apply concepts of ASP.NET to develop a Full Stack application. [Application]					
Course Content:							
Module 1	C# Programming for Full Stack Development	Project		Programming			10 Sessions
	Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework Assignment: Develop a small application for managing library using C#.						
Module 2	Entity Framework Core 2.0	Project		Programming			06 Sessions
	Topics:						

	Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET Assignment: Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project		Programming	06 Sessions
	Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; Assignment: Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project		Programming	08 Sessions
	Topics: Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application Assignment: Develop a software tool to do inventory management in a warehouse.				
	Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Visual Studio				
	Project work/Assignment:				
1.	2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using .NET.				
	Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 T2. Valerio De Sanctis, “ <i>ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11</i> ”, 4th Edition, Packt, 2021.				
	References R1. Benjamin Perkins, Jon D. Reid, “ <i>Beginning C# and .NET</i> ”, Wiley, 2021 Reid, 2021. R2. Piotr Gankiewicz, “ <i>Full Stack .NET Web Development</i> ”, Packt Publishing, 2017. R3. Tamir Dresher, Amir Zuker, Shay Friedman, “ <i>Hands-On Full-Stack Web Development with ASP.NET Core</i> ”, Packt Publishing, 2018. R4. Dustin Metzgar, “ <i>Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core</i> ”, Manning, 2017.				

Course Code: CSE390	Course Title: Front-end Full Stack Development		L- T-P- C	0	0	4	2
Version No.		1.0					
Course Pre-requisites		Nil					
Anti-requisites		NIL					
Course Description		This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Outcomes		On successful completion of the course the students shall be able to: 1] Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension] 2] Illustrate a basic web design using HTML, CSS< Javascript. [Application] 3] Illustrate development of a responsive web. [Application] 4] Apply concepts of Angular.js to develop a web front-end. [Application]					
Course Content:							
Module 1	Fundamentals of DevOps	Project		Programming		04 Sessions	
	Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control.						
Module 2	Web Design & Development	Project		Programming		03 Sessions	
	Topics: HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform; Assignment: Develop a website for managing HR policies of a department..						
Module 3	Responsive web design	Project		Programming		08 Sessions	
	Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society..						

Module 4	Fundamentals of Angular.js	Project		Programming	15 Sessions
Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Overview of React.js Assignment: Develop a software tool to do inventory management in a warehouse.					
Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: GCC compiler.					
Project work/Assignment:					
2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.					
Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 T2. Northwood, Chris, “ <i>The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer</i> ”, APress, 2018					
References: R1. Flanagan D S, “ <i>Javascript : The Definitive Guide</i> ” 7th Edition. 7th ed. O'Reilly Media; 2020. R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. “ <i>Responsive Web Design with HTML5 and CSS3 Essentials</i> ”, Packt Publishing, 2016 R3. Duckett J Ruppert G Moore J. “ <i>Javascript & JQuery : Interactive Front-End Web Development.</i> ”; Wiley; 2014. R4. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxIY_uTWA&index=2					

Course Code: CSE391	Course Title: Java Full Stack Development			L- T-P- C	0	0	4	2
Version No.		1.0						
Course Pre-requisites		Nil						
Anti-requisites		CSE392 .NET Full Stack Development						
Course Description		This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.						
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.						
Course Outcomes		On successful completion of the course the students shall be able to: 1] Practice the use of Java for full stack development [Application] 2] Show web applications using Java EE. [Application] 3] Solve simple applications using Java Persistence and Hibernate [Application] 4] Apply concepts of Spring to develop a Full Stack application. [Application] 5] Employ automation tools like Maven, Selenium for Full Stack development. [Application]						
Course Content:								
Module 1	Introduction	Project		Programming	03 Sessions			
	Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.							
Module 2	Java EE Web Applications	Project		Programming	05 Sessions			
	Topics: Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App Assignment: Develop an application for managing HR policies of a department.							
Module 3	Java Persistence	Project		Programming	06 Sessions			

	using JPA and Hibernate				
	Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) Assignment: Design and develop a website that can actively keep track of entry-exit information of a housing society..				
Module 4	Spring Core	Project		Programming	10 Sessions
	Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development Assignment: Develop a software tool to do inventory management in a warehouse.				
Module 5	Automation tools	Project		Programming	06 Sessions
	Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands Assignment: Illustrate the use of automation tools in the development of a small software project.				
	Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.				
	Project work/Assignment:				
1.	2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using Java.				
	Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015				
	References R1. Soni, Ravi Kant. “ <i>Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful.</i> ”, Apress, 2017. R2. Mardan, Azat. “ <i>Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB.</i> ”, Apress, 2015				

Course Code: CSE392	Course Title: .NET Full Stack Development			L- T-P- C	0	0	4	2
Version No.		1.0						
Course Pre-requisites		Nil						
Anti-requisites		CSE391 Java Full Stack Development						
Course Description		This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.						
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.						
Course Outcomes		On successful completion of the course the students shall be able to: 1] Practice the use of C# for developing a small application [Application] 2] Show web applications using Entity Framework. [Application] 3]Solve simple web applications that use SQL and ASP.NET [Application] 4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]						
Course Content:								
Module 1	C# Programming for Full Stack Development	Project		Programming	10 Sessions			
	Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework Assignment: Develop a small application for managing library using C#.							
Module 2	Entity Framework Core 2.0	Project		Programming	06 Sessions			
	Topics:							

	Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET Assignment: Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project		Programming	06 Sessions
	Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; Assignment: Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project		Programming	08 Sessions
	Topics: Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application Assignment: Develop a software tool to do inventory management in a warehouse.				
	Targeted Application & Tools that can be used: Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: Visual Studio				
	Project work/Assignment:				
1.	2. Problem Solving: Design of Algorithms and implementation of programs. 2. Programming: Implementation of given scenario using .NET.				
	Text Book: T1. Fender, Young, “ <i>Front-end Fundamentals</i> ”, Leanpub, 2015 T2. Valerio De Sanctis, “ <i>ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11</i> ”, 4th Edition, Packt, 2021.				
	References R1. Benjamin Perkins, Jon D. Reid, “ <i>Beginning C# and .NET</i> ”, Wiley, 2021 Reid, 2021. R2. Piotr Gankiewicz, “ <i>Full Stack .NET Web Development</i> ”, Packt Publishing, 2017. R3. Tamir Dresher, Amir Zuker, Shay Friedman, “ <i>Hands-On Full-Stack Web Development with ASP.NET Core</i> ”, Packt Publishing, 2018. R4. Dustin Metzgar, “ <i>Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core</i> ”, Manning, 2017.				

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