PRESIDENCY UNIVERSITY

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PROGRAMME REGULATIONS & CURRICULUM

2021-25

PRESIDENCY SCHOOL OF COMPUTER SCIENCE & ENGINEERING

BACHELOR OF TECHNOLOGY (B.TECH.)

COMPUTER ENGINEERING [ARTIFICIAL INTELLIGENCE & MACHINE LEARNING]

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 ENGINEERING [Artificial Intelligence & Machine Learning]

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-24.05/SOCSE04/CEI/2021-2025

AUGUST-2024

Resolution No. 05 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, towards enhancing 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, 2025 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, 2021-2025;*

ff. *"Program" means the Bachelor of Technology (B.Tech.) Degree Program;*

gg. *"PSCS" means the Presidency School of Computer Science and Engineering;*

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 16.1 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 19.0 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:

PEO1. Demonstrate expertise as competent and ethical Computer Engineering professionals by leveraging foundational knowledge, technical skills, and innovative approaches to analyze, design, and develop cutting-edge solutions in the fields of Artificial Intelligence, Machine Learning, and related technologies.

PEO2. Become a teaching and research professional in the area of Computer Engineering through lifelong learning.

PEO3. Evolve as a consultant in the Computer Engineering Industry.

PEO4. Transform as an entrepreneur in the Computer Engineering 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: An ability to use and develop cloud software, administrative features Infrastructure services and architectural patterns: ethical hacking and forensic security technologies

PSO 02: An ability to gain knowledge on design and control strategy; techniques to secure information and adapt to the fast-changing world of information

PSO 03: An ability to gain working Knowledge on emerging software tools and technologies and apply the knowledge of secure computing tools and techniques in the field of Information science and technology for solving real world problems.

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 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 B.Tech Program in Computer Engineering [AI & ML] 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 Engineering [AI & ML] 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 Engineering (AI & ML) 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, 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 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./ B.E/ B.S. 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 (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

S.No	Credit Structure [L-T-P-C]	Percentage/ Marks	CA		Mid-Term		End-term		Project	Total	Exam Conducted by
			Theory	Practical	Theory	Practical	Theory	Practical			
1	3-0-0-3	Percentage	25%	-	25%	-	50%	-	-	100 %	Mid-Term & End Term by CoE
		Marks	50	-	50	-	100	-	-	200	
2	2-0-2-3	Percentage	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	Percentage	-	25%	10%	40%	5%	20%	-	100 %	Mid-Term & End Term by School
		Marks	-	25	10	40	5	20	-	100	
4	2-0-4-4	Percentage	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	Percentage	-	50%	-	-	-	-	50%	100 %	Project evaluated by IC at School level
		Marks	-	50	-	-	-	-	50	100	
6	0-0-2-1	Percentage	-	100%	-	-	-	-	-	100 %	Only CA at School Level
		Marks	-	100	-	-	-	-	-	100	
7	3-0-2-4	Percentage	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.

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 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 17.3 (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 17.3 (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 Engineering [AI & ML] 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 Engineering [AI & ML]) 2021-2025: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	School Core	55
4	Program Core	61
5	Discipline Elective	30
6	Open Elective	15
	Total Credits	161 (Minimum)

In the entire Program, the practical and skill based course component contribute to an extent of approximately 57% out of the total credits of 160 for B.Tech. (Computer 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	PPS (Soft Skills)	0	0	2	1
4	Kali Kannada / Thili Kannada	1	0	0	1
5	PPS (Soft Skills for Engineers)	0	0	2	1
6	(PPS) Introduction to Aptitude	0	0	2	1
7	(PPS) Logical and Critical Thinking	0	0	2	1
8	Aptitude for Employability	0	0	2	2
9	Preparedness for Interview	0	0	2	1
10	Being Corporate Ready	0	0	2	1
	Total No. of Credits				13

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 Using Raspberry Pi	0	0	0	1
Total No. of Credits					14

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	Applied Machine Learning	2	0	2	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	Artificial Intelligence and Machine Learning	2	0	2	3
13	Cryptography and Network Security	3	0	0	3
14	Theory of Computation	3	0	0	3
15	Cloud Computing	3	0	0	3
16	Neural Network and Fuzzy logic	3	0	0	3
17	Data Analysis and Visualization	2	0	4	4
18	Reinforcement Learning	3	0	0	3

19	Fundamentals of Natural Language Processing	3	0	0	3
20	Deep Learning Techniques	2	0	2	3
21	Coding Skills in Python	2	0	2	3
				Total No. of Credits	64

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	9
				Total No. of Credits	13

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, 2021, 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 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 12-14 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 A 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

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	
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	Antirequisites	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	Introdcution 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/ ES	-	-	-
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

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

The following Open-Elective courses are not to be offered for Computer Science and Engineering students and Allied Branches.

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	ion 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					BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	**MAT1001**	Calculus and Linear Algebra	3	0	2	4	5	School Core		
2.	**CSE1001**	Problem Solving using JAVA	2	0	2	3	4	School Core		
3.	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	School Core		
4.	**ENG1001/ ENG1002**	Foundation English/ Technical English	1	0	2	2	3	School Core		
5.	XXXXXX	Open Elective – I	3	0	0	3	3	Open Elective		
6.	**PPS1001**	Introduction to soft skills	0	0	2	1	2	School Core		
7.	CSE1002	Innovative Projects- Arduino using Embedded 'C'	0	0	4	2	4	School Core		
		TOTAL	**12**	**0**	**14**	**19**	**26**			

Semester 2										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	3	School Core		
2.	MAT1003	Applied Statistics	1	0	2	2	3	School Core		
3.	CSE2001	Data Structures and Algorithms	3	0	2	4	5	School Core		
4.	ENG1002/ENG2001	Technical English/Advanced English	1	0	2	2	3	School Core		
5.	**PHY1002**	Optoelectronics and Device Physics	2	0	2	3	4	School Core		
6.	ECE2007	Digital Design	2	0	2	3	4	Program Core		
7.	CSE2067	Web Technologies	2	0	2	3	4	Program Core		
8.	CSE2014	Software Engineering	3	0	0	3	3	Program Core		

9.	XXXXXXX	Open Elective-II	3	0	0	3	3	Open Elective		
10.	PPS1002	Soft Skills for Engineers	0	0	2	1	2	School Core		
11.	**KAN1001/KAN1002**	Kali Kannada/Thili Kannada	1	0	0	1	1	School Core		
12	CHE1001	Environmental Studies	2	0	0	0	2	School Core		
		TOTAL	**23**	**0**	**14**	**28**	**37**			

Semester 3										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	CSE2011	Data Communications and Computer Networks	3	0	0	3	3	Program Core		
2.	CSE2009	Computer Organization and Architecture	3	0	0	3	3	Program Core		
3.	CSE2074	Database Management Systems	2	0	2	3	4	Program Core		
4.	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	Program Core		
5.	CSE3001	Artificial Intelligence and Machine Learning	2	0	2	3	4	Program Core		
6.	CSEXXXX	Discipline Elective – I	3	0	0	3	3	Discipline Elective		
7.	PPS2001	Reasoning and Employment Skills	0	0	2	1	2	School Core		
8.	CSE1003	Innovation Project - Rasberry Pi using Python	0	0	4	2	4	School Core		
		TOTAL	**16**	**0**	**10**	**21**	**26**			

Semester 4										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	School Core		
2.	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	Program Core		
3.	CSE3078	Cryptography & Network Security	3	0	0	3	3	Program Core		
4.	CSE2018	Theory of Computation	3	0	0	3	3	Program Core		
5.	CSE2027	Fundamental of Data Analytics	3	0	0	3	3	Program Core		
6.	CSE3016	Neural Network and Fuzzy logic	3	0	0	3	3	Program Core		
7.	CSE2010	Operating Systems	3	0	0	3	3	Program		

								Core		
8.	CSEXXXX	Discipline Elective – II	3	0	0	3	3	Discipline Elective		
9.	PPS2002	Being Corporate Ready	0	0	2	1	2	School Core		
		TOTAL	**22**	**0**	**4**	**24**	**26**			

Semester 5										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1.	CSE2015	Data analysis and Visualization	2	0	4	4	6	Program Core		
2.	CSE3087	Applied Machine Learning	2	0	2	3	4	Program Core		
3.	CSE2013	Cloud Computing	3	0	0	3	3	Program Core		
4.	CSEXXXX	Discipline Elective - III	3	0	0	3	3	Discipline Elective		
5.	CSEXXXX	Discipline Elective – IV	3	0	0	3	3	Discipline Elective		
6.	CSEXXXX	Discipline Elective – V	3	0	0	3	3	Discipline Elective		
7.	XXXXXXX	Open Elective-III (Management Basket)	3	0	0	3	3	Open Elective		
8.	PPS4002	Introduction to Aptitude	0	0	2	1	2	School Core		
		TOTAL	**19**	**0**	**8**	**23**	**27**			

Semester 6										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE						TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS	BASKET		
1.	CSE3011	Reinforcement Learning	3	0	0	3	3	Program Core		
2.	CSE3014	Fundamentals of Natural Language Processing	3	0	0	3	3	Program Core		
3.	CSE3010	Deep Learning Techniques	2	0	2	3	4	Program Core		
4.	CSEXXXX	Discipline Elective – VI	3	0	0	3	3	Discipline Elective		
5.	CSEXXXX	Discipline Elective – VII	3	0	0	3	3	Discipline Elective		
6.	CSEXXXX	Discipline Elective - VIII	3	0	0	3	3	Discipline Elective		
7.	CSE3119	Coding Skills in Python	2	0	2	3	4	Open Elective		

8.	PPS4005	Aptitude for Employability	0	0	2	2	2	School Core		
9.	PIP1001	Apprenticeship	0	0	0	0	0	School Core		
		TOTAL	**19**	**0**	**6**	**23**	**25**			

Semester 7										
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	PIP2001	Capstone Project	-	0	-	4	-	School Core		
2.	CSEXXXX	Discipline Elective – IX	3	0	0	3	3	Discipline Elective		
3.	CSEXXXX	Discipline Elective – X	3	0	0	3	3	Discipline Elective		
4.	XXXXXXX	Open Elective-V (Management Basket)	3	0	0	3	3	Open Elective		
5.	PPS3018	Preparedness for Interview	0	0	2	1	2	School Core		
6.	XXXXXXX	Open Elective-VI**	-	-	-	1	-	Open Elective		
		TOTAL	**9**	**0**	**2**	**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	TYPE OF SKILL	COURSE ADDRESSES TO
			L	T	P	C	CONTACT HOURS			
1.	PIP4004	Internship	-	0	-	9	-	School Core		
2.		**TOTAL**				**9**	-			

23. Course Catalogue

Course Catalogue of all Courses Listed including the Courses Offered by other School / Department and Discipline / Programme Electives – Course Code, Course Name, Prerequisite, Anti-requisite, Course Description, Course Outcome, Course Content (with Blooms Level, CO, No. of Contact Hours), Reference Resources.

Course Catalogues:

Course Code: CSE2007	**Course Title:** Data Structures and Algorithms **Type of Course: Integrated**			**L- T-P-C**	3	0	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 to familiarize the learners with the concepts of Data Structures and Algorithms and attain Skill Development through Experiential Learning techniques.							
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Implement program for given problems using fundamentals of data structures. [Application] **CO2:** Apply an appropriate linear data structure for a given scenarios. [Application] **CO3:** Apply an appropriate non-linear data structure for a given scenarios. [Application] **CO4:** Explain the performance analysis of given searching and sorting algorithms.							
Course Content:								
Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**	Assignment	Program activity				**18 Sessions**	
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack -** Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -** Representation of queue, Queue Operations, Queue implementation using array, Types								

of Queue and Applications of Queue.

Module 2	**Linear Data Structure- Linked List**	Assignment	Program activity	**17 Sessions**

Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list.
Recursion - Recursive Definition and Processes, Programming examples.

Module 3	**Non-linear Data Structures - Trees and Graph**	Assignment	Program activity	**15 Sessions**

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	**14sessions**

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 Exercises on Queues and its operations with conditions
Level 2: -

Lab sheet -5
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 -6
Level 1: -
Level 2: Programming scenario based application using Linked List

Lab sheet -7
Level 1: Programming Exercises on factorial of a number
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -8
Level 1: -
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9
Level 1: Programming Exercise on Doubly linked list and its operations
Level 2: -

Lab sheet -10
Level 1: Program to Construct Binary Search Tree and Graph
Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and

post-order) and implement BFS and DFS

Lab sheet -11

Level 1: Program to Implement the Linear Search & Binary Search

Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -12

Level 1: Program to Implement and Estimate the Time complexity of Insertion Sort

Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -13

Level 1: Program to Implement and Estimate the Time complexity of Selection Sort

Level 2: Program to Implement and Estimate the Time complexity of Selection Sort

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Ubuntu for lab programs to execute. Tool is Codetantra tool.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text Book

T1 Narasimha Karumanchi: *"Data Structures and Algorithms Made Easy in Java",* 5th Edition, CareerMonk Publications, 2017.

References

R1 Mark Allen Weiss: *"Data Structures and Algorithm Analysis in Java",* 4th Edition, Pearson Educational Limited, 2014.

R2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: *"Data Structures and Algorithms in Java"*, 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014.

R3 Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: *"Introduction to Algorithms",* 3rd Edition, PHI Learning Private Limited.

Web resources:

1. For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview
2. For Lab : codetantra tool
3. https://puniversity.informaticsglobal.com/login

Topics relevant to "SKILL DEVELOPMENT": Llinked list and its type, Tree traversal and hashing tables for Skill Development through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE228	Course Title: Principles of Artificial Intelligence Type of Course: Theory Only	L- T-P-C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	• Mathematics: Logic, Algebra, Probability • Formal Languages					
Anti-requisites	NIL					
Course Description	This Course will introduce the basic principles in artificial intelligence. It will cover representation schemes, problem solving paradigms, constraint propagation, search strategies, knowledge representation, Probabilistic Reasoning. Topics include: AI methodology and fundamentals, intelligent agents, search algorithms, game playing, supervised and unsupervised learning, uncertainty and probability theory, probabilistic reasoning in AI, Bayesian networks, statistical learning.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Principles of Artificial Intelligence and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Explain the basic concepts of Artificial Intelligence. 2. Apply techniques logic rules for Knowledge Representation. 3. Apply Artificial Intelligence techniques for selected problem solving. 4. Apply probabilistic reasoning in AI.					
Course Content:						
Module 1	**Introduction to Artificial Intelligence and Knowledge based systems**	Comprehension		**9 Sessions**		
Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Structure of Intelligent agent and its functions, reactive agents, deliberative agents, goal-driven agents, utility-driven agents, and learning agents; Introduction to Knowledge representation, approaches and issues in knowledge representation, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space, Knowledge-based agent and its Structure, Knowledge-Based Systems; Frame Structures, Conceptual graphs.						
Module 2	**Logic based Knowledge Representation**	Application		**9 Sessions**		
Introduction, Syntax and Semantics, Proof Systems, Natural Deduction, Tableau Method, Resolution Method, 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 3	**Problem Solving by searching**	Application		**12 Sessions**		
Introduction to Problem space and state space, State space search techniques solving problems by searching: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications, Introduction to reasoning, various types of reasoning methods, Certainty factors and rule-based systems Dempster Shafer Theory.						
Module 4	**Learning and Probabilistic reasoning in AI**	Application		**10 Sessions**		
Introduction to learning, Forms of Learning: Statistical learning, Supervised Learning, Unsupervised Learning, Learning rules of AI, Probabilistic reasoning in AI, Bayesian networks, Hidden Markov Model.						

Targeted Application & Tools that can be used:
Google Colab, Python

Text Book

1. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall.
2. Elaine Rich, Kevin Knight and ShivashankarB.Nair, "Artificial Intelligence", TataMcGraw-Hill, Third Edition, 2009[R.N.].

References

1. N J Nilsson (1997). Artificial Intelligence- A new synthesis, Elsevier Publications.
2. N J Nilsson (1982). Principles of Artificial Intelligence, Springer.
3. Patterson, D. W. (1990). Introduction to artificial intelligence and expert systems. Englewood Cliffs, Prentice Hall.
4. Luger, G. F. (2002). Artificial intelligence: Structures and strategies for complex problem solving, Harlow, Pearson Education.

E-Resources
https://puuniversity.informaticsglobal.com

Topics relevant to "SKILL DEVELOPMENT": Knowledge Based Systems, Probabilistic reasoning in AI, Bayesian networks, Hidden Markov Model for Skill Development through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout.

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. 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:**

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
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.
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:

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):

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

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=Cj0KCQiA2-2eBhClARIsAGLQ2RmJTkYGvtgbA1Xx9NLGFHwRL3JQ3OdgDGXr7prF0hw4pMM8UWi3x_kaAjzHEALw_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:** • 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	**10 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	**10 Sessions**
Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. **Web analytics tools:** Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis				
Module 3	**Network Data Analytics:**	Quiz	Case studies / Case let	**11 Sessions**
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. (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites)				
Module 4	**Processing and Visualizing Data**	Quiz	Case studies / Case let	**08 Sessions**
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.				

Practical: Students should analyze the social media of any ongoing campaigns and present the findings.

Project work/Assignment:

Assignment on: Types of Data, Data Transfer, Fundamental Twitter Terminology

Text Book

T1 Mathew A. Russell, "*Mining the Social Web*", O'Reilly, 3rd Edition, 2019.

T2 Marco Bonzanini, "*Mastering Social Media Mining with Python*", PacktPub, 2016

References

R1 Michal Krystyanczuk and Siddhartha Chatterjee, "Python Social Media Analytics", Packt Publishing, 2017

R2 Sponder, M "*Social media analytics: Effective tools for building, interpreting, and using metrics"*. McGraw Hill Professional.

E book link R1:

E book link R2

Web resources:

a. https://www.coursera.org/learn/social-media-data-analytics
b. https://www.udemy.com/course/introduction-to-social-analytics/
c. https://onlinecourses.nptel.ac.in/noc21_cs28
d. https://research.facebook.com/publications/realtime-data-processing-at-facebook/

Weblinks:

1. **https://www.coursera.org/learn/social-media-analytics-introduction**
2. **https://academy.quintly.com/courses/free-social-media-analytics**
3. **https://presidencyuniversity.in/facility/library/**

Topics relevant to "EMPLOYABILITY SKILLS":

Handling Unstrucuted Data for Employability skills through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3035	Course Title: R Programming For Data Science Type of Course: Integrated	L- P- C	1	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:** • 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	**6 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, gglot2 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	**8 Sessions**
Topics: **Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest 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 Anslysis

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	The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles. The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course covers software quality, configuration management and maintenance.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Software Engineering 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 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				**09 Hours**
Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle **Models:** Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.						
Module 2	**Software Requirements, Analysis and Design (Comprehension level)**	Assignment	Development of SRS documents for a given scenario			**11 Hours**
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. **Design:** Design concepts, Architectural design, Component based design, User interface design.						
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 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, McGraw-2017.

2] Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-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.1st 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	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. The student should have knowledge and skill to select and use most appropriate big data tools to solve business problems. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills. 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.					
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	On successful completion of the course the students shall be able to: • 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

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.

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.

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.

Module 2	Hadoop Ecosystem Tools	Programming Assignment	Data Collection and Analysis	8 Classes

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.

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 3	Spark	Programming Assignment	Data analysis	**8 Classes**

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.
Scala: The Basics, Control Structures and functions, Working with arrays, Maps and Tuples.

List of Laboratory Tasks:

1. **Level 1:** To install the Hadoop in pseudo cluster mode.
   Level 1: HDFS Shell Commands – Files and Folders.
   Level 2: HDFS Shell Commands – Management.

2. 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).

3. 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.

4. **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

5. **Level 1:** Installation of Hive, working on basic hive commands. (Create, Alter and Drop tables)
   Level 2: Apply Hive commands to student database/employee database.

6. **Level 1:** Working on advance hive commands. (Static Partitioning & Dynamic partitioning)
   Level 2: Continue the previous experiment, select and apply suitable partitioning technique.

7. **Level 1:** Working on advance hive commands-2. (Bucketing)
   Level 2: Continue the previous experiment, apply bucketing technique to bring out the difference between partitioning and bucketing.

8. **Level 1:** Installing Ecosystem tools such as Scoop, Hbase.
   Level 2: Scoop – Move Data into Hadoop.

9. **Level 1:** Working on basic Hbase commands (General commands, DDL Commands)
   Level 2: Apply Hbase commands on Insurance database/employee dataset.

10. **Level 1:** Working on advanced Hbase commands. (DML).
    Level 2: Continue the previous experiment to demonstrate CRUD operations.

11. **Level 1:** Install, Deploy & configure Apache Spark.
    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

12. **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.

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.

13. **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.
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 the last
two - for the second cell. The program should output YES if a king can go from the
first cell to the second in one move, or NO otherwise.

Level 2: Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.
Write a single Spark application that:

- 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.

Targeted Application & Tools that can be used:

- **Business Analytical Applications**
- **Social media Data Analysis**
- **Predictive Analytics**

Tools: Hadoop Framework tools like map reduce, Hive, Hbase, Scoop, Spark.

Text Book

Seema Acharya, Subhashini Chellappan. 2015. *Big Data and Analytics*. Wiley Publication.
Matei Zaharia, Bill Chambers. 2018. *SPARK: The Definitive Guide*. Oreilly.

References

Tom White. 2016. *Hadoop: The Definitive Guide*. O'Reilley.
Cay S. Horstmann. 2017. *Scala for the Impatient*. Wesley.

Topics relevant to development of "Skill Development": Real time application development using Hadoop Ecosystem tools through Experiential Learning as mentioned in the course handout.

Course Code: CSE3125/CSE265	**Course Title:** Service Oriented Architecture **Type of Course:** Program Core	**L-T-P-C**	3	0	0	3
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**		**08 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**		**08 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**		**11 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):

1. Thomas Erl, "*Service Oriented Architecture: Concepts, Technology, and Design*", Pearson Education, 2016.
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6532

2. Ron Schmelzer et al. "*XML and Web Services*", Pearson Education, 2013
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6645

References

1. Frank P.Coyle, "*XML, Web Services and the Data Revolution*", Pearson Education, 2002
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6647

2. Eric Newcomer, Greg Lomow, "*Understanding SOA with Web Services*", Pearson Education, 2005
   http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=6619

3. Sandeep Chatterjee and James Webber, "*Developing Enterprise Web Services: An Architect's Guide*", 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, "*Java Web Services Architecture*", Morgan Kaufmann Publishers, 2003.
   https://www.elsevier.com/books/java-web-services-architecture/mcgovern/978-1-55860-900-6

Web Resources:

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** **Type of Course: Program Core Theory**	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	• 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	**10 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	**8 Sessions**

Topics:

Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization, Artificial Neural network.

Module 3	Deep Supervised Learning Models	Assignment	Programming	**10 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	**10 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			**10 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**	Case studies / Case let	Case studies / Case let			**08 Sessions**

	Storage Systems			

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	**08 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. "*Information Storage and Management"*, EMC Education Services, Wiley India. 2nd Edition.2012.

References

R1. Ulf Troppens, Rainer Erkens and Wolfgang Muller. *"Storage Networks Explained*", Wiley India. 2nd Edition.2015.
R2. Rebert Spalding. *"Storage Networks The Complete Reference*", Tata McGraw Hill, Indian Edition.2017.
R3. Richard Barker and Paul Massiglia. "*Storage Area Networks Essentials A Complete Guide to Understanding and Implementing SANs*", Wiley. 1stEdition.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 **Type of Course: Theory Only Course**	**L-T- P-C**	3	0	0	3
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	**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, —"*Information Retrieval: Implementing and Evaluating Search Engines*", The MIT Press, 2017. R2 Jian-Yun Nie Morgan & Claypool –" *Cross-Language Information Retrieval*", Publisher series 2011. R3 Stefan M. Rüger Morgan & Claypool – "*Multimedia Information Retrieval*", Publisher series 2014. R4 B. Liu, Springer, - "*Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data*", 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:** 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:** • 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:** [20 Hrs - L[10] + T[10]] [Application] **Module: 2: Advanced CSS** [16 Hrs – L[8] + T[8]] [Application] **XML:** Basics, demonstration of applications using XML **Module 3: PHP** [20 Hrs – L[10] + T[10]] [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		**16 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		**20 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		**20 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: 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

1. Notepad++
2. WAMP

Project work/Assignment:

Assignment: Mini Project on development of a Website

Text Book

T1 Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 8th Edition,2015.

T2. CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)

T3. Deitel, Deitel, Goldberg,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education,2021.

References

R1. Randy Connolly, Ricardo Hoar,"Fundamentals of Web Development", Pearson Education India, 1st. Edition.2016.

R2. Jeffrey C. Jackson,"Web Technologies: A Computer Science Perspective", Pearson Education, 1st Edition,2016.

R3 **Web resources:**

W1. **Journal resources**

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 15Issue 1March 2015 Article No. 4pp 1–21,https://doi.org/10.1145/2700514
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
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

W2. Course NPTEL / Swayam Link : https://nptel.ac.in/courses/106105084

W3. Coursera Link :https://www.coursera.org/learn/html-css-javascript-for-web-developers

W4. PU Library Link : https://puniversity.informaticsglobal.com/login

Or

: http://182.72.188.193/

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.

Course Code: CSE219	Course Title: Big Data Analytics Type of Course: Laboratory Integrated	L- T-P-C	1	0	4	3
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	**10 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	**10 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	**10 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	**10 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

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

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

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

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**			**10 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**			**10 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		**08 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 softwa**re – 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 Type of Course: Theory	L- T-P-C	2	0	2	3
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 E**xperiential Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Identify areas where Pattern Recognition and Machine Learning can offer a solution.[knowledge] CO2: Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems[Comprehensive] CO3: Describe genetic algorithms, validation methods and sampling techniques[Comprehensive] CO4: Describe and model data to solve problems in regression and classification[Comprehensive] CO5: Implement learning algorithms for supervised tasks. [Application]					
Course Content:						

Module 1		quiz	Case studies / Case let	**8 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	**8 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	**10 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				**12 Session**
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				

Text Book

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.

References

R1. The Elements of Statistical Learning: Trevor Hastie, Springer-Verlag New York, LLC (Paper Back), 2009. R2. Pattern Classification: Richard O. Duda, Peter E. Hart, David G. Stork. John Wiley & Sons, 2012.
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.

Course Code: CSE 2050	**Course Title:** System Software **Type of Course:** Theory Only	**L-T-P-C**	3	0	0	3
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 andimplementation 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	On successful completion of the course the students shall be able to: CO1 : Distinguish different software into different categories. CO2 : Design, analyze and implement one pass, two pass or multi pass assembler CO3 : Design, analyze and implement loader and linker. CO4 : Design, analyze and implement macro processors CO5 : Critique the features of modern editing /debugging tools.					
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	**10 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	**9 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	**9 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	**10 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/networkplanningd0000humm/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	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 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.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating System with Linux Internals and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1) Explain** the structure and functions of OS **(2) Solve** problems on various CPU Scheduling Algorithms **(3) Apply** different techniques to various synchronization problems **(4) Discuss** various memory management techniques **(5)Apply** appropriate Linux commands for memory management and directory management					
Course Content:						
Module 1	**Introduction**	Quiz	Programming		**09 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		**9 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**	Coding Assignment/Case Study	Pseudocode/Programming		**9 Classes**	

	and Deadlocks			

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

Experiment No. 5: Programs to demonstrate inter process communication using message queues

Level 1: Program to create a message queue with read and write permissions and to write messages with different priority numbers

Level 2: Program to receive messages of different priorities from the message queue and display them

Experiment No. 6: Programs to demonstrate process synchronization using Semaphores

Level 1: Program that illustrates suspending and resuming processes using signals

Level 2: Program that illustrates access of shared memory using counting semaphore

Experiment No. 7: Programs to demonstrate the event of a deadlock and its avoidance

Level 1: Using POSIX Semaphores demonstrate the scenario where in deadlock happens due to incorrect use of semaphores

Level 2: Program to implement a solution to the Dining Philosopher problem using Monitors

Targeted Application & Tools that can be used:

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.

Software Tools:

Linux Environment

Project work/Assignment:

Each batch of students (self-selected batch mates) will identify projects and implement with the most suitable 2 or 3 antecedents.

Textbook(s):

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

References

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)

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.

Course Code: CSE2056	**Course Title:** WEB 2.0 **Type of Course:** Program Core **Laboratory Integrated Course**	**L-T-P-C**	2	0	2	3
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: 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				**9 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				**9 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				**9 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				**9 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:

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 **Type of Course:** Theory & Integrated Laboratory	**L-T-P- C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	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. 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					

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 E**xperiential Learning** techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: 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) 1.			
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.

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 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:** • 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 Infrasturcture,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:

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:

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

- **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 NETWORKS AND TESTING	Quiz	Case studies / Case let	**8 Sessions**
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:

- 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 DEVELOPMET": Wireless and Cellular networks for **Skill Development** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE 3132	**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		**12 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	**12 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	**14 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	**14 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	**14 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 Type of Course: Integrated	L- T-P- C	1	0	4	3
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	**18 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	**18 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	**19 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 potentio meter. 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 Madisetti, 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:** • 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						**10 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						**10 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						**09 Sessions**
Cloud Security and Standards : Cloud Security Challenges, Software-as-a-Service Security, Application standards, Client standards, Infrastructure and Service standards.						
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 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

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.

Web resources: https://presiuniv.knimbus.com/user#/home

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:** • 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	10 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	**10 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	**09 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	**09 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** [07 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. **Module 4: Outlier detection** [06 Hrs] [Application] 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.					

	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. **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. **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 **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 **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/
	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.

Course Code: CSE2034	**Course Title: Edge Computing** **Type of Course: Theory Only Course Discipline Elective**	**L-P-C**	**3**	**0**	**3**
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 IoT Modules	Term paper/Assignment/**Case Study**	Programming/Simulation/Data Collection/any other such associated activity	**9 Sessions**
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 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	**7 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	Term paper/Assignment/Case	**Programming/Simulation**/Data Collection/any other such	**7 Sessions**

	with RaspberryPi	Study	associated activity	

Topics: Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

Targeted Application & Tools that can be used:

- **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- P- C	3	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:** • 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	**10 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	**8 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	**8 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 Sko¨ld, 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-networksmodern-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-P-C**	3	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- P- C**	2	2	3
Version No.	1.0				
Course Pre-requisites	1. 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 E**xperiential 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		**15 Sessions**
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. **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					
Module 3	NOSQL Databases and Big Data Storage Systems	Assignment	Case studies / Case let		**15 Sessions**

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

List of Laboratory Tasks:

Lab sheet -1 [2 Practical Sessions]

Experiment No 1:

Level 1 – Study and Configure Hadoop for Big Data

Lab sheet – 2 [2Practical Sessions]

Experiment No. 2:

Level 1– Study of NoSQL Databases such as Hive/Hbase/Cassendra/DynamoD

Level 2 - Design Data Model using NoSQL Databases such as Hive/Hbase/Cassendra/DynamoDB

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

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/ Cassendra column based databases

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

Targeted Application & Tools that can be used

MangoDB

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, JennifferWidom, “Database systems: The Complete Book”, 2nd edition, Pearson Publication,2013.
2.AviSilberschatz, 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&sorFieldId=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- P- C**	2	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 E**xperiential Learning** techniques.				
Course Out Comes	**On successful completion of the course the students shall be able to:** • **Understand** how to solve different problems in natural language processing. [Comprehension] • **Solve** natural language generation problems such as machine translation and text summarization. [Application] • **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**				**4 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**				**7 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**				**6 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**				**7 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: 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:

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. "*Speech and Language Processing*" (3rd edition draft, 2022).

T2 Abhijit Mishra, and Pushpak Bhattacharyya. "*Cognitively Inspired Natural Language Processing: An Investigation Based on Eye Tracking*". Springer, Singapore. 2018.

References

R1 Steven Bird, Ewan Klein, and Edward Loper. "*Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*". O'Reilly Publishers. 2009.

R2 Chris Manning, and Heinrich Schutze. "*Foundations of Statistical Natural Language Processing*". 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-P-C**	2	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 E**xperiential Learning** techniques.				

Course Out Comes	On successful completion of this course the students shall be able to: 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:8**
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: 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: • IBM SPSS • Julia and Jupyter Notebook • Matplotlib				
Project work/Assignment:				

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):

1. Applied Data Science with Python and Jupyter-Alex Galea,Packt Publishing,October2018
2. Data Visualization in Python with Pandas and Matplotlib Paperback –DavidLandup, June 16, 2021

References:

1.Data Science with Python and Dask- Jesse Daniel,1st Edition,July30,2019

Weblinks:

- 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- P- C**	3	0	3
Version No.	1				
Course Pre-requisites	• Real-time embedded programming • Optimal estimation and control • Linear algebra				
Anti-requisites	NIL				
Course Description	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. **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				
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	**On successful completion of the course the students shall be able to:** **CO1**. Understand the Autonomous system's and its requirements. Explain algorithm, sensing, object recognition and tracking of an Autonomous system [Understand] **CO2**. Do the error analysis of Localization systems and use the tools and techniques [Application] **CO3**. Explain, plan and control the traffic behavior, and shall be able to do lane level routing and create simple algorithms [Understand] **CO4**. Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform. [Understand]				

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	**8 Sessions**
Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Sterio, 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.	
Text Book **T1:** Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 1st Edition, 2018 **T2:** Ronald K. Jurgen Autonomous Vehicles for Safer Driving SAE International Edition, 2013	
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 "EMPLOYABILITY SKILLS": Autonomous driving **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**	

Course Code: CSE 395	**Course Title: Image Processing** **Type of Course: Theory Only**	**L- T-P- C**	3	0	0	3
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	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. 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.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Image Processing** and attain Entreprenership 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		**9 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		**10 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		**9 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)

Image Processing for Engineering and Science | Coursera

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 Type of Course: Theory	L-P-C	3	0	3
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	**9 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	**9 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	**9 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	**9 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, "*Blockchain for Smart Cities*", Elsevier, 2021.
   https://doi.org/10.1016/C2020-0-01958-4

2. Christopher G. Reddick, Manuel Pedro Rodríguez-Bolívar, Hans Jochen Scholl, "*Blockchain and the Public Sector Theories, Reforms, and Case Studies*", Stanford University Press, 2021.
   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

References

1. Sheikh Mohammad Idrees, Parul Agarwal, M. Afshar Alam, "*Blockchain for Healthcare Systems: Challenges, Privacy, and Securing of Data*", CRC Press, 2021 .
   https://books.google.co.in/books/about/Blockchain_for_Healthcare_Systems.html?id=hiU7EAAAQBAJ&redir_esc=y

Web Resources:

1. https://link.springer.com/book/10.1007/978-3-030-55746-1
2. https://consensys.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://stlpartners.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/

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.**

Course Code: CSE 3044	**Course Title:** BUILD AND RELEASE MANAGEMENT **Type of Course: Theory Only Course**	**L- P- C**	3	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:** • 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		**12 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		**12 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**	Quiz	Case studies / Case let		**14 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

- **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- P- C**	3	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	**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:	**10 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:	**09 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	**09 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

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)

References

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).

Web resources: http://pu.informatics.global

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-P-C**	3	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

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

1. Successful Business Intelligence, Second Edition: Unlock the Value of BI & Big Data 2nd Edition, Kindle Edition

Weblinks:

W1: https://www.coursera.org/learn/business-intelligence-data-analytics#
W2: https://onlinecourses.nptel.ac.in/noc20_mg11/preview

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 **Type of Course: Theory Only**	**L-P-C**	3	0	3
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:7**

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:9

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:8

Topics:
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.
Case Study: Cloud Security: Risks, privacy and privacy impacts assessments.

Targeted Application & Tools that can be used:
Public cloud platforms like AWS, GCP and Azure.

Project work/Assignment:

1. **Create an Amazon EC2 Instance (Linux) or use equivalent other cloud platform such as Google Cloud or Azure to create a virtual machine service.**
2. **Create an Amazon S3 Bucket or use equivalent other cloud platform such as Google Cloud or Azure to create a storage service.**
3. **Create a static website in AWS using S3 and cloud front.**

Textbook(s):

1. **Dan Marinescu, "Cloud Computing: Theory and Practice||", 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.**

References

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.**

Web Resources and Research Articles:

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/**

Topics relevant to "EMPLOYABILITY SKILLS": EC2 **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE3095	**Course Title:** Cloud Security **Type of Course:** Theory		**L- P- C**	3	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 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 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill Education, July 2017. 2. Roland L Krutz and Russell Dean Vines, "*Cloud Security - A Comprehensive Guide to Secure Cloud Computing*", Wiley Publishing, Inc. 2010.					

References

1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, "*Secure Cloud Computing*", Springer, ISBN 978-1-4614-9278-8 (eBook).
2. John Rittinghouse and James Ransome, "*Cloud Computing, Implementation, Management and Security*", 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-P-C**	3	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: • 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	**Psycological 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 softwa**re				
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- P- C**	3	0	3
Version No.	1				
Course Pre-requisites	• 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	**8 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	**10 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	**10 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	**10 Sessions**
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.				
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.				
Project work/Assignment:				
Assignment: 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				
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.				

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.

E book link R1: http://fincen.gov/statutes_regs/guidance/html/FIN-2013-G001.html

E book link R2: http://www.scribd.com/doc/212058352/Bit-Coin

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

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.

Course Code: CSE3096	**Course Title: Cyber Digital Twin** **Type of Course: Theory Only Course**	**L- P- C**	3	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:09**	
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:10**

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:10**

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 **Type of Course:1] Discipline Elective** **2] Theory Only**	**L- P- C**	3	0	3
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**	**10 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

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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	**9 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, 5th Edition,2012

T2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018 .

T3. Dejey and Murugan, "Cyber Forensics", Oxford University Press, 2018.

References

R1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5th Ed, Pearson Education, 2015.

R2. Behrouz A Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd 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-UeDgJ ,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** **Type of Course: Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Mathematical Logic, Algebra, probability and Statistics, Vectors, Matrices.					
Anti-requisites	NIL					
Course Description	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. 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.					
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	On successful completion of the course the students shall be able to: CO 1: Explain the basic concepts on Machine Learning. [Comprehension] CO 2: Apply Supervised Machine Learning algorithms on real time Applications. [Application]					

	CO 3: Apply Un-Supervised Machine Learning algorithm for real time problems. [Application] CO 4: Illustrate advanced concepts in machine learning [Application]			
Course Content:				
Module 1	**Introduction**	Assignment	Simulation/Data Analysis	**6 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	**8 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, "*Introduction to Machine Learning*", 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- P- C**	3	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 • 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	**8 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	**8 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- P- C**	3	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 : 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		**L: 10**

			and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.	

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/

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-P-C**	3	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: • 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	**7 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	**8 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	**7 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 Type of Course: Discipline Theory	L- P- C	3	0	3
Version No.	1.0				
Course Pre-requisites	• 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	6 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	7 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	8 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,1st edition,2006
T2- Gupta, Seema. Marketing Analytics,1st Edition,Wiley,1st 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", *Journal of Business & Industrial Marketing*, 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/htm
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:

1. https://www.digimat.in/nptel/courses/video/110105083/L01.html
2. https://www.digimat.in/nptel/courses/video/110105083/L60.html
3. http://www.digimat.in/nptel/courses/video/110105083/L22.html
4. https://onlinecourses.nptel.ac.in/noc20_mg30/preview (Sessions on Marketing Analytics)

Web Based Resources:

W1. https://hbr.org/2018/05/why-marketing-analytics-hasnt-lived-up-to-its-promise
W2. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Deloitte-Analytics/dttl-analytics-us-da-pricinganalytics3minguide.pdf
W3. https://hbr.org/2010/11/using-customer-journey-maps-to improve customer satisfaction
W4. https://www.zoho.com/subscriptions/guides/what-is-customer-lifetime-val
W5. https://www.mediassociates.com/wp-content/uploads/2018/12/Mediassociates-whitepaper-Predictive-Analytics_2018.pdf

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- P- C**	3	0	3
Version No.	1				
Course Pre-requisites	• 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		**8 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		**10 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		**10 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- P- C	3	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 Expert Systems Assignment Theory 10hrs
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. 2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education.
References 1. 1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', Fourth Edition, Pearson Education, 2002. 2. 2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Second Edition Tata McGraw Hill, 1995. 3. 3. Janakiraman, K.Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science. 4. 4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.
Links : **pu.informatics.global,** https://sm-nitk.vlabs.ac.in/
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** **Type of Course:** **Program Core**	**L-P-C**	2	2	3
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:12**

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:13**

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**

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. 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/

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.

Course Code: CSE 3025	Course Title: Industry Use Cases using Blockchain Type of Course: Theory Only	L-P-C	3	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	• 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:9

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:8

Topics:

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.

Assignment: Bitcoin Blockchain and use cases.

Module 3	**Cryptographic Applications in Blockchain**	**Case Study**	**Application, Quizzes**	**No. of Classes:10**

Topics:
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.
Case Study: Use of Cryptography in Blockchain.

Module 4	**Types of Consensus Algorithms**	**Case study**	**Application, Quizzes**	**No. of Classes:10**

Topics:

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
Case Study: Blockchain Use Case: Supply Chain Management, Smart Health Care, Transportation

Targeted Application & Tools that can be used:
Private Blockchain, Health sector, Finance, Supply Chain Management
Ethereum, Hyper ledger

Project work/Assignment:

1. Defend your blockchain analysis of real world systems and present relevant findings and arguments in a structured logical and compelling manner.
2. 9. Determine real world challenges that blockchain technologies may assist (or explain why not) in solving.

Textbook(s):

1. **Blockchain and Distributed Ledger Technology Use Cases: Applications and Lessons Learned Treiblmaier, Horst, and Trevor Clohessy ,1st ed. 2020 Edition, Kindle Edition**
2. **Ritesh Modi, Solidity Programming Essentials : A beginner's guide to build smart contracts for Ethereum and blockchain, Packt Publishing Limited, 2018.**

References:

R1. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016 .

R2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017.

R3: Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

Web Resources and Research Articles:

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
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.

Course Code: CSE2060	**Course Title:** Information Security and Management **Type of Course:** **Theory Only Course**	**L- P- C**	3	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:** • 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	**10 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	**13 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	**14 Sessions**	
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.					
Targeted Application & Tools that can be used: 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.					

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.

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.

ISO/IEC 27001 is the best-known standard in the family providing requirements for an information security management system (ISMS).

Project work/Assignment:

Assignment:

Text Book

T1 Management of Information Security by Michael E.Whilman and Herbert J.Mattord

T2 Information Security: The Complete Reference, Second Edition, 2nd Edition. by Mark Rhodes-Ousley. Released April 2013. Publisher(s): McGraw-Hill.

.

References

R1 Title, Cryptography & Network Security (Sie) 2E. Author, Forouzan. Publisher, McGraw-Hill Education (India) Pvt Limited.

R2 Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices. Nina Godbole.

E book link R1: http://www.iso.org/iso/home/standards/management-standards/iso27001.html

E book link R2: http://csrc.nist.gov/publications/nistpubs/800-55-Rev1/SP800-55-rev1.pdf

BLINKS: pu.informatics.global , https://sm-nitk.vlabs.ac.in.

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.

Course Code: CSE3086	**Course Title:** Information Theory and Coding **Type of Course: Theory Only**	**L-P-C**	3	0	0
Version No.	1.1				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	Information Theory is the science for measuring, preserving, transmitting, and estimating *information* 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.
Course Objective	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.
Course Out Comes	On successful completion of the course the students shall be able to: **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** — **8 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** — **8 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** — **8 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**	**8 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, 2ndEdition, 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** **Type of Course: Theory Only**		**L- P- C**	**3**	**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	**7 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	**10 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	**10 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.

Course Code: CSE3033	**Course Title:** INFORMATION VISUALIZATION **Type of Course: Integrated**	**L- P- C**	2	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 E**xperiential 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	**08 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	**09 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	**09 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- P- C**	3	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 typesviruses, 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**
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 **Assignment:** Demonstration of wireshark						

Module 4	**Malware Functionality and Detection Techniques**		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
Assignment: Packet malware signature

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.

Text Book

1. Michael Sikorski and Andrew Honig, 2012: " Practical Malware Analysis", No Starch Press.

E-Resources

W1. https://www.geeksforgeeks.org/introduction-to-malware-analysis/
W2. https://ine.com/learning/courses/malware-analysis
W3: https://sm-nitk.vlabs.ac.in/

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.

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 **Type of Course:** **Program Core Theory Based Course**	**L-C**	3	0	3
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 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		**9 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		**9 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		**9 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		**9 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- P- C	2	2	3
Version No.	1.0				
Course Pre-requisites	CSE2021- Data Mining				
Anti-requisites	NIL				
Course Description	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. The student should have the knowledge and skill to select and use the most appropriate mining tools to solve business problems. 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.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Mining Massive Datasets** and attain **Skill Development** through E**xperiential Learning** techniques. .				
Course Outcomes	On successful completion of the course the students shall be able to: • 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	09 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	10 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	10 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	Programming Assignment	Data Collection and Analysis	11 Classes	

	Learning			

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:

- **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

1. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Standford 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

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-ycs0007-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** **Type of Course: Discipline Elective in Artificial Intelligence and Machine Learning Basket Theory**	**L- P-C**	3	0	3
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	**8 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	**10 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	**9 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 plances, stochastic gradient.				
Targeted Application & Tools that can be used: Use of Matlab tool				
Project work/Assignment: **Survey on Methods for convex optimization**				
Text Book T1. Charu C. Aggarwal, " *Linear Algebra and Optimization for Machine Learning*", Springer, 2020. T2. Sra Suvrit, Nowozin Sebastian, and Wright Stephen J, "*Optimization for Machine Learning*", The MIT Press,2012.				
References R1.Guanghui Lan, "*First-order and Stochastic Optimization Methods for Machine Learning*", Springer Cham, 2020. **Web References** W1. https://sm-nitk.vlabs.ac.in/ W2. https://nptel.ac.in/courses/				
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.				

Course Code: CSE3063	**Course Title: Privacy and Security in IoT** **Type of Course: Program Core & Theory only**	**L- P- C**	3	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: E**lliptic 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		**10 Classes**
Topics: **IoT Communication model and Protocols :** 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.					

Targeted Application & Tools that can be used:

Application areas are to secure crypto currency- Bitcoin, Ethereum and Ripple using ECC in key agreement, digital signatures.

Professionally Used Software: elliptic2

: https://www.graui.de/code/elliptic2/

Project work/Assignment:

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

Project Assignment:

Assignment: 1] Collect the running time of ECC on different standard NIST curves.

Assignment 2: Prepare a compressive report on the efficiency of NIST Vs SECP curves.

Textbook(s):

1. **I. Blake, G. Seroussi, N. Smart, Elliptic Curves in Cryptography , Cambridge University 2020**
2. **Arshdeep Bagha, Vijay Madisetti, "Internet of Things - A hands on approach", Universities Press, 2021.**

References

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**

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.

Course Code: CSE2038	**Course Title: Privacy and Security in Online Social Media** **Type of Course: Program Core & Theory Only**	**L-P-C**	3		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		**8 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	**8 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,2012,1st Edition

Online Resources: -

W1: https://presiuniv.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- P- C**	3	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:** • 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		**9 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		**9 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		**10 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		**10 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

brary 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-P-C**	2	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	Lab evaluation	Programming/Problem Solving		**07 Hours**

	Services			
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]**

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.

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.

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.**
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1. **Problem Solving: Understanding different system administration services.** 2. **Programming: Implementation of different cloud infrastructure services.**
Text Book 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.**
References: **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 asessment component as mentioned in the course handout.

Course Code: CSE257	**Course Title:** **Network Programming** **Type of Course:** **Laboratory only**	**L-P-C**	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

Task 3: Demonstrate the working of client-server TCP/IP socket programming

Task 4: Demonstrate the Wireshark tool Usage

Task 5: Demonstration of Network Simulator Version 2

Targeted Application & Tools that can be used:

Simulate networking scenarios using Cisco Packet Tracer.
Demonstrate the usage of Wireshark tool in networking.
Practice the simulation-based network performance evaluation techniques using NS2.

Textbooks:

1. Behrouz A. Forouzan, Data Communications and Networking 5E, 5th Edition, Tata McGraw-Hill, 2017.

References

R1. "Network Simulation Lab Manual" Presidency University.

E-Resource

18 Most Popular Network Simulation Software Tools in 2022 (networkstraining.com)

Virtual Labs (vlab.co.in)

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/

Topics relevant to "SKILL DEVELOPMENT": Troubleshoot using network DOS command, Demonstration of Cisco Packet Tracer Tool for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE465	**Course Title: Reinforcement Learning** **Type of Course: Theory Only**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	• 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 Programing	Assignment	Programming	No. of Classes:10

Topics:

Overview of dynamic programing 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.

- **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/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**

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.

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.

- **Robotics**

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.

- **Web System Configuration**

There are more than 100 configurable parameters in a web system and the process of tuning the parameters requires a skilled operator and numerous trail-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.

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.

Text Book

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

References

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):

E-Resources

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

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.**

Course Code: PIP103	**Course Title:** Professional Practice– II **Type of Course:** NTCC	**L- T-P-C**	-	-	-	15
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: 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 Accepter, 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 Turning Machine	**07 Sessions**
Topics: Definition of a Turing Machine, Turing Machines as Language Accepters, 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: 1. Text Processing 2. Compilers 3. Text Editors 4. Robotics Applications 5. Artificial Intelligence Tools: 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 6th 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, Turning 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	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. 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.					
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: 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

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

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"

E-Resources: https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/

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.

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: Xylinx 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** **Type of Course: Theory Only**	**L-P-C**	3	0	3
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**	
Topics: 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					

Module 3	Basic of I/O Interfacing and Introduction to Microcontroller	Application	Programming	**10 Sessions**

Topics:

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.

Targeted Application & Tools that can be used:

Microsoft Assembler (MASM), TASM and KELL

Text Book

T1: Microprocessors and Interfacing (SIE), 3rd ed. by Douglas V. Hall & S.S.S.P. Rao, 3rd edition, Mc Graw Hill, 2012.

T2: Barry B Brey, "The Intel Microprocessors", 8th edition, Pearson, 2014.

References

R1: Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", First Impression, Pearson Education.

R2: Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 4e, Prentice Hall, 1998

Web resources:

https://nptel.ac.in/courses/108107029

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

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.

Course Code: CSE258	**Course Title:** Problem Solving Using Python **Type of Course:** Laboratory Integrated		**L-T-P- C**	1	0	4	3
Version No.	2.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	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. 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					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **PROBLEM SOLVING USING PYTHON** and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Demonstrate problem solving through understanding the basics of python. 2. Manipulate functions and data structures. 3. Apply Tuple, Dictionaries, File and Exception Handling concepts to solve real time problems. 4. Practice object-oriented programming. 5. Produce data visualization using modules and packages. 1.					
Course Content:						
Module 1	**Problem Solving Techniques and Basics of Python Programming**	assignments	Quizzes form basics of python			**15 Sessions**
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 Data Visualization**	Term paper/Assignment	Quizzes form advanced python			**15 Sessions**
Tuples and dictionaries, Introduction To NumPy and pandas, DataFrame ,Series						
Module 4	**Data Wrangling and Object-Oriented Programming**	Term paper/Assignment	Application on data visualization			**15 Sessions**
Data Transformation, Plotting and Visualization and Object-oriented programming concepts						
List of Laboratory Tasks: Each Lab sheets experiments are prepared by level 0 and level 1 module wise.						

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:2229/login.aspx

Topics relevant to the development of SKILLS:

Problem solving techniques – Function - Object oriented programming - data visualization for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 2010	Course Title: Operating Systems Type of Course: **Theory Only**	L- P- C	3	0	3
Version No.	2.0				
Course Pre-requisites	Basic knowledge on computers, computer software & hardware, and Computer Organization.				
Anti-requisites	Nil				
Course Description	Operating systems being central to computing activities, this Course provide understanding of the functions and functional modules of operating systems. The design and implementation of Operating systems is also covered.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques				
Course Out Comes	**On successful completion of the course the students shall be able to:** • CO1: Describe the fundamental concepts of operating Systems [Knowledge Level] • CO2: Demonstrate various CPU scheduling algorithms. [Application Level] • CO3: Apply synchronization tools to a given problem. [Application Level] • CO4: Discuss various memory management techniques.[Comprehension Level]				
Course Content:					
Module 1	**Introduction**	Assignment	Data Analysis task		**7 Sessions**
Topics: Overview of OS and design, Introduction- Computer System Architecture, Operating System Structure, Operations, Computing environments, OS implementation, Operating System Services, User and OS interface, System Calls and its types, System Programs [loaders, linkers], UNIX/LINUX commands: System Programs[CLI/SHELL, loaders, linkers]					
Module 2	**Process Management**	Assignments	Analysis, Data Collection		**10 Sessions**
Topics: Process Concept, Operations on Processes, Inter Process Communication, Introduction to threads - Multithreading Models, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, RR, Priority, Multilevel Queue, Linux Scheduler, CASE STUDY: Linux Scheduler					
Module 3	**Process Synchronization and Deadlocks**	Quiz	Case studies / Case let		**10 Sessions**
Topics: The Critical-Section Problem- Peterson's Solution, Synchronization hardware, Test and Set, Mutex locks, Semaphores, Advanced Synchronization Problems-IBM Quality and implementation, Monitors. Introduction to Deadlocks, Deadlock Characterization, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation Deadlock detection & Recovery from Deadlock.					
Module 4	**Memory Management and File Systems**	Assignment	Case Studies / Case let		**11 Sessions**
Topics: Introduction to Memory Management, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Demand Paging – Page Replacement, Allocation of Frames – Thrashing. RAID Structures: Disk Scheduling, RAID LEVELS					
Targeted Application & Tools that can be used: UNIX					
Project work/Assignment: • Mini Project: Demonstration of File Handling techniques/Memory and Disk Management.					
Text Book					

T1: Silberschatz A, Galvin P B and Gagne G, *"Operating System Concepts"*, 9th edition Wiley, 2013.

References

R1. William Stallings, "Operating systems", Prentice Hall, 7th Edition, Pearson, 2013.
R2. Andrew S Tanenbaum and Albert S Woodhull, "Operating Systems Design and Implementation", 3rd Edition, Pearson, 2015.

E book link R1: Details for: Operating systems : internals and design principles › Koha online catalog

E book link R2: Details for: Operating systems : design and implementation › Koha online catalog

Web resources:
ttps://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O
ttps://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeR-n6mkO
ttps://www.youtube.com/watch?v=HW2Wcx-ktsc
ttps://www.youtube.com/watch?v=MYgmmJJfdBg
ıttps://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to "Skill Development":
Page replacement algorithms, Scheduling policies, Deadlocks **for Skill Development through Participative Learning techniques**. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE2052	**Course Title:** DISTRIBUTED SYSTEM **Type of Course:** Theory based	**L- P- C**	3	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;		**6 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		**8 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		**7 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	6 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

Course Code: CSE-404	**Course Title:** Social Network Analytics **Type of Course:** Program Core	**L-P-C**	3	0	3
Version No.	2.0				
Course Pre-requisites	Data Mining, Machine Learning, Graph Theory and Combinatorics, Working knowledge of Python syntax and semantics				
Anti-requisites	NIL				
Course Description	The Course Social Network Analysis is to provide students with essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks. The Course presents mathematical methods and computational tools for Social Network Analysis (SNA). Students learn how to identify key individuals and groups in social systems, to detect and generate fundamental network structures, and to model growth and diffusion processes in networks. The course also includes the popular algorithms behind Recommender systems and Search Engine Optimization.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Social Network Analysis and attain ENTREPRENEURIAL SKILLS through PROBLEM SOLVING techniques				
Course Out Comes	On successful completion of this course the students shall be able to: 1. Describe network structure and various types of network centrality measures. (Comprehension) 2. Explain the relevance of 'influence' and 'homophily' in social network communities. (Application) 3. Interpret the popular algorithms behind Recommender systems and Search Engine Optimization. (Application)				
Course Content:					
Module 1	**Introduction to Network Science and Measures**	**Quiz**	**Knowledge based quiz on** Network Density, Describing Networks, Distance between nodes, walks, trails and paths	**No. of Sessions:9**	
Topics: Introduction to network science, Relational Data, Nodes, edges and boundaries, Types of Relations, Types of Networks, Representation of Network data, Network Density, Describing Networks, Distance between nodes, walks, trails and paths, Centrality, Degree centrality, Betweenness centrality, Eigenvector centrality, Group centrality.					
Module 2	**Community Analysis**	**Assignment**	Node Centric Community Detection & Network Centric Community Detection	**No. of Sessions:10**	
Topics: Introduction to Community, Communities in Social Media, Taxonomy of Community Criteria, Node Centric Community Detection, Network Centric Community Detection, Edge Betweenness, Community evolution, Evolution of networks in Community Detection, Community Evaluation, Evaluation with and without ground truth, Evaluation measures.					
Module 3	**Influence and Homophily**	**Quiz**	Assortativity for Nominal and Ordinal Attributes	**No. of Sessions:8**	
Topics: Measuring Assortativity, Homophily, Test of Homophily, Mechanisms Underlying Homophily,					

Selection and Social Influence, Modelling Influence and Schelling Model.

Module 4	**Recommendation systems and SEO**	**Case Study**	**How Long Does It Take to Rank for A Keyword – Bloggers Passion SEO Case Study**	**No. of Sessions:10**

Topics:
Recommendation in Social Media, Recommender System,
Content-Based Methods, Collaborative Filtering(CF),Evaluating Recommendations, Search Engine Optimization, Google PageRank algorithm, Citation Analysis, Dangling Links, IBM HITS algorithm, Limitations of HITS.

List of Laboratory Tasks: NA

Project work/Assignment:

Textbook(s):

1. "Social Media Mining: An Introduction", Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Cambridge University Press, 2018.
2. "Social Network Analysis, Methods and Applications." Stanley Wasserman and Katherine Faust, Cambridge University Press, 2019

References:

1. "Web Mining and Social Networking: Techniques and Applications", Guandong Xu, Yanchun Zhang, Lin Li, Springer, 2016

Web References :

1. https://presiuniv.knimbus.com/user

Topics relevant to "ENTREPRENEURIAL SKILL": Content-Based Methods, Collaborative Filtering(CF),Evaluating Recommendations, Search Engine Optimization, Google PageRank algorithm ENTREPRENEURIAL SKILLS through PROBLEM SOLVING techniques the assessment is mentioned in the course handout

Course Code: CSE301	**Course Title: Programming in Advanced JAVA Type of Course: Program Core Laboratory integrated**	**L-P-C**	1	4	3
Version No.	2.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	This intensive, hands-on Course explores advanced Java features and packages. Students will learn Multi-threaded applications, client server programming and JDBC connection. This Course provide in-depth knowledge in JAVA programming - advanced concepts in java , packages and applets, GUI concepts in java-swing, java database connectivity, servlets, J2EE framework, java script and XML.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Advanced Java Programming** and attain **Employability** through **Experiential Learning** techniques.				
Course Out Comes	**COURSE OUTCOMES:** On successful completion of the course the students shall be able to**:** • Implement communication of GUI with DBMS • Develop application using Swing MVC • Develop Server side Application using Servlets and JSP • Implement Inversion of Control and Dependency Injection • Integrate different technology using spring Framework • Practice Enterprise Application				
Course Content:					
Module 1	**Database Connectivity**	Assignment	Programming Task	**10 Sessions**	
Topics: SQL basic, Introduction to JDBC, JDBC Drivers & Architecture, CRUD operations using JDBC, Merging data from multiple tables: Joining, Manipulating database with JDBC, Invoking Stored Procedure, JDBC with PostgreSQL.					
Module 2	**Swings**	Assignment	Programming Task	**10 Sessions**	
Topics: Introduction to Swings and MVC, Swing MVC Architecture, Component Classes : JButton, JLabel, JTextField, JComboBox, JLiJLists, JTable and JTree. Layout Managers, Database Operation using Event Handling.					
Module 3	**Web Programming with Servlets & JSP**	Assignment	Programming Task	**12 Sessions**	
Topics: **Servlets** Introduction, Life Cycle of a Servlet, using Tomcat for servlet development, simple servlet: 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, Using Cookies, Session Tracking. **Java Server Pages (JSP):** Introduction to JSP, Creating simple JSP Programs, How JSP is processed, JSP Scripting Constructs,					

Predefined Variables, JSP Directives, JSTL (Core Tags, Function Tags, Formatting Tags, SQL Tags).

Module 4	Introduction to Spring Frameworks	Assignment	Programming/Data analysis task	**10 Sessions**

Topics: Hibernate and Java Web Frameworks(Spring):

Spring JPA, JPA Specification, Classes and Interfaces, Object Relational Mapping using JPA, JPA implementation with Hibernate, Simple JPA-Hibernate program to Create Database schemas.
Spring CORE, Overview of Spring, Spring Architecture, bean life cycle, XML Configuration on Spring, Managing Database

Targeted Application & Tools that can be used:
IDE, Eclipse, Application server, Version control system.

Text Book

1. Cay S Horstmann and Gary Cornell, *"CORE JAVA volume II-Advanced Features"*. Prentice Hall.
2. Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.

References

R1.Herbert Schildt, *"Java 2: The Complete Reference"*, Tata McGraw-Hill Education.
R2.Y. Daniel Liang, "Introduction to Java Programming Comprehensive Version", Pearson Education. R3.Paul Deitel Harvey Deitel, "*Java How to Program"*, Pearson Education.
R4.Core and Advanced Java Black Book, Dream Tech Press

Weblinks:
https://nptel.ac.in/courses/106105191- **IIT Kharagpur,** Prof. Debasis Samanta

Case study link:
https://www.researchgate.net/publication/215893899_Mashing_up_JavaScript_-_Advanced_techniques_for_modern_web_applications

E book link R1:
https://edube.org/study/jse1?gclid=Cj0KCQiAmaibBhCAARIsAKUlaKT0G0zv7oo_9r4QIX0DS2e-EKkfDcz_o7s2E_9salVSOrP5zxXKRhEaAhNpEALw_wcB

E book link R2:
https://www.packtpub.com/product/advanced-javascript/9781789800104

Topics relevant to development of "Employability": JDBC Drivers & Architecture, Life Cycle of a Servlet, using Tomcat for servlet development for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE311	Course Title: Web Services Type of Course: Laboratory integrated	L- P- C	1	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** (Knowldge)	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, "*Service-Oriented Architecture: Concepts, Technology, and Design"*, Pearson Education. 2005				
Reference Book(s): 1. Heather Williamson, "*XML, The Complete Reference*", McGraw Hill Education.2001 2. Frank. P. Coyle, "*XML, Web Services And The Data Revolution*", Pearson Education.2002 3. James Snell, Doug Tidwell, Pavel Kulchenko, "*Programming Web Services with SOAP*", 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- P- C	3	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:** • **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 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

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.

Web resources: https://puniversity.informaticsglobal.com:2229/login.aspx

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: CSE 314	**Course Title: Software Architecture** **Type of Course: Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Software Engineering and Object-oriented Analysis and design					
Anti-requisites	NIL					
Course Description	This course deals with basic concepts and principles regarding software architecture and software design. It starts with discussion on importance of Architectures, design issues, followed by coverage on design patterns. It then gives an overview of architectural structures and styles. Practical approaches and methods for creating and analysing software architecture is presented. The emphasis is on the interaction between quality attributes and software architecture. Students will also gain experience with examples in design pattern application and case studies in software architecture.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Software Architecture and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques.**					
Course Out Comes	**COURSE OUTCOMES: On successful completion of the course the students shall be able to:** CO1. Describe the importance of software architecture in large-scale software systems. CO2. Recognize the major software architectural styles, design patterns, and frameworks. CO3. Distinguish the quality attributes of a system at the architecture, security and performance levels. CO4. Identify the appropriate architectural pattern(s) for a given scenario					
Course Content:						
Module 1	Introduction	Quiz	Patterns	**08 Sessions**		
Topics: The Architecture Business Cycle: Where do architectures come from. Software processes and the architecture business cycle; What makes a "good" architecture. Influence of software architecture on organization-both business and technical, What software architecture is and what it is not; Other points of view; Architectural patterns, reference models and reference architectures; Architectural structures and views.						
Module 2	Architectural Styles and Case Studies	Quiz	SOA	**07 Sessions**		
Topics: Architectural styles; Four Architectural Designs for the KWIC System; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Service oriented architecture, Hypertext style, Repositories; Interpreters; Heterogeneous architectures. Case Studies: Keyword in Context, Mobile Robot system.						
Module 3	Quality: Functionality and architecture	Quiz	MVC	**09 Sessions**		
Topics:Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Business qualities; Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics, Security tactics. Quality Model, Application of The Customized Quality Model to a Case Study						
Module 4	Architectural patterns and styles	Seminar	Architectural styles	**17 Sessions**		
Topics: Architectural Patterns: Introduction; From Mud to Structure: Layers, Pipes and Filters, Blackboard, Distributed Systems: Broker. Design Patterns: Structural decomposition: Whole – Part; Organization of work: Master – Slave; Model View Controller and Reflection patterns. Introduction to Service Oriented Architecture, Three Types of Service-Oriented Architecture						

Targeted Application & Tools that can be used:

Multiple integrations with other major architecture software(ArchX, Archisoft, Build software, Astena, Bouwsoft, Teamleader, Total Synergy, etc.) and export opportunities with google drive, dropbox, and CSV formats allow this tool to be widely and comfortably used in the industry.

Professionally used software – Slack**,** Google calendar**,** outlook email**, and others.**

Text Book

1. T1. Software Architecture in Practice – Len Bass, Paul Clements, Rick Kazman, 2nd Edition, Pearson Education, 2003.
   T2. Pattern-Oriented Software Architecture, A System of Patterns - Volume 1 – Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, John Wiley and Sons, 2007.
   T3. Mary Shaw and David Garlan: Software Architecture-Perspectives on an Emerging Discipline, Prentice-Hall of India, 2007.

References

R1. Design Patterns- Elements of Reusable Object-Oriented Software – E. Gamma, R. Helm, R. Johnson, J. Vlissides:, Addison- Wesley, 1995.

E-Resources

W1. Web site for Patterns: http://www.hillside.net/patterns/

Topics relevant to the development of SKILLS: Case study on Architectural styles, Model View Presenter (MVP) Architecture for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 217	**Compiler Design** **Type of Course: Theory Only**	**L-T-P- C**	3	1	0	4
Version No.	2.0					
Course Pre-requisites	nil					
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, Garbage Collection, Parallel Architectures.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Compiler 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. Explain the basic concepts of compiler and its various phases. 2. Construct front end of the compiler. 3. Apply suitable data structure to improve efficiency of compiler. 4. Generate Intermediate code for the given statements. 5. Discuss how to optimize the program for backend of the compiler for different computer architecture					
Course Content:						
Module 1	Introduction And Lexical Analysis	Term paper	Data Analysis	**13 Sessions**		
Topics: Compilers , Analysis of the source program ,Phases of a compiler ,Cousins of the Compiler , Grouping of Phases, Compiler construction tools , Lexical Analysis , Role of Lexical Analyzer , Input Buffering, Specification of Token, – Recognizer - Introduction to LEX Programming.						
Module 2	Syntax Analysis	Term paper	Data Analysis	**15 Sessions**		
Topics: Role of the parser, Top Down parsing, Recursive decent parser - Predictive parser -Bottom-up parsing Shift reduce parser - LR parser – SLR parser – Canonical parser – LALR parser - YACC programming.						
Module 3	Semantic Analysis And Intermediate Code Generation	Data Analysis	Data Analysis	**8 Sessions**		
Introduction to syntax directed translation - Synthesis and inherited attributes - Type Checking - Type Conversions .Topics: Intermediate languages, Declarations, Assignment Statements , Boolean Expressions ,Case Statements – Back patching – Looping statements - Procedure calls.						
Module 4	Code Optimization	Data Analysis	Data Analysis	**8 Sessions**		
Topics: Optimization of basic Blocks, Introduction to Global Data Flow Analysis, Basic Blocks and Flow Graphs, Next-use Information, Machine Independent Code Optimizations, DAG representation of Basic Blocks, Peephole Optimization.						
Module 5	Code Generation	Data Analysis	Data Analysis	**8 Sessions**		
Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management, Issues in the design of code generator, The target machine Register allocation, A simple Code generator						

Targeted Application & Tools that can be used:

The knowledge of this course can be applied in the building automatic translators (compilers) for higher level programming languages. Professionally used software –lex and YACC

Assignment:

Assignment 1- Translate the arithmetic expression: a+ -(b+c) into quadraples, triples and indirect triples.

Assignment 2- Draw the DAG for the arithmetic expressiona+a*(b-c)+(b-c)*d.

Text Book

1. Alfred V. Aho, Jeffrey D Ullman, “Compilers: Principles, Techniques and Tools”, Pearson .

References

1. Jean Paul Tremblay, Paul G Serenson, "The Theory and Practice of Compiler Writing", BS Publications.
2. C. N. Fischer and R. J. LeBlanc, “Crafting a compiler with C”, Benjamin Cummings.
3. HenkAlblas and Albert Nymeyer, “Practice and Principles of Compiler Building with C”, PHI.
4. Kenneth C. Louden, “Compiler Construction: Principles and Practice”, Thompson Learning.
5. Dhamdhere, D. M., "Compiler Construction Principles and Practice", Macmillan India Ltd.

E-Resources

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Topics relevant to the development of SKILLS:

To optimize the program for backend of the compiler for different computer architecture for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE252	Course Title: Digital Design Laboratory Type of Course: Laboratory Only	L-P-C	0	2	1
Version No.	2.0				
Course Pre-requisites	Basics of Electronics: AC & DC Circuits, Boolean Algebra, Number Systems, Logic Gates.				
Anti-requisites	**NIL**				
Course Description	Implementing digital design concepts like verification of logic gates, De Morgan's theorem, Reducing Boolean expression using K-map, Adder and subtractor circuits, Number conversion, Multiplexer and De multiplexer using gates, Flip flops, shift registers and counters.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Design and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.				
Course Outcome	After successful completion of course, students shall be able to i. Develop a simplified logic through simplification technique for complex Boolean functions using logic gates and Hardware Description Language. ii. Demonstrate various combinational and sequential circuits. iii. Implement logic circuits that can function in real life situations				
Course Content:					

1.	:	Verify the truth table / functionality of basic logic gates and universal gates using appropriate ICs
2.	:	Federal bank has implemented Intrusion Detection and Avoidance System, customer can access his locker only under below mentioned conditions. The security system for locker should not allow anybody to access the lockers at any other circumstances. • Lock A, B, C are Open. • Lock A and B are Open but Lock C is Closed. • Lock A and C are Open but Lock B is Closed. • Lock C and B are Open but Lock A is Closed. i. Draw a truth table for this situation and obtain a Boolean expression. Minimize this expression and implement the logic circuit using NAND gates only
3.	:	Mercedes Benz has implemented failsafe sensors for its latest engine. It has 4 failsafe sensors. Engine should switch off to safeguard the passenger and the vehicle for certain hazardous situations, else, engine should keep running unless any of the following conditions arise: • If sensor 1 is activated. • If sensor 2 and sensor 3 are activated at the same time. • If sensor 4 and sensor 3 are activated at the same time. • If sensors 2, 3, 4 are activated at the same time. Implement the simplified logic using NAND gates only

<table>
<tr><td>4.</td><td>:</td><td>A digital system is to be designed in which the month of the year is given as input in four-bit form. The month January is represented as '0000', February '0001' and so on. The output of the system should be '1' corresponding to the input of the month containing 31 days or otherwise it is '0'. Consider the excess numbers in the input beyond '1011' as don't care conditions for system of four variables (A, B, C, D).
Design and implement the simplified logic using NAND gates only</td></tr>
<tr><td>5.</td><td>:</td><td>Realize and implement a logic circuit that can convert a given binary value to its gray code equivalent and vice versa</td></tr>
<tr><td>6.</td><td>:</td><td>Infosys provides intercom facility (EPABX) to all its employees. Development team A is comprised of 16 people positioned in D block. All the team members can communicate with the outer world individually, but the outgoing line is only one. The condition is, the EPABX system is equipped with an 8:1 multiplexer. Realize and implement a logic circuit to enable all the 16 people communicate with the outer world (Function is given).</td></tr>
<tr><td>7.</td><td>:</td><td>An event detector is implemented using single JK flip-flop. The output of the event detector becomes uncertain when both the inputs are high. Rectify the problem by cascading one more JK Flip Flop to the first one. Note the changes observed in the output and verify the truth table.</td></tr>
<tr><td>8.</td><td>:</td><td>Implement a circuit to count number of floors in ascending order for an elevator that can travel from 0th floor to 7th floor using IC-7476</td></tr>
<tr><td>9.</td><td>:</td><td>Using IC-7495, design a circuit to implement the following:
i.Ring Counter
ii.Johnson Counter</td></tr>
<tr><td>10.</td><td>:</td><td>Implement the following function as a decoder using basic gates.
<table>
<tr><td>1</td><td>F1 = x’yz’ + xz
F2 = xy’z’ + x’y
F3 = x’y’z’ + xy</td><td>2</td><td>F1 = (y’+x)z
F2 = y’z’ + x’y + yz’
F3 = (x+y)z</td></tr>
</table>
</td></tr>
<tr><td>11.</td><td>:</td><td>Write Verilog program for the following combinational design along with test bench to verify the design 2 to 4 decoder realization using NAND gates only (structural model)</td></tr>
<tr><td>12.</td><td>:</td><td>Write Verilog program for the following combinational design along with test bench to verify the design b. 8 to 3 encoder with priority and without priority (behavioural model)</td></tr>
<tr><td>13.</td><td>:</td><td>Write Verilog program for the following combinational design along with test bench to verify the design 8 to 1 multiplexer using case statement and if statements</td></tr>
<tr><td>14.</td><td>:</td><td>Write Verilog program for the following combinational design along with test bench to verify the design 4-bit binary to gray converter using 1-bit gray to binary converter 1-bit adder and subtractor</td></tr>
<tr><td>15.</td><td>:</td><td>Model in Verilog for a full adder and add functionality to perform logical operations of XOR, XNOR, AND and OR gates. Write test bench with appropriate input patterns to verify the modeled behaviour</td></tr>
</table>

Targeted Application & Tools that can be used: **Xilynx 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. 2. https://nptel.ac.in/courses/108106177
Topics relevant to "SKILL DEVELOPMENT": 8:1 multiplexer, Ring Counter,Jhonson Counter, JK Flip-Flop, decoder for **Skill Development** through **Experiential 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- P- C**	3	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:** • 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%.

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=JnNpdGU9ZWhvc3QtbGl2ZQ%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: 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: CSE203	**Course Title: Discrete Mathematics** **Type of Course: Program Core& Theory Only**	**L-P-C**	4	0	4
Version No.	2.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	This course highlights the basics of discrete structures and develop ability to solve problems involving mathematical logic, sets, functions, relations, principles of counting, pigeonhole principles, recurrence relations, Principles of Inclusion and Exclusion. forces, and moments with their applications in allied subjects. It is a prerequisite for several Courses involving Compiler Design, Artificial Intelligence. This course is both conceptual and analytical in nature that would help the student to use the concepts of discrete structures to solve and prediction of data analytics. The students should have prior knowledge of basic mathematics pursue the Course. After successful completion of the Course, the students would acquire knowledge to solve problems involving mathematical logic, sets, functions, relations, principles of counting, pigeon hole principles, recurrence relations, Principles of Inclusion and Exclusion with an emphasis on real-world engineering applications and problem solving.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Discrete Mathematics and attain SKILL DEVELOPMENT through PROBLEM SOLVING Methodologies techniques.				
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe a logic sentence in terms of predicates, quantifiers, and logical connectives. 2] Solve problems on Functions and Relations using basic principles of Set Theory. 3] Explain the concepts of Boolean Algebra. 4] Apply basic counting techniques to combinatorial problem.				
Course Content:					
Module 1	**Foundations of Logics and Proofs**	Assignment	Problem Solving	**10 Sessions**	
Topics: Propositional Logic, Propositional Logic Equivalences, Inference rules, Normal forms, Introduction					

to Proofs, Resolution by Refutation, Predicates and Quantifiers, Introduction to Proofs. **Assignment: Problems.**				
Module 2	**Basic Structures: Sets, Functions, Relations**	Assignment	Problem Solving	**10 Sessions**
Topics: Sets and set-operations, Venn Diagram, Cardinality of Sets, Functions: Types, Invertible Functions, Composition, Sequences and Summations, Relations and their properties & representations, Equivalence Relations, Closure of Relations. **Assignment:** Problems and applications				
Module 3	**Posets, Lattices and Boolean Algebra**	Assignment	Problem Solving	**10 Sessions**
Topics: Partial ordering, Posset, Hasse Diagram, Lattices & Algebraic structures, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra,Topological Sorting. Assignment: Problems and Applications				
Module 4	**Principles of Counting Techniques**	Assignment	Problem Solving	**12 Sessions**
Topics: Number Theory: Integers and Division, GCD, Chinese Remainder Theorem, Solving Congruences, Pigeon Hole Principle, Mathematical Induction, Generalized Permutations and Combinations, Recurrence Relations, Applications of Recurrence Relations, Generating Functions, Principle of Inclusion and Exclusion, Applications of Inclusion and Exclusion. Assignment: Problems and Applications				
Targeted Application & Tools that can be used: NIL				
Project work/Assignment:				
Problems on all the topics and relevance with field of computer science				
Text Book T1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, McGraw-Hill,s 7th Edition,2018.				
References R1: Susanna EPP, “Discrete Mathematics with Applications”, Cengage Learning, 4th Edition, 2010 R2. Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier, India, 2009. R3: Discrete mathematics for Computer Scientists and Mathematicians, Paperback (Rs. 533), Joel Mott, Abraham Kandel, Theodore Baker; Pearson Education India; 2 edition (2015), **ISBN-13:** 978-9332550490 **Weblinks:** W1: https://puniversity.informaticsglobal.com:2229/login.aspx W2: https://www.youtube.com/playlist?list=PLBlnK6fEyqRhqJPDXcvYlLfXPh37L89g3				
Topics relevant to development of “SKILL”: Mathematical Logic, Permutation and Combinations for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in 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**	
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, **Algorithm on networks**: Shortest path algorithm- Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm.					
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					

Text Book 1. K H Rosen, “Discrete Mathematics and its Application”, McGraw Hill. 2. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004.
References 1. Harris, Hirst amd Mossinghoff,” 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]
Weblinks **https://puniversity.informaticsglobal.com:2229/login.aspx**
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.

Course Code: **CSE 211**	**Course Title: COMPUTER NETWORKS** **Type of Course: Program Core** **Theory**	**L-P-C**	3	0	3
Version No.	2.0				
Course Pre-requisites	Analog and digital signals, Number representation-binary, decimal, hexadecimal, Binary-Logical, Operations, Frequency, Amplitude and Phase, Knowledge about directed and undirected graphs and Basics of Communications.				
Anti-requisites	NIL				
Course Description	The main emphasis of this Course is on the organization and management of networks. The Course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and protocols, and gaining practical experience in the installation, monitoring, and troubleshooting of LAN systems.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **COMPUTER NETWORKS** and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques				

Course Out Comes	On successful completion of the course the students shall be able to: **CO1: Describe The Basic Concepts Of Computer Networks And Reference Models. [Knowledge]** **CO2: Describe The Physical And Data Link Layer Functionalities. [Comprehension]** **CO3: Apply the knowledge of IP addressing and routing mechanisms onnect to a computer network. [Application]** **CO4:Explain The Functionalities Of Transport Layer And Application er.[Comprehension]**			
Course Content:				
Module 1	Introduction to data communication and computer networks:	Assignment	Knowledge	**No. of Sessions:9**
Topics: Introduction, Networks, Network Types**, Internet History**, Protocol Layering, The OSI Model, TCP/IP Protocol Suite, Networking Devices				
Module 2	Physical And Data Link Layer	Assignment	Comprehension	**No. of Sessions: 9**
Topics**: Data And Signals, Digital Signals, Transmission Impairment, Data Rate Limits: Noiseless Channel, Nyquist Bit Rate, Noisy Channel: Shannon Capacity Performance,** Error – Detection And Correction – Parity, CRC, Flow Control And Error Control-Stop And Wait, Go Back-N ARQ, Selective Repeat ARQ, Sliding Window, MAC, Wired LAN Ethernet				
Module 3	Network Layer:	Assignment	Application	**No. of Sessions:12**
Topics: Network Layer Services, Packet Switching, Ipv4 Addresses, IPv4 Header, Basic Routing Algorithm, Unicast Routing Protocols: Interior Gateway Protocols, Exterior Gateway Protocols, **Introduction To Troubleshooting And The Future Of Networking, Ping: Internet Control Message Protocol, Traceroute, Ipv6 Headers, Transition From Ipv4 To Ipv6**				
Module 4	Transport layer and Application Layer	Assignment	Application	**No. of Sessions: 12**
Topics: Introduction To The Transport Layers, UDP, TCP, The Application Layer: Domain Name System (DNS), Domain Name Space, Name/Address Mapping, **Telnet, SSH**, HTTP, SMTP, FTP.				

Text Books

1. Behrouz A. Forouzan, Data Communications and Networking , 4th Edition, Tata McGraw-Hill, 2013.

References

1. Alberto Leon-Garcia and Indra Widjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.
2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
3. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.
4. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007.

E-references

https://nptel.ac.in/courses/106105183

Topics relevant to "SKILL DEVELOPMENT": Domain Name Space, Name/Address Mapping for Skill Development through Participative Learning. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE255	**Course Title: ANALYSIS OF ALGORITHMS LAB** **Type of Course: Practical**	**L- T-P- C**	0	0	2	1
Version No.	2.0					
Course Pre-requisites	Meaning of Analysis and various analysis and its extension, Mathematical Induction and its importance to analysis of Algorithms, Introduction to Pseudo code, Knowledge of Recursive and Non Recursive algorithms.					
Anti-requisites						
Course Description	This Course introduces techniques for the design and analysis of efficient algorithms and methods of applications. It deals with analyzing time and space complexity of algorithms, and to evaluate trade-offs between different algorithms. Topics include: Brute force- Bubble sort, linear search, Divide-and-conquer- Merge sort, Quick sort. Dynamic programming and greedy technique- Prim's, Kruskal's, Dijkstra's Algorithm, Warshall's algorithm, Floy'd algorithm, Coin changing problem, Multi stage graph – Optimal Binary Search Trees ,Backtracking – N Queens Problem, Hamiltonian Path Problem, M Coloring Problem. Backtracking.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analysis of Algorithms Lab and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Compute time complexities for various Recursive and non-recursive Algorithms **[Application].** 2. Demonstrate the Brute Force Technique for real world problems **[Application]** 3. Apply divide and conquer technique for searching and sorting **[Application]** 4. Demonstrate the Dynamic Programming and Greedy Algorithms for various applications **[Application]**					
Course Content:	Non-recursive algorithms: Factorial, Max. Recursive algorithms: Factorial, GCD, Search, Tower of Hanoi. Brute Force Technique: Bubble sort, Linear Search. Divide and Conquer: merge sort, quick sort. Dynamic programming: Coin changing problem, Multi stage graph – Optimal Binary Search Trees ,The knapsack problem, Warshall's Algorithm, Floyd's Algorithm. The Greedy Method: Prim's and Kruskal's algorithm to find Minimum Spanning Tree, Single source shortest path (Djikstra's Algorithm), Boolean Satisfiability Problem (SAT). Hamiltonian Path Problem, M Coloring Problem. Backtracking: N-Queens problem.					

List of Laboratory Tasks

1. Apply non recursive algorithmic designing technique to solve Factorial of a number, Linear Search , finding max element problem and calculate the time efficiency (best, average & worst).
2. Apply recursive algorithmic designing technique to solve Factorial, GCD, , Tower of Hanoi, problems and calculate time (Best, average & worst) efficiency.
3. Apply Brute force algorithmic designing technique to sort elements using bubble sort algorithm and calculate time (Best, average & worst) efficiency.
4. Apply divide and conquer algorithmic designing technique to sort elements using merge sort algorithm and calculate time (Best, average & worst) efficiency.
5. Apply divide and conquer algorithmic designing technique to sort elements using Quick sort algorithm and calculate time (Best, average & worst) efficiency
6. Apply dynamic programming algorithmic designing technique to find All pair Shortest Path for a given graph using Floyds and Warshall's algorithm
7. Apply dynamic programming algorithmic designing technique for Solving 0/1 knapsack problem and find its efficiency.

Apply dynamic programming algorithmic designing technique for Solving Coin changing problem and find its efficiency.

Apply dynamic programming algorithmic designing technique to find Optimal Binary Search Trees.

10. Apply greedy algorithmic designing technique for constructing MST for a given graph using prim's algorithm
11. Apply greedy algorithmic designing technique for constructing minimum spanning tree using Kruskal's algorithm

Apply backtracking algorithmic designing technique for M Coloring Problem

13. Apply backtracking algorithmic designing technique for solving queen's problems for 4, 8 and 16 inputs.

Targeted Application & Tools that can be used:

Social media networks, GPS applications, Google search, e-commerce platforms, Netflix recommendation systems, etc.

Text Book

1. **Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI Learning Private Limited.**

References

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 3rd edition.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson

E-Resources

NPTEL course – https://nptel.ac.in/courses/106106131

Topics relevant to the development of SKILLS:

1. **Quick sort**
2. **The knapsack problem**
3. **Warshall's Algorithm**
4. **Floyd's Algorithm.**
5. **Prim's and Kruskal's algorithm to find Minimum Spanning Tree**
6. **Single source shortest path (Dijkstra's Algorithm).**
7. **Backtracking: N-Queens problem.**

for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE218	**Course Title: Human-Computer Interaction** **Type of Course: Theory Only**	**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:

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, *"Designing the User Interface: Strategies for Effective Human-Computer Interaction", 6th Edition,* Pearson Addison Wesley, 2016.

T2. Dix A. et al. *"Human-Computer Interaction", 3rd Edition, Pearson* Prentice Hall, 2004.

References

R1. Yvonne Rogers, Helen sharp, Jenny Preece, "Interaction Design: Beyond Human Computer Interaction", 5th 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:

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 databases and Sequence Similarity**	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 **Type of Course:** Lab Integrated	**L- T-P- C**	2	0	2	3
Version No.	2.0					
Course Pre-requisites	Basic knowledge of software engineering and programming knowledge					
Anti-requisites						
Course Description	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. 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.					
Course Objective	This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIAL LEARNING Techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 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 B Testing, Fundamentals of Black Box Testing, When and How to do Black Box Testing. Proble 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- P- C	2	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 Anslysis

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":

1. Linear Regression
2. Logistic Regression
3. K-means Algorithm
4. Hierarchical clustering
5. CURE Algorithm
6. Decision Tree Learning

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

Course Code: CSE2074	**Course Title: Database Management Systems** **Type of Course: 1) School Core** **2) Laboratory Integrated**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve the information efficiently. It helps the students to learn and practice data modeling and database designs. The associated laboratory is designed to implement database design using MySQL (My Structured Query Language-Open Source) in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Database Management Systems** and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.				
Course Outcomes:	On successful completion of the course the students shall be able to: 1] Understand core concepts of database (Knowledge) 2] Apply normalization techniques to refine database schema (Application) 3] Develop database with concurrent transactions execution feature (Application)				
Course Content					
Module 1	Introduction to Database and its Conceptual Model (Knowledge)	Assignment	Problem Solving	**6 Classes**	
Topics: **Introduction to Database:** Schema, Instance, 3-shema architecture, *physical and logical data independence, Data isolation problem in traditional file system*, advantages of database over traditional file systems. **Conceptual Data Modelling:** Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model.					
Module 2	Query Languages (Application)	Assignment	Problem Solving	**7 Classes**	
Topics: **Relational Algebra** with selection, projection, rename, set operations, cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations. **MySQL Database Querying,** DDL, DML, Constraints, Operators, Set Operators, Aggregate Functions, Joins, Views, Procedures, Functions and Triggers.					
Module 3	Designing and Refining Database Schema (Application)	Assignment	Programming Task	**7 Classes**	

Topics:
Schema Design: *Problems in schema design, redundancy and anomalies*.
Schema refinement: Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), Join Dependencies (Fifth Normal Form), *lossy and lossless decompositions.*

Module 4	Transaction Management and Concurrency Control (Application)	Assignment	Problem Solving	**6 Classes**

Topics:
Transaction: Desirable properties (ACID) of Transactions, *Simultaneous Transactions and their problems like dirty read, lost update and incorrect summary*, Serializability, Conflict Serializability, View Serializability;
Concurrency Control: Locking and Time-stamping concurrency schemes.

List of Laboratory Tasks:
Create Employee, Student, Banking and Library databases and populate them with required data. Do the following experiments of different lab sheets on those databases.

Labsheet-1 [3 Practical Sessions]
Experiment No 1: [1 Session]
To study and implement Data Definition Language (DDL) commands and Data Manipulation Language (DML) commands of MySQL.
Level 1: Perform operations using Data Definition Language and Data Manipulation Language commands including different variants of SELECT on Student DB.
Level 2: Identify the given requirements; valid attributes and data types and Perform DDL and DML operations on a given scenario. [Banking Databases]
Experiment No. 2: [2 Sessions]
To implement different types of MySQL constraints and relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators.
Level 1: Create tables on Banking database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Student Database.
Level 2: Enforce different types of data and referential integrity constraints. Then try queries with special operators based on the student database. [Banking Database].

Labsheet-2 [3 Practical Sessions]
Experiment No. 3: [1 Session]
To try for aggregation of data in to groups and sub-groups using Group by, HAVING clauses and sort data using Order By Clauses.
Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database**.**
Level 2: Implement MySQL queries on library database using appropriate clauses and aggregate functions**.** Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4: [2 Session]
To study and implement different types of Set and Join Operations [3 Slots]
Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Banking Database.
Level 2: Use Set and Join operations to retrieve the data from two or more relations(tables) as per the given scenario. [Library databases]

Labsheet-3 [3 Practical Sessions]

Experiment No. 5: [3 sessions]
To study and implement Views, and Procedures in MySQL.
Level 1: Implement MySQL Views, and Procedures in MySQL on Employee database.
Level 2: Analyze the requirement and construct views, and Procedures on Mini Project Domain. [Banking Database]

Labsheet-4 [3 Practical Sessions]
Experiment No. 6: [3 Sessions]
To study and implement Functions, and Triggers in MySQL.
Level 1: Implement MySQL Functions and Triggers in MySQL on Employee database.
Level 2: Analyze the requirement and construct Functions and Triggers on Mini Project Domain. [Banking Database]

Targeted Application & Tools that can be used:
Application Area: Relational database systems for Business, Scientific and Engineering Applications.
Tools/Simulator used: MySQL

Text Book
1] Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2017.

References
1] Hector Garcia Molina, Jeffery D Ullman, Jennifferwidom , "Database systems: The Complete Book", Pearson Publication, 2nd edition.
2] Avi Silberschatz, Henry F. Korth , S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.

Topics relevant to development of "Skill Development": Relational database design using ER-Relational mapping, Implementation of given database scenario using MySQL for Skill development through Experiential Learning Techniques. This is attained through assessment component in the course handout.

Course Code: CSE3006	**Course Title: Artificial Intelligence and Neural Networks** **Type of Course: Theory only**	**L-P-C**	3	0	3
Version No.	2.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	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. 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.				
Course Objective	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				

Course Out Comes	On successful completion of the course the students shall be able to: 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**
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				
Module 2	**Problem Solving by Searching**	Assignment	Theory	**13 Sessions**
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.				
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 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 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 ShivashankarB.Nair, "Artificial Intelligence", TataMcGraw- 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. LaureneFausett(2004) , Fundamentals Of Neural Networks, Prentice-Hall, Inc,USA

E-References

8. https://presiuniv.knimbus.com/user#/home

Topics relevant to development of "EMPLOYABILITY SKILLS":

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: CSE248	**Course Title:** Object Oriented analysis and Design with UML **Type of Course: Integrated Only**	**L- T-P- C**	3	0	2	4
Version No.	2.0					
Course Pre-requisites	Object Oriented Programming fundamentals, Software Engineering					
Anti-requisites						
Course Description	This course deals with producing detailed object models and designs from system requirements; using the modeling concepts provided by UML; identifying use cases and expanding them into full behavioral designs; expanding the analyzing into a design ready for implementing and constructing designs that are reliable. The course begins with an overview of the object oriented analysis and design.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **A** Object Oriented analysis and Design with UML and attain SKILL DEVELOPMENT through EXPERENTIAL LEARNING techniques					
Course Out Comes	CO1 : Ability to analyze and model software specifications. CO2 : Ability to abstract object-based views for generic software systems. CO3 : Ability to deliver robust software components.					
Course Content:						

Module 1	Introduction to Object oriented system-Knowledge level	Assignment	SRS	**20 Sessions**
Object Basics-Object Oriented System Development Life Cycle- Use case driven approach-Rumbaugh Object Model- Booch Methodology-Jacobson Methodology-Unified Approach, Framing problem statement and SRS document.				
Module 2	**Object oriented analysis-Comprehensive Level**	Assignment	Class diagram	**10 Sessions**
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.				
Module 3	**Object oriented design-Comprehensive Level**	Term paper/Assignment	Object Diagram	**11 Sessions**
Object Oriented Design Axioms-Designing Classes -Class visibility -Redefining attributes -				

Designing methods and protocols -Packages and managing classes -Access Layer- Object Storage Persistence - Object oriented Database System-Designing view layer classes -Macro level process -Micro level process- Prototyping the user interface –Quality Assurance Tests-Testing Strategies.				
Module 4	**Object oriented UML Modeling-Application level**	Term paper/Assignment	Dynamic Diagrams	**9 Sessions**
Static and Dynamic Modeling-Unified Modeling Language -UML diagrams: Class Diagrams-Use case Diagram- UML Dynamic modeling: Interaction diagram, Sequence diagram, Collaboration diagram, State-chart diagram, Activity diagram				

Targeted Application & Tools that can be used:

Star UML

Text Book

Object Oriented Modeling and Design using UML, Second Edition, Michael Blaha and James Rumbaugh, Pearson Education, Second Edition, 2007

References

R1. Applying UML and Patterns, Third Edition, Craig Larman, Pearson Education, 2008 R2. Object Oriented Analysis and Design with Applications, Grady Booch, Addison-Wesly SecondEdition, 1994 R3. Object Oriented Systems Development using Unified Modeling Language, Ali Behrami, McGraw Hill International Edition, 1999 R4. Design Patterns, Gamma et. al., Pearson Education, 2006.

E-Resources

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Topics relevant to the development of SKILLS:

1. Aggregation
2. Quality Assurance Tests
3. Responsibilities and Collaborators
4. Swimlane Diagram
5. Pattern Model

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- P- C**	2	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	**14 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	**14 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	**14 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**
ps://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q
ps://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to development of "Skill Development":

1. Static Polymorphism
2. Method overloading, constructors
3. constructor overloading
4. this keyword
5. static keyword and Inner classes
6. Inheritance and Polymorphism.

for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: **CSE302**	**Course Title: Programming in C# and .NET Framework** **Type of Course: Program Core Theory & Laboratory integrated**	**L- P - C**	1	4	3
Version No.	2.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	This course is designed to teach third-year computer science students, to provide an introduction to the .net framework and C# language. This course deals with the programming skills that are required to create applications using the C# language. Helps the students to build an application that incorporates several features of the .NET Framework.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Programming in C# and .NET Framework** and attain **EMPLOYABILITY SKILLS** through **EXPERIENTIAL LEARNING** techniques				
Course Out Comes	**COURSE OUTCOMES:** On successful completion of the course the students shall be able to**:** • Apply OOPS concepts in C# for solutions to real-world problems • Use ADO.NET to manage databases; • Write GUI applications in C#.				
Course Content:					
Module 1	**C # Language Syntax**	Assignment	Programming Task	**12 Sessions**	
Topics: **C # Language Syntax** - Datatypes & Variables Declaration, Implicit and Explicit Casting, Checked and Unchecked Blocks, Enum and Constant, Operators, Control Statements, Working with Arrays, working with Methods, Pass by value and by reference and out parameters. **OOPs-Concept** - Learning about Class, Object, Component, encapsulation, Inheritance, Polymorphism.Abstract Class, Types of Inheritance with example programs . Exception Handling-Defining Exception, Understandings try and catch keywords, Using “finally” block, Throw , Throws , Throwing exceptions, Creating User-defined/Custom Exception class and basic example for the both exception.					
Module 2	**Developing GUI Application Using WINFORMS**	Assignment	Data Collection/Excel	**12 Sessions**	

Topics:

Developing GUI Application Using WINFORMS- Basic Controls, Panel & Layouts, Drawing and GDI Devices, MenuStrip, ToolbarStrip and ContextMenuStrip , Model and Modeless Dialog boxes ,Multiple Document Interface(MDI) ,Form Inheritance , Building Login Form, Working with Resource Files and Setting, Notify Icon Controls, Using Components like Timer, FileSystemWatcher, Solving few case studies in developing GUI Application using WINFORMS.

Database Programming Using ADO.NET -Introduction, and Evolution of ADO.NET, Understanding the Role of Managed Provider and ADO.NET Objects, Connecting to Database and Connection Pooling, Performing Insert, Update and Delete Operations, Fetching Data from the database - Executing Select Statements, basics query. Solving few case studies .

Module 3	**Managing Data using DataSet**	Assignment	Programming/Data analysis task	**14 Sessions**

Managing Data using DataSet -Introduction DataSet and its Object Model, Filling DataSet using DataAdapter, Binding DataSet to DataGridView, Updating changes to the database using DataAdapter, DataAdapter events.

A few Advanced Features-Reflection and Attributes, Delegates & Events**,** User Control and Custom Control. Multithreading- Threading Overview, Thread States, Methods of Thread Class, Thread Pool, Thread Synchronization, Advantages of threads and thread in built functions .Solving some real world examples on threads .

Targeted Application & Tools that can be used:

Text Book

1. Andrew Troelsen, “C# and the .NET Platform”
2. J . Liberty, “Programming C#”, O’Reilly

References

R1:E. Balagurusamy, “Programming in C#”, Tata McGraw-Hill.

R2: Microsoft Visual C# Step by Step, 9th Edition By John Sharp, Microsoft Press

R3:Herbert Schildt, “The Complete Reference: C#”

Weblinks:

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

https://dotnet.microsoft.com/en-us/apps/aspnet

Case study link:

https://www.researchgate.net/publication/296561714_C_and_the_NET_Framework

https://docs.microsoft.com/en-us/dotnet/csharp/getting-started/

E book link R1:

https://www.oreilly.com/library/view/mastering-c-and/9781785884375/

E book link R2:

https://www.packtpub.com/product/mastering-c-and-net-framework/9781785884375

Topics relevant to development of "Skill":

1. **MVC** — Model-View-Controller
2. **Encapsulation**
3. **Inheritance**
4. **Polymorphism**
5. **Connection pooling**

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

Course Code: CSE397	Course Title: Digital and Mobile Forensics Type of Course: Theory	L- P- C	3	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	orensic 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:

- 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:

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Topics relevant to "Employability":

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: CSE3001	**Course Title: Artificial Intelligence and Machine Learning** **Type of Course: Integrated**	**L- P- C**	**2**	**2**	**3**
Version No.	2.0				
Course Pre-requisites	CSE1003 Innovation Project - Raspberry Pi Using Python				
Anti-requisites	**NIL**				
Course Description	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. 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.				
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	**On successful completion of the course the students shall be able to:** **CO1:** To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents. **[Comprehension]** **CO2:** Produce machine learning models for predictive analytics. **[Application]** **CO3:** Apply ensemble learning, optimization and hyper parameter tuning techniques for machine learning algorithms. **[Application]** **CO4:** Demonstrate different types of clustering techniques. **[Application]** **CO5:** Employ time series forecasting techniques/models for real world problems**.** **[Application]**				
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		**16 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

Level 1- Hyper parameter Tuning methods Hyper parameter tuning using Grid Search for Nearest Neighbor Classifiers and

Level 2- Hyper parameter tuning using Grid Search for Decision Tree Classifiers.

Lab sheet -9

Level 1 - Hyper parameter Tuning for Ensemble models Ensemble Learning – Random Forest – Building the model, Grid Search for optimal parameters,

Level 2 - Feature Importance. Ada Boost Classifiers and Gradient Boosting Classifiers

Lab sheet -10

Level 2 - Clustering – Kmeans – cluster centers and interpreting the clusters, finding the optimal number of clusters using Elbow Curve method.

Level 2 - Agglomerative Hierarchical Clustering – Compare the clusters formed by kmeans and Agglomerative Clustering

Lab sheet -1 1

Level 1 – Probability theory(Conditional Probability)

Level 2 - Naïve Bayes Model

Lab sheet -12

Level 1- Models forecasting Applications

Level 2 - Models for Forecasting Time Series data

Lab sheet -13

Level 1- Recommender Systems - Association Rule Mining using Apriori for frequent Itemset Generation.

Level 2 - Recommender Systems – user based similarity

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.

Project work/Assignment:

Assignment:

1. Programming: Implementation of given scenario using Python and Colab.

Assignment: Learning courses for 4 Hours from the following link

https://learn.datacamp.com/courses?topics=Machine%20Learning

Text Book

T1. Andreas C Muller, Sarah Guido, "Introduction to Machine Learning with Python :A Guide for Data Scientists", Oreilly, First Edition, 2016

T2. Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall.

References

R1. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining", Pearson Education, 2016.

R2. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.

R3. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning Using Python", Wiley, First Edition 2019.

E-References

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

Topics relevant to development of "Skill Development":

1. Regression Models
2. Decision Tree Classifiers
3. Hyper parameter Tuning methods
4. Agglomerative Hierarchical clustering
5. Decision tree classifiers

for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 1002	**Course Title: Innovation Project-Arduino Using Embedded C** **Type of Course:** Lab only	**L- P- C**	0	4	2
Version No.	2.0				
Course Pre-requisites	NIL				
Anti-requisites	NIL				
Course Description	The course deals with the 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 an Arduino prototype board. The course will also demonstrate how to assemble various sensory devices and program them using the 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 Objective	The objective of the course is to familiarize the learners with the concepts of **Innovation Project-Arduino Using Embedded C** and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques				
Course Out Comes	**On successful completion of the course the students shall be able to:** • Write a program using Arduino programming language using Embedded 'C'. • Explain the main features of the Arduino prototype board • Demonstrate the hardware interfacing of the peripherals to Arduino system. • Demonstrate the functioning of live various projects carried out using Arduino system.				
Course Content:					
Module 1	**Basics of C, Branching and looping**	Quiz	Problem Solving	**9 Sessions**	
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 Sessions**	
Topics: Arrays: Introduction ,one dimensional array, two dimensional array, Functions: User defined functions, Categories, searching and sorting Strings: Introduction, string handling functions.					
Module 3	Structures and Pointers		Problem Solving	7 Sessions	
Topics: Structure definition, syntax and application of structures, definition of pointers ,syntax, pass –by-reference.					
Module 4	Introduction to Arduino and Sensory Devices	Project Development	Modeling and Simulation task	6 Sessions	

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.

List of Laboratory Tasks

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:

z1- Fundamentals of C-Programs,
z2- Basics of Embedded C and Arduino
Project work

Text Book

T1 E Balagurusamy *"Programming in ANSI C"* , Mc Graw Hill Publications,7th Edition.
T2 Monk Simon *"Programming Arduino: Getting Started with Sketches",* Mc Graw Hill Publications Second Edition.

References

R1 https://www.tutorialspoint.com/arduino/index.html.
R2 https://create.arduino.cc/projecthub/projects/tags/sensor.

Web resources: https://3dprinting.com/what-is-3d-printing.

ttps://puuniversity.informaticsglobal.com

Topics relevant to the development of "Skill Development":

1. Basic Concepts of C-Programming
2. Embedded 'C' and Arduino
3. Problem solving
4. Creative Thinking
5. Team work
6. Prototype Development.

for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 2066	**Course Title:** Computer Graphics	**L-P-C**	3	0	3
Version No.	2.0				
Course Pre-requisites	C Programming				
Anti-requisites	NIL				
Course Description	This course demonstrates 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. The course uses assignments to develop visualization skills of the students. The key topics covered in this course include algorithms for drawing basic primitives, transformations, viewing and clipping for both 2D and 3D objects				

	along with Bezier curves and Surfaces.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Computer Graphics and** attain **Skill Development** through **Participative Learning** techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: CO 1: Illustrate algorithms for drawing basic primitives like Point, Line and Polygon. CO 2: Illustrate algorithms for performing 2D Geometric Transformations, viewing and clipping. CO 3: Illustrate algorithms for performing 3D Geometric Transformations, clipping. CO 4: Describe plane Bezier curves and Bezier surfaces.		
Course Content:			
Module 1	**Overview: Basics of Computer Graphics**	Assignment	**No. of Sessions 13**
Topics: An Introduction Graphics System: Computer Graphics and Its Types, Application of computer graphics. Graphics Systems: Video Display Devices, Raster Scan Systems, Random Scan Systems, Raster graphics Vs. Random Graphics, Flat panel Displays – emissive and non-emissive displays, Input Devices, logical inputs, Graphics tools and software Line drawing algorithms - Midpoint, DDA, Bresenham's. Circle generation algorithms - Midpoint circle drawing algorithm, Bresenham's circle algorithm. Basics of 2D and 3D objects. **Assignment:** Numerical problems based on Line and circle drawing algorithm			
Module 2	**2D Geometric Transformations, viewing and clipping**	Assignment	**No. of Sessions : 12**
2D Geometric Transformations: Basics of translation, scaling, rotation, reflection and shearing. Matrix representations and homogeneous coordinates for translation, scaling, rotation, reflection and shearing. 2D Composite transformations, General pivot point rotation and scaling. Introduction to OpenGL concepts and libraries. OpenGL geometric transformations functions. Basics of 2D viewing and Clipping: Basics of viewing and Clipping, 2D viewing pipeline, Viewing Transformation systems, Normalization and Viewport Transformation Types of clipping: point, Line and polygon clipping, 2D line clipping algorithms: cohen-sutherland line clipping, Liang-Barsky line clipping algorithm, polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm, OpenGL 2D viewing and clipping functions. **Assignment:** Numerical problems based on 2D transformations.			
Module 3	**3D Geometric Transformations, clipping:**	Mini-project	**No. of Sessions : 11**
3D Geometric Transformations: 3D translation, rotation, scaling, reflection and shearing, composite 3D transformations, OpenGL 3D geometric transformations functions, Transformations between 3D Coordinate Systems. Basics of 3D Viewing and Clipping: 3D viewing concepts, 3D viewing coordinate parameters, Transformation from world to viewing coordinates, Projection transformation, parallel projections - orthogonal projections and oblique projections, parallel-Projection Transformation Matrix, perspective projections, Perspective-Projection Transformation Matrix Assignment: Based on the activities in the link: pu.informatics.global			
Module 4	**Plane curves and surfaces**	Quiz	**No. of Classes : 9**

Plane Curves: Plane Curves representation, Nonparametric Curves, Parametric Curves, Curved Surfaces, Quadric Surfaces.
Basics of Curves and surfaces: Interpolation and Approximation Splines, Parametric Continuity Conditions, Geometric Continuity Conditions, Spline Specifications. Representation of Space Curves, Cubic Splines, Bezier Curves, Parametric Cubic Curves, Quadric Surfaces, Bezier Surfaces. OpenGL Quadric-Surface and Cubic-Surface Functions

Targeted Application & Tools that can be used:
Application Area: Game design and Animation
Tools/Simulator/Software used: Visual Studio 17.0 / CodeBlock

Text Book:

T1: Donald D. Hearn, M. Pauline Baker and Warren Carither, Computer Graphics with OpenGL, Pearson Education, 4th Edition, 2021

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

E-References

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

Topics relevant to development of "Skill Development":

1. Line drawing algorithms (DDA, Bresenham's)
2. Graphics tools and software
3. Liang-Barsky line clipping algorithm
4. cohen-sutherland line clipping
5. OpenGL 2D viewing and clipping functions

for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 215 / CSE 3078	**Cryptography and Network Security**	**L- P- C**	3	0	3
Version No.	2.0				
Course Pre-requisites	Basic Knowledge in Number Theory, Binary Operations				
Anti-requisites	**NIL**				
Course Description	The Course deals with the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cryptography and Network Security above** and attain **Skill Development** through **Problem Solving** methodologies.				
Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe the basic concept of Cryptography 2. Classify different types of Cryptographic Algorithms 3. Solve Mathematical problems required for Cryptography 4. Illustrate Network Security concepts				

Course Content:				
Module 1	**Introduction to Cryptography**	Assignment	Recognize the techniques	07 Sessions
Topics: 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 Ciphers : Play-fair and Hill Cipher, Vigenere cipher, Introduction to Block Cipher and Stream Cipher, Feistel Structure, ECB modes of block cipher				
Module 2	**Symmetric Encryption Algorithms**	Assignment	Analysis of results	09 Sessions
Topics: Symmetric Encryption Algorithms : Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, Applications of Fermat's little theorem in modular athematic, brief about primality testing and factorization, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese remainder theorem.				
Module 3	**Public Key Cryptography**	Assignment	Analysis of solutions	09 Sessions
Topics: Overview of Public Key Cryptography, RSA, Diffie-Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Ei-gamal Encryption, Elliptic curve cryptography overview.				
Module 4	**Network Security**	Assignment	Analysis of solutions	05 Sessions
Topics: Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IPSec architecture, Network Security applications: DNS Security.				
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.				
Textbooks: **T1** William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson publication, ISBN: 978-93-325-8522-5, 2017				
References: **R1** Bruice Schneier, "Applied Cryptography – Protocols, Algorithms and Source code in C", Second Edition, Wiley Publication, ISBN: 978-81-265-1368-0, 2017 **R2** Cryptography and Network Security, Express Learning, ITL Education Solution Limited. **R3** e-pg pathshala UGC lecture series Web references: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live https://nptel.ac.in/courses/106105031.				
Topics relevant to "Skill Development": Topics relevant to "Skill Development": 1. Play-fair and Hill Cipher 2. Euclidean and Extended Euclidean Algorithm 3. Secure Hash Algorithm 4. Diffie-Helman Key exchange 5. Totient Function. 6. Fermat's little theorem				

Course Code: CSE2027	**Course Title: Fundamentals of Data Analytics** **Type of Course: Theory only**	**L- P- C**	3	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		**8 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	Project MAT Lab	Data analysis with		**12 Sessions**

	MATLAB		optimization	

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

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

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.

Web Links:
https://presiuniv.knimbus.com/user#/home

Topics relevant to development of "FOUNDATION SKILLS":

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: CSE2008	**Course Title: Programming in Java (Object Oriented Programming)** **Type of Course: Program Core** **Theory and Laboratory Integrated**	**L-P-C**	1	4	3
Version No.	1.0				
Course Pre-requisites	Basic knowledge of any structured programming: Data types, variables, constants, operators, conditional & control structures, Loops, arrays & function.				
Anti-requisites	NIL				
Course Description	This course introduces the core concepts of object-oriented programming by using Java. 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 Programming in Java and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.
Course Out Comes	On successful completion of the course the students shall be able to: 1. Write programs using basic concepts in JAVA 2. Apply the concept of arrays, strings, polymorphism & inheritance for building desktop 3. Implement interface & packages for building secure applications 4. Apply the concepts of error handling mechanism and multithreading. 5. Apply the concepts of Collections to develop high performance applications.
Course Content:	

Module 1	INTRODUCTION	Assignment	Programming	**No. of Classes:10**

Topics: Introduction to Object Oriented Programming, Java Evolution, and How Java differs from C++, Features of Java,
Java Environment: Installing JDK (JVM, JRE), Java Source File Structure, Compilation and Execution of Java Programs.
TOKENS: Data types, 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 , Autoboxing and Unboxing,

Module 2	Arrays, Strings, inheritance and Polymorphism	Assignment	Programming	**No. of Classes:6**

Topics:Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array.
Operation on String, Mutable & Immutable String, Creating Strings using StringBuffer or StringBuilder.
Defining a subclass, types of Inheritance, method overriding, super keyword, dynamic method invocation, dynamic polymorphism, usage of final abstract and this keyword.

Module 3	Interfaces, Packages and Exception Handling	Assignment	Programming	**No. of Classes:8**

Topics:Defining interfaces, extending an interface, Implementing interfaces. Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining a Package, Library Packages, import packages.
Exception handling: Introduction to Exceptions, Difference between Exceptions & Errors, Types of Exception. Handling Exceptions: Use of try, catch, finally, throw, throws. User Defined Exceptions, Checked and Un-Checked Exceptions.

Module 4	MULTITHREADED PROGRAMMING:	Assignment	Programming	**No. of Classes:12**

Topics: Introduction to threads, life cycle of a thread, creating threads, extending the Thread Class, Implementing the “runnable‟ interface. Thread Priority, Thread synchronization, Inter communication of Threads

Module 5	Collections and Graphic Programming(AWT,Swings)	Assignment	Mini Project	**No. of Classes:12**

Introduction to Collections, Classification of Collection. Introduction to List, Map and Set Interface, Introduction to Applets.
Introduction to the abstract window toolkit (AWT), Frames, Event-driven programming: Mouse and Key Event handling.
Introduction to Swings, JFC, Swing GUI Components and Layout Manager.

List of Laboratory Tasks:
Experiment N0 1: Programming assignment with class, objects and basic control structures.

(Application:
Build a basic menu driven application)
Level 1: Programming scenarios which use control structures to solve simple case scenarios (Eg: Check if a number is odd or even)

Level 2: Programming assignment which will build menu driven application by identifying the class and its relevant methods.

Experiment No. 2: Programming assignment using Arrays and Strings. (Application: Develop application on Matrices, build String based application like Telephone directory)

Level 1: Programming scenarios which build single dimensional and multidimensional array, apply the different methods to operate on strings.

Level 2: Programming assignment which will manipulate the data stored in matrices and identify the appropriate usage String methods.

Experiment No. 3: Programming assignment using Inheritance and Polymorphism

Level 1: Programming scenarios which use the concept the polymorphism for method overloading. Scenarios which apply the concept of inheritance (identifying parent, child class and its relationship)

Level 2: Programming assignment which build application which have same functions in different forms.

Experiment No. 4: Programming assignment using Exception Handling

Level 1: Programming assignment on building applications using built in Exceptions.

Level 2: Programming assignment on building application using user defined Exceptions.

Experiment No. 5: Programming assignment using Multithreading. (Eg: Building an application which performs different arithmetic operations and sharing the resources using threads)

Level 1: Programming scenarios to build a thread, assign priority and use the thread methods to perform operations

Level 2: Programming scenarios for building synchronized applications.

Experiment No. 8: Programming assignment using Collections

Level 1: Programming Scenarios to apply and use the Collection framework (List, SET, Map, Interface)

Experiment No. 9: Programming assignment to build GUI Applications.

Level 1: Programming Scenarios to build GUI for a given scenario using AWT and Swings concepts.

Targeted Application & Tools that can be used:

- Platform independent Application Development
- Secure Application Development
- Data Mining
- Operating Systems.
- Database Management Systems
- Banking software
- Automobiles
- Mobile Applications

Tools: JDK (Java Development Tool kit), Integrated Development Environment (IDE), Apache NetBeans,

Eclipse.

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.
A scenario will be given to the student to be developed as a Java Application.
On completion of Module 5, student will be asked to develop a Mini Project using the GUI functionalities.

Text Book

1. **Cay S Horstmann and Cary Gornell, *"CORE JAVA volume I-Fundamentals"*, Pearson.**
2. **Cay S Horstmann and Cary Gornell, *"CORE JAVA volume II-Advanced Features"*, Pearson.**

References

1)Herbert Schildt, *"The Complete Reference Java 2",* Tata McGraw Hill Education.
2)James W. Cooper*, "Java TM Design Patterns – A Tutorial"*, Addison-Wesley Publishers.

Topics relevant to development of "Skill Development": **Real time application development using OOPs concept, Naming and coding convention for Project Development** for Skill development through Experiential Learning Techniques. This is attained through assessment component mentioned in the course handout.

Course Code: CSE2067	**Course Title: Web Technology** **Type of Course: Program core** **Theory Only**	**L- P- C**	3	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		**8 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	14 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, "*Programming the World Wide Web*", Pearson Education, 8th Edition, 2015.

2] *CSS Notes for Professionals*, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)

3] Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", 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: CSE 151	Course Title: **Computer Programming** Type of Course: **Laboratory Integrated Course**	L- P- C	2	4	4
Version No.	1				
Course Pre-requisites	NA				
Anti-requisites	NA				
Course Description	This Course will provide an introduction to foundational concepts of computer programming to students of all branches of Engineering. This course includes a mix of traditional lectures and laboratory sessions. Each meeting starts with a lecture and finishes with a laboratory session. Topics covered in this Course are problem formulation and development of simple programs, Pseudo code, Flow Chart, Algorithms, data types, operators, decision making and branching, looping statements, arrays, functions, structures and union. In the lab session students are required to solve problems based on the above concepts to illustrate the features of the structured programming.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Computer Programming** and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques				

Course Out Comes	**On successful completion of the course the students shall be able to:** **COURSE OUTCOMES: On successful completion of the course the students shall be able to:** CO 1: Apply the basic concepts and control structures of programming to so particular problems (L3) CO 2: Apply the concepts of array and strings to represent data and its operations.(L3) CO 3: Illustrate the concepts of functions, structure and unions in programming.(L3)			
Course Content:				
Module 1	**Introduction**	Quizzes		**7 Sessions**
Topics: Introduction to Problem Solving Basic organization of Computer, System software and Application software, Operating System and Programming languages. Logical analysis using Algorithm and Flowchart. Introduction to C Structure of C program, variables, keywords, data types and sizes, declaration and initialization of variables, storage class, operators and expression, managing input and output operations, compiling and linking.				
Module 2	Branching and looping	Quizzes	Assignments	**8 Sessions**
Decision Making and Branching: if, if-else, if-else ladder, nested if and switch case Unconditional: break, continue, and return Decision Making and Looping: for, while, do-while, and nested looping statements.				
Module 3	**Arrays and Functions**	Quizzes	Assignments	**12 Sessions**
Arrays Introduction, one-dimensional arrays, two dimensional arrays, multi-dimensional arrays, searching and sorting. Functions Introduction, user defined functions, categories of functions, nesting of functions, recursion, passing arrays to function, the scope, visibility and lifetime of a variable.				
Module 4	**Strings, Structures and union**	Quizzes		**9 Sessions**
Strings Introduction to strings, String Handling Functions, Passing string as parameter to function. Structure and Union Introduction, array of structure, structure within a structure, unions, passing structure and union as parameter to the function.				
Targeted Application & Tools that can be used: 1. **C**				
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 Books 1. E. Balagurusamy, "*Programming in ANSI C*", Seventh Edition - Tata McGraw Hill.				
References 1. Behrouz A Forouzan, Richard F Gilberg, "*Computer Science: A structured programming approach using C*", Cengage Learning. 2. Brian W. Kernighan / Dennis Ritchie, "*The C Programming Language* " ,Pearson				

Edition.

3. Yashavant Kanetkar, "*Let Us C*", 16th edition , BPB Publications

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

Topics relevant to development of "Skill Development":
Assignment implementations in software, batch wise presentations.

1. Decision Making and Looping
2. Storage class
3. Compiling and linking
4. Nesting of functions

for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 304	**Course Title:** Mobile Communication **Type of Course: Program Core - Theory**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites					
Anti-requisites	**NIL**				
Course Description	The course helps the students to apply the engineering principles in the specification, design, development, and deployment of mobile communications. Students will develop a detailed knowledge and critical understanding of the core skills in mobile communications and networks. Topics include: Fundamental knowledge of wireless and mobile networks, mobile communication systems / networks / architecture. The cellular communications, mobile networks, including wireless transmission technology, wireless PAN/ LAN/ MAN/ WAN, Mobile IP, Ad-Hoc networks, sensor networks, wireless mesh networks.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain EMPLOYABILITY through PARTICIPATIVE LEARNING techniques				
Course Outcomes	On successful completion of this course the students shall be able to: 1. Explain the limitations of fixed networks, the need and the trend toward mobility, the concepts of portability and mobility. 2. Describe the network infrastructure requirements to support mobile devices and users. 3. Explain the concepts, techniques, protocols, and architecture employed in wireless local area networks, cellular networks, and perform basic requirements analysis. 4. Apply techniques and technologies to design a communication application for mobile devices.				
Course Content:					
Module 1	Introduction	Assignment	Multiplexing and Modulation	09 Sessions	
Topics: Introduction to Wireless Communication – Mobile and Wireless Devices - Antennas - Signal Propagation - Multiplexing - Modulations - Cellular Systems.					

Module 2	**MOBILE TELECOMMUNICATION SYSTEM**	Assignment	GPRS, RFID	9 Sessions
Topics: Global System for Mobile Communications (GSM) - General Packet Radio Service (GPRS) - Universal Mobile Telecommunication System (UMTS) – Radio Frequency Identification (RFID) – Bluetooth – SMS and MMS.				
Module 3	**WIRELESS PROTOCOLS AND STANDARDS**	Seminar	Routing Protocols	09 Sessions
Topics: MAC Protocol – Wireless MAC Issues – Code Division Multiple Access (CDMA) – Wireless LANs and PANs - IEEE802.11 – Mobile Internet Protocol – DHCP – Routing Protocols.				
Module 4	**MOBILE APPLICATIONS AND PLATFORMS**	Case Study	Applications of Cloud and IoT	10 Sessions
Topics: Mobile Phones - Tablet and Other Handheld Devices - Mobile Device Operating Systems - Mobile Computing: Applications, Characteristics and Structure - Mobile Computing Support: Cloud and Internet of Things - Wireless Security				

Targeted Application & Tools that can be used:

Application Area:

Tools:

Textbooks:

1. Jochen Schiller, "Mobile Communications", Pearson Education Limited, Second Edition 2007.
2. Asoke K. Talukder, Hasan Ahmed, Roopa R. Yavagal, "Mobile Computing: Technology, Applications, and Service Creation", Tata McGraw-Hill, Second Edition 2010.

References:

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. William Stallings, "Wireless Communications and Networks" Pearson Education, Second Edition 2005.
3. C.K.Toh, "AdHoc Mobile Wireless Networks", Pearson Education Limited, First Edition 2002.
4. NPTEL: https://onlinecourses.nptel.ac.in/noc20_ee61/preview

Web references:

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 "Employability": **Routing Protocols, Cloud Applications in Mobile** for developing Employability Skills through Participative Learning Techniques. This is attained through assessment component in course handout.

Course Code: **CSE2051**	**Course Title:** Information Retrieval **Type of Course: Theory Only Course**	**L- P- C**	3	0	3
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, —"*Information Retrieval: Implementing and Evaluating Search Engines*", The MIT Press, 2017. R2 Jian-Yun Nie Morgan & Claypool –" *Cross-Language Information Retrieval*", Publisher series 2011. R3 Stefan M. Rüger Morgan & Claypool – "*Multimedia Information Retrieval*", Publisher series 2014. R4 B. Liu, Springer, - "*Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data*", 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: **CSE2011**	**Course Title:** Data Communications and Computer Networks **Type of Course:** **Program Core - Theory**	**L- P-C**	3	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	O7 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:

1. Instant Messaging
2. Telnet
3. File Transfer Protocol
4. Video Conferencing

Textbooks:

T1. James F. Kurose, Keith W. Ross, "*Computer Networking A Top down Approach",* 8th Edition, Pearson, 2021.

T2. Behrouz A. Forouzan, "*Data Communications and Networking*", 6th Edition, Tata McGraw-Hill, 2021.

References:

R1. William Stallings: "*Data and Computer Communication*", 10th Edition, Pearson Education, 2017.

R2. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 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: CSE2036	**Course Title: Programming in C++** **Type of Course: Discipline Elective Theory & Integrated Laboratory**	**L-P-C**	1	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 E**xperiential 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		**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	Lab evaluation	Programming/Problem Solving		**07 Hours**

	overloading, Strings			
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.
Level 2: Use of static members, new and delete.

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.

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.

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.

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.

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.

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.

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.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1. **Problem Solving: Understanding different OOPS and implementation of programs.**
2. **Programming: Implementation of given scenario using C++.**

Text Book

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.**

References

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, traction, Encapsulation for developing **Employability Skills** through **Experiential Learning** nniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3070	**Course Title: ADVANCED COMPUTER NETWORK** **Type of Course: Theory Only**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Computer Networks and Computer Architecture Course				
Anti-requisites					
Course Description	This course aims to provide understanding of advanced computer network concepts, building on the basic functions of various layers, protocols and standards used in practice to have a comprehensive and deep knowledge in computer networks.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Advanced Computer Network and attain EMPLOYBILITY SKILL through PARTICIPATIVE LEARNING techniques				
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Describe network architecture and application programming interface concepts (L2) 2. Explain working of internetworking protocols (L2) 3. Illustrate different routing protocols and end-to-end transmission (L3) 4. Distinguish the various protocols used at the transport layer (L2				

	5. Summarize working of traditional, multimedia applications and overlay networks (L2)			
Course Content:				
Module 1	**Introduction**	Assignment	Data Collection/Interpretation	**12Sessions**
Topics: Introduction: Applications, Requirements – Perspectives, Scalable Connectivity, Cost-Effective Resource Sharing, Support for Common Services. Network Architecture- Layering and Protocols, OSI Architecture, Internet Architecture. Implementing Network Software- Application Programming Interface (Sockets). Performance- Bandwidth and Latency, Delay×Bandwidth Product, Application Performance Needs.				
Module 2	**Internetworking**	Case studies / Case let	Case studies / Case let	**12 Sessions**
Topics: **Internetworking (Part - I): Switching and Bridging**-Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN switches. **Basic Internetworking (IP)-**What is an internetwork, service model, global addresses, Datagram Forwarding in IP, Subnetting and classless addressing, address translation (ARP), DHCP, ICMP, Virtual Networks and Tunnels.				
Module 3	**Internetworking and Advanced Internetworking**	Quiz	Case studies / Case let	**14 Sessions**
Topics: **Inter-networking (Part - II):** Routing - Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics. **Implementation and Performance-** Switch Basics, Ports, Fabrics, Router Implementation. **Advanced Internetworking:** The Global Internet – Routing Areas, Inter domain Routing (BGP), IP Version 6 (IPv6). **Multicast:** Multicast addresses, Multicast routing (DVMRP, PIM)				
Module 4	**Advanced Internetworking and End-to-End Protocols**	Quiz	Case studies / Case let	**14 Sessions**
Topics: **Multiprotocol Label Switching (MPLS):** Destination-Based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels, **Routing among Mobile Devices:** Challenges for Mobile Networking, Routing to Mobile Hosts (Mobile IP), **End-to-End Protocols:** Simple Demultiplexer (UDP), Reliable Byte Stream (TCP) - End-to-End Issues, Segment Format, Connection Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Performance, Alternative Design Choices. **Congestion Control and Resource Allocation:** Issues in Resource Allocation - Network Model, Taxonomy, Evaluation Criteria. Queuing Disciplines - FIFO, Fair Queuing.				
Targeted Application & Tools that can be used:				
Project work/Assignment:				
Assignment:				
Text Book: **T1.** Larry L. Peterson, Bruce S. Davie. Computer Networks, A Systems Approach, Morgan Kaufmann Publishers, Fifth Edition, 2012				
References R1. W. R. Stevens. Unix Network Programming, Vol.1, Pearson Education, 1990 R2. Andrew S Tanenbaum and David J Wetherall, Computer Networks, 5/e, Pearson Education, 2010 R3. Darren Spohn, Data Network Design, 3/e TMH, 2002 R4. D. Bertsekas, R. Gallager, Data Networks, 2/e, PHI, 1992 **E-book link R1: https://cseweb.ucsd.edu/classes/wi19/cse124-a/courseoverview/compnetworks.pdf**				

Web resources:

NPTEL Course -**https://onlinecourses.nptel.ac.in/noc23_cs35/preview**

Coursera - **https://in.coursera.org/specializations/computer-communications**

ps://presiuniv.knimbus.com/user#/home

informatics.global, **https://sm-nitk.vlabs.ac.in/**

Topics relevant to development of "Employability":

IP addressing for developing Employability Skills through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: (CSE225)	**Course Title: Introduction to Combinatorics and Graph Theory** **Type of Course: Program Core - Theory**	**L-P-C**	3	0	3
Version No.	version 1				
Course Pre-requisites	Basic logic and Set theory				
Anti-requisites	nil				
Course Description	Graph Theory 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 **: Introduction to Combinatorics and Graph Theory** and attain **Skill Development** through **Participative Learning** techniques.				
Course Outcomes	CO1: Explain the fundamental concepts of Graph theory. [L1: Knowledge] CO2: Discuss theorems of matching, connectivity, coloring and planar graphs. [L2: Comprehension] CO3: Discuss different types of trees and traversal techniques. [L2: Comprehension] CO4: Apply different algorithms to find optimal path for a given graph. [L3: Applications]				
Course Content:					
Module 1	**Introduction to Graph Theory**	Assignment	Data Collection	07 Sessions	
Introduction to Graph Theory **07H** **[Knowledge Level]** 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).					
Module 2	**Introduction to Graph Theory contd**	Assignment	Analysis of test results and also can be dealt with Lab	11 Sessions	
Introduction to Graph Theory contd. **11H** **[Comprehension Level]** Graph isomorphism, Eulerian graph, Hamiltonian graph, Planar graph (three utility problem), Graph coloring, Combinatorics-Principle of Inclusion and Exclusion.					

Module 3	**Trees**	Assignment	MS Excel, Using Graphs and Pi Charts and tables for analysis	13 Sessions

Trees **13H [Comprehension Level]** Tree: Definitions, properties, Rooted trees, Binary search tree, Decision tree, prefix code, Tree traversal: in-order, pre-order, post-order, infix, postfix, prefix, spanning tree: BFS, DFS.

Module 3	**Algorithm on networks**	Assignment	MS Excel, Using Graphs and Pi Charts and tables for analysis	13 Sessions	Assignment	MS Excel, Using Graphs and Pi Charts and tables for analysis	13 Sessions

Algorithm on networks Shortest path algorithm- Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm, Transport network-Max-flow/Min-cut algorithm, Combinatorics-Rook polynomial, Derrangements .

Targeted Application & Tools that can be used:

Project work/Assignment:

Project Assignment:
Assignment 1:
Assignment 2:

Textbooks:

K H Rosen, "Discrete Mathematics and its Application", McGraw Hill. [T1]

References:

1. Harris, Hirst amd Mossinghoff," 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]

Web references: **https://onlinecourses.nptel.ac.in/noc22_ma10/preview**

Topics relevant to "SKILL DEVELOPMENT":

Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm, Transport network-Max-flow/Min-cut algorithm, Combinatorics-Rook polynomial, Derrangements for **skill development** through **Participative Learning techniques.** This is attained through the assessment component mentioned in the course handout.

[Text Wrapping Break]

Course Code: CSE 261	**Course Title: Machine Learning Using Python** **Type of Course: Laboratory Integrated**	**L- P- C**	2	2	4
Version No.	2.0				
Course Pre-requisites	Data Structures, Statistics, Linear Algebra, Python, Database				
Anti-requisites	--				
Course Description	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. AI and ML are important skills that every engineering graduate will require to advance in their career. Python is the leading programming language used by several organizations for creating end-to-end solutions using ML. 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.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Machine Learning Using Python** and attain **Skill Development** through **Experiential Learning** techniques.				
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Produce Machine Learning Models for Predictive Analytics. [**Application**]. **CO2:** Apply Ensemble Learning, Optimization and Hyper Parameter Tuning Techniques for machine learning algorithms. [**Application**] **CO3:** Demonstrate different types of Clustering Algorithms.[**Application**] **CO4:**Illustrate advanced concepts in Machine Learning such as time series forecasting techniques, Recommender systems, Sentiment Classification. [**Application**]				
Course Content:					
Module 1	**Supervised Machine Learning Algorithms**	Assignment	Data Collection/Interpretation		**8 Sessions**
Topics: Introduction to the Machine Learning (ML) Framework, types of ML, Feature Engineering, One-hot encoding, Simple Linear Regression, Multiple Linear Regression, Model Evaluation, 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, Multi-class classification and Class Imbalance problem.					
Module 2	**Advanced Machine Learning Concepts**	Case studies / Case let	Case studies / Case let		**12 Sessions**
Topics: Nearest Neighbor techniques, Support Vector Machine, Cost functions and Optimization Technique – introduction to Gradient Descent, its applications on Linear Regression. Ensemble Learning algorithms – Bagging (Random Forest), Boosting(AdaBoost), Hyperparameter Tuning for nearest neighbor learning using Grid Search. Introduction to					

Regularization with Advanced Regression models- LASSO and Ridge Regression an introduction.

Module 3	**Clustering and Forecasting with Time-Series Data**	Quiz	Case studies / Case let	**14 Sessions**

Topics:

Partitional Clustering – K-means and Hierarchical Clustering techniques, cluster validity measures, Dimensionality Reduction Techniques-Linear Discriminant Analysis, Principal Component Analysis, Components of Time Series data, forecasting using moving average, exponential smoothing, calculating forecast accuracy, decomposing time series data.

Module 4	**Recommender Systems and Text Analytics**	Quiz	Case studies / Case let	**14 Sessions**

Topics:

Association Rule Mining, Collaborative Filtering – User based and item based similarity, Text Analytics – text preprocessing, representation using BoW and vector space model. Naïve Bayes Classifiers and Naive Bayes model for sentiment classification – an introduction.

List of Laboratory Tasks:

- 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, Programming exercises to revise variables, control statements and collections – lists, list comprehension
- Programming exercises on Tuples, dictionaries, functions using math, random modules.
- Introduction to Data Frames using Pandas and working with frames – shape, summary, cross tabs, sorting by column names, creating new columns, aggregation and grouping, CO11filtering records, removing a column/row, handling missing values, Plotting using matplot library histogram, scatter Plot
- Regression Models Simple linear regression, outlier detection, multiple linear regression – model evaluation, multi-collinearity and handling multi-collinearity, outlier detection
- Decision Tree Classifiers - Decision Tree classifier using Gini Index- measuring test accuracy, displaying the tree, confusion matrix and ROC, Decision Tree Classifier using Entropy.
- Optimization Techniques Developing a Gradient Descent Algorithm for linear regression – using NumPy and using sklearn
- Hyperparameter Tuning methods Hyperparameter tuning using Grid Search for Nearest Neighbor Classifiers and Decision Tree Classifiers
- Hyperparameter Tuning for Ensemble models Ensemble Learning – Random Forest – Building the model, GridSearch for optimal parameters, Feature Importance. Ada Boost Classifiers and Gradient Boosting Classifiers
- Clustering – Kmeans – cluster centers and interpreting the clusters, finding the optimal number of clusters using Elbow Curve method, Agglomerative Hierarchical Clustering – Compare the clusters formed by kmeans and Agglomerative Clustering
- Models for Forecasting Time Series data
- Recommender Systems - Association Rule Mining using Apriori for frequent Itemset Generation.
- Recommender Systems – user based similarity
- Naïve Bayes Model

Targeted Application & Tools that can be used

- **Rapid Miner**
- **Orange**
- **MatLab**

Project work/Assignment:

Assignment:

Text book(s):

1. Manaranjan Pradhan, U Dinesh Kumar, "*Machine Learning Using Python*", Wiley, First Edition 2019.
2. Rehan Guha, "*Machine Learning Cookbook with Python*", BPB Publications, First Edition, 2020.

Reference Book(s):

1. Tan P. N., Steinbach M & Kumar V. "*Introduction to Data Mining*", Pearson Education, 2016.
2. Giuseppe Bonaccorso, "*Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning*", Packt Publishing, 2017.

E book link R1:
ps://www.pdfdrive.com/machine-learning-step-by-step-guide-to-implement-machine-learning-algorithms-with-python-e158324853.html

E book link R2:
ps://www.pdfdrive.com/hands-on-machine-learning-with-scikit-learn-and-tensorflow-concepts-tools-and-techniques-to-build-intelligent-systems-e168440497.html

Web resources:
https://machinelearningmastery.com/seaborn-data-visualization-for-machine-learning/
https://link.springer.com/article/10.1007/s42979-021-00592-x
https://pu.informatics.global/

Topics relevant to "SKILL DEVELOPMENT": Data Visualization using Seaborn library, Applications of Machine Learning in different domains **for Skill Development through Experiential Learning techniques. This is attained through the Lab Experiments as mentioned in the assessment component**

Course Code: CSE3066	**Course Title: Mobile Application for IoT** **Type of Course: Program Core& Theory Only**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	Mobile Application is the essential part for IoT infrastructure, which helps in understanding the architectural overview of IOT. The purpose of this course is to expose the students to understand the IoT Reference Architecture and Real World Design Constraints along with various IOT protocols. This course is both conceptual and analytical in nature that would help the student to predict the effects of forces and its motion while carrying out creative design functions.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Mobile and Application for IoT** and attain **Skill Development** through **Participative Learning** techniques.				

Course Out Comes	On successful completion of the course the students shall be able to: 1. Able to understand the application areas of IOT 2. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks 3. Able to understand building blocks of Internet of Things and characteristics. 4. Learn about android application development			
Course Content:				
Module 1	Overview	Assignment	Programming Task	**9 Sessions**
Topics: IoT-An Architectural Overview Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management				
Assignment: Case study on Business processes in IoT.				
Module 2	Basic Design	Assignment	Data Collection/Excel	**10 Sessions**
Topics: Introduction Basics of embedded systems design Embedded OS - Design constraints for mobile applications, both hardware and software related Architecting mobile applications user interfaces for mobile applications touch events and gestures Achieving quality constraints performance, usability, security, availability and modifiability. **Assignment:** Recent trends In mobile application development				
Module 3	IOT mobile apps	Assignment	Programming/Data analysis task	**9 Sessions**
Topics: IoT Mobile App Development Trends In 2020 - Role of Mobile Apps in revolutionizing the world of IoT - UX / UI design for IoT Mobile apps - challenges of UX/UI design for IoT applications - practice tips on design for IoT mobile apps IoT App Design Solutions **Assignment:** Challenges faced during mobile application development				
Module 4	TECHNOLOGY I-ANDROID	Assignment	Programming/Data analysis task	**10 Sessions**
Topics: Introduction Establishing the development environment Android architecture Activities and views Interacting with UI Persisting data using SQLite Packaging and deployment Interaction with server side applications Using Google Maps, GPS and Wifi Integration with social media applications.				
Targeted Protocols & Tools that can be used: Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread				

Text Book

T1: "From machine to machine to the internet of things: Introduction to the new age of intelligence", 1st edition, Academic press, 2014.
T2: Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012

References

R1: Bernd Scholz- -3-642-19156-5 e-ISBN 978-3- 642-19157-2, Springer
R2: Andrea Goldsmith, "Android in practice," Cambridge University Press, 2005

Weblinks:

W1: https://relevant.software/blog/mobile-iot-apps/
W2: https://medium.com/@its.mattfitzgerald/top-14-iot-mobile-app-development-trends-to-expect-in-2020-7fd7718155dc
W3:https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-%2520live%26ebv%3dEB%26ppid%3dpp_xiii

Topics relevant to "SKILL DEVELOPMENT":

Wifi integration and social media analysis for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3055	**Course Title: Wireless communication in IOT** **Type of Course: Program Core& Theory Only**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	Wireless communication system is the essential part for IoT infrastructure, which acts as the bridge for dual directional communication for data collection and control message delivery. The purpose of this course is to expose the students to understand the fundamentals of wireless network and problems related to real-world scenarios. This course is both conceptual and analytical in nature.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Wireless communication in IOT** and attain **Skill Development** through **Participative Learning** techniques.				
Course Out Comes	On successful completion of the course the students shall be able to: 1. To understand the fundamentals of wireless networks 2. Analyze the standards of IoT which employed for wireless networks 3. Explain the use of various wireless technologies in IoT 4. Design and develop various applications of IoT				
Course Content:					
Module 1	Cellular standards	Assignment	Programming Task	**9 Sessions**	
Topics: Cellular carriers and Frequencies, Channel allocation, Cell coverage, Cell Splitting, Microcells, Picocells, Handoff, 1st, 2nd, 3rd and 4th Generation Cellular Systems (GSM, CDMA, GPRS, EDGE,UMTS), Mobile IP, WCDMA					

Assignment: Case study on generation cellular systems.				
Module 2	Radio Frequency (RF) Fundamentals	Assignment	Data Collection/Excel	**10 Sessions**

Topics:
Introduction to RF & Wireless Communications Systems, RF and Microwave Spectral Analysis, Communication Standards, Understanding RF & Microwave Specifications. Spectrum Analysis of RF Environment, Protocol Analysis of RF Environment, Units of RF measurements, Factors affecting network range and speed, Environment, Line-of-sight, Interference, Defining differences between physical layers- OFDM.

Assignment: Determination of RF and Microwave spectral Analysis

Module 3	WLAN: Wi-Fi Organizations and Standards	Assignment	Programming/Data analysis task	**9 Sessions**

Topics:
IEEE, Wi-Fi Alliance, WLAN Connectivity, WLAN QoS & Power-Save, IEEE 802.11 Standards,802.11- 2007,802.11a/b/g, 802.11e/h/I,802.11n

Assignment: Protocols on WLAN connectivity

Module 4	Wi-Fi Hardware & Software	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:
Access Points, WLAN Routers, WLAN Bridges, WLAN Repeaters, Direct-connect Aps, Distributed connect Aps, PoE Infrastructure, Endpoint, Client hardware and software, Wi-Fi Applications

Targeted Protocols & Tools that can be used:
Bluetooth, ZigBee, LoRa, NBIoT, WiFi, and Thread

Text Book

T1: Wireless Communications – Principles and Practice; by Theodore S Rappaport, Pearson Education Pte. Ltd.

T2: Wireless Communications and Networking; By: Stallings, William; Pearson Education Pte. Ltd.

References

R1:Bluetooth Revealed; By: Miller, Brent A, Bisdikian, Chatschik; Addison Wesley Longman Pte Ltd., Delhi 4. R2:Wilson , "Sensor Technology hand book," Elsevier publications 2005. 5.

R3: Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005

Weblinks:

W1: https://pianalytix.com/wireless-communication-protocols-in-iot/

W2: https://behrtech.com/blog/6-leading-types-of-iot-wireless-tech-and-their-best-use-cases/

Topics relevant to "SKILL DEVELOPMENT":
GSM, CDMA for developing **Skill Development** through **Participative Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3053	Course Title: **Big Data Analytics for IoT** Type of Course: **Program Core** **Theory with embedded lab**	L- P- C	1	4	3
Version No.	1.0				
Course Pre-requisites					
Anti-requisites	**NIL**				
Course Description	The course covers basic concepts for IOT Analytics, collection of data for IOT, Integration of IOT with Cloud, Big Data Environments. Students can learn about applying geospatial analytics and applying machine learning to the IOT data. The course also covers the organization of the IOT data, cost benefits of using IOT and review of IOT in various sectors.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics for IoT and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.				
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Demonstrate IOT Data Analytics and machine learning application in IOT (Apply) CO2: Apply appropriate Hadoop Ecosystem tools to perform data analytics for a given problem (Apply) CO3: Examine concepts of cloud based IOT, Big data and IOT (Apply) CO4: Illustrate techniques and strategies for data collection and Geospatial Analytics to IOT Data (Apply)				
Course Content:					

Module 1	IOT Analytics	Assignment		**5 sessions**
Introduction – IOT Data, Challenges of IOT analytics Applications – IOT analytics Lifecycle and Techniques. IOT Cloud and Big Data Integration – Cloud based IOT platform – Data Analytics for IOT, IOT devices in different domains. IOT Analytics for the Cloud.				
Module 2	Hadoop Ecosystem Tools			**5 sessions**
Introduction – Big Data and Big Data Analytics – Hadoop Ecosystem – Hadoop Distributed File System (HDFS) – MapReduce – YARN Architecture – PIG Architecture – Apache HIVE – Mahout – Apache Spark – Apache HBase –Apache Zookeeper.				
Module 3	Overview of AWS and Thingworx	Assignment		**5 sessions**
AWS overview - AWS key services for IOT analytics. Thingworx overview. Creating an AWS Cloud Analytics environment.				

Module 4	Geospatial Analytics to IOT Data	Case Study	Data Collection and Analysis
Strategies and Techniques in Data collection: Designing data processing for analytics – Applying big data to storage for Geospatial.			

List of Practical Tasks:

Experiment 1:[Module 1]

Level 1: Installation of Raspbian OS,working basic commands on raspberry pi

Level 2: Demonstrate to obtain the temperature using DHT22 sensors .

Experiment 2: [Module 1]

Level 1: Design and Simulate the RADAR SYSTEM Using Arduino and display on the serial monitor using ultrasonic sensor/PIR WITH &WITH OUT BUZZER/Servo motor

Level 2: using a raspberry pi to Demonstrate to find the distance using ultrasonic sensor hc-sr04

Experiment 3: [Module 1]

Level 1 : using a raspberry pi Set the connections of healthcare sensors

Level 2: using a raspberry pi to Demonstrate to find the ECG, Temperature, etc using Healthcare sensors

Experiment 4: [Module 2]

Level 1: Hadoop Single node cluster installation on ubuntu

Level 2: Hadoop Multiple node cluster installation, windows installation

Experiment 5: [Module 2]

Level 1: Basic hadoop commands and Word count analysis for given dataset

Level 2: Analysis on particular matching word on huge dataset

Experiment 6: [Module 2]

Level 1: Basic hadoop commands and Stock analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 7: [Module 2]

Level 1: Basic hadoop commands and Temperature analysis on given dataset

Level 2: Analysis with max, min, average functions on particular field with missing values

Experiment 8: [Module 3]

Level 1: Working on hive commands

Level 2: Apply bucketing technique to bring out the difference between partitioning and bucketing

Experiment 9: [Module 3]

Level 1: Working on Hbase commands .

Level 2: Apply Hbase commands on Insurance database/employee dataset.

Experiment 10: [Module 3]

Level 1: Installation of spark and word count analysis

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

Experiment 11: [Module 4]

Level 1: Temperature Data stored in cloud through IoT devices

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Experiment 12: [Module 4]

Level 1: Healthcare Data stored through IoT sensors in Cloud

Level 2: Retrieve the data set for cloud and Apply data analytics techniques

Targeted Application & Tools that can be used:

Hadoop ecosystem tools, Thingworx , AWS Cloud

Project work/Assignment:

Student will be asked to carry out a mini project integrating IoT & data Analytics.

Text Book

T1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, Wiley., 2nd Edition, 2019.
T2. Analytics for the Internet of things,Andrew Minteer. Packt publishing, 1st Edition,2017.
T3. Big Data and the Internet of Things, Robert Stackowiak, Art Licht, Venu Mantha and Louis Nagode, Apress, 2nd Edition, 2020

References

R1. IOT and Analytics in Agriculture.,Prasant Kumar Pattnaik, Raghvendra Kumar, Souvik Pal, S. N. Panda. Springer, First Edition, 2020.
R2. Building blocks for IOT Analytics. Internet-of-Things Analytics. John Soldatos (Editor). River Publisher Series in Signal Image and Speech Processing.2020

(iii) web resources

W1. NPTEL: https://onlinecourses.nptel.ac.in/noc20_cs92/preview
W2. Coursera: https://www.coursera.org/learn/big-data-introduction
W3. EDX: https://www.edx.org/course/big-data-fundamentals
W4. E-book Link : https://www.wiley.com /en-us/Internet+of+Things+and+ Data+ Analytics + Handbook -p-9781119173625

https://presiuniv.knimbus.com/user#/home
Topics relevant to "SKILL DEVELOPMENT": Organize IOT data – Linked analytics datasets – Managing data lakes for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2032	Course Title: Introduction to Fog Computing Type of Course: 1] Discipline Elective 2] Lab Integrated Course	L- P- C	3	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,EventManagement,DeviceManagement,cloudification,virualization, 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.				
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.				
Text Book 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. **Web Links:** Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya. Fog Computing | Wiley Online Books 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 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)				

References

1. FlavioBonomi, Rodolfo Milito, Jiang Zhu, SateeshAddepalli, —Fog Computing and Its Role in the Internet of Things‖, 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 Issues‖, 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 Edge‖, 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

Topics relevant to "SKILL DEVELOPMENT":

Fog Computing requirements for **SKILL DEVELOPMENT** through **Problem Solving Techniques**. This is attained through the assessment component mentioned in course handout.

[Text Wrapping Break]

Last Modified: 25/05/2022

Course Code: CSE3046	**Course Title:** **DevOps Tools And Internals** **Type of Course:** **Theory & Integrated Laboratory**	**L-P-C**	**2**	**2**	**3**
Version No.	1.2				
Course Pre-requisites	**Fundamentals of Devops**				
Anti-requisites	**NIL**				
Course Description	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. **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.				
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	On successful completion of this course the students shall be able to: **1] Apply** the features and common Git workflow. [Application] 2] **Practice** the filters and plugins to populate, manipulate, and manage data used by Ansible Playbooks. [Application] 3] **Compute** the features of selenium IDE. [Application] 4] **Interpret** the installation and features of Jenkins and build jobs. [Application]				
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 Using Docker	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.
   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.
   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.

4. Level 1: Installation of Ansible
   Level 2: Create a basic inventory file
   Level 2: Running your first Ad-Hoc Ansible command.

Ansible

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

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

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 .yml 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.

Selenium

8. Level 1: Selenium IDE Download and Install
Level 2: Selenium IDE - First Test Case, Login Test and command usage

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.

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.

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

Jenkins

12. Level 1:
Environment Setup
Level 2:
Jenkins downloading and installation

13. Level 1:
1. Setup a Jenkins Job with Apache Ant Build Tool
2. Setup a Jenkins Job with Apache Maven

Level 2 :
1. Setup a Jenkins Job with Batch Script.

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

Targeted Application & Tools that can be used:

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 Jekins

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

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.

Text Book

1. Craig Berg, "*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) (Code tutorials)*", Paperback – June 12, 2020.
2. Ferdinando Santacroce, "*Git Essentials*", Packt Publishing, April 2015, ISBN: 9781785287909
3. John Ferguson Smart. "*Jenkins: The Definitive Guide*", O'Reilly Media, Inc., July 2011, ISBN: 9781449305352

References

1. Jeff Geerling, "*Ansible for DevOps: Server and configuration management for humans*", Leanpub, August 5, 2020
2. Unmesh Gundecha, Carl Cocchiaro, "*Learn Selenium*", Packt Publishing, July 2019, ISBN: 9781838983048
3. Gaurav Agarwal, "*Modern DevOps Practices: Implement and secure DevOps in the public cloud with cutting-edge tools, tips, tricks, and techniques*", July 2021.
4. Mikael Krief, "*Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps*", October 2019

Weblinks:

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** **Type of Course:** **Elective in Devops Basket** **Theory & Integrated Laboratory**	**L- P- C**	2	2	3
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 I. **Understand** the automated software delivery and deployment process[Knowledge] II. **Analyze** the various automation scenarios .[Comprehension] III. **Demonstrate** the interaction with linux environment[Application] IV. **Implement** scripts[Application] V. **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

Assignemnt: 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, recu,rsive makefile, Building Binary from Source Code, Conditionals in "Makefile", Best Practices in writing "Makefiles". Assignment: Best practices in writing Makefiles				

List of Laboratory Tasks:

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

Experiment No 2: Working with Linux File System, Partitions, Common System Directories

Level 1: Simple commands for exploring paritions, common system directories

Level 2: configuring linux system

Experiment No 3: Working with writing automation scripts

Level 1: Simple automation scripts

Level 2: Complicated automation scripts

Experiment No 4: Working with variable substituition, conditionals, regular expressions

Level 1: Simple regular expressions, conditionals

Level 2: Advanced regular expressions, conditionals

Experiment No 5: creation of makefile , Structure of makefile

Level 1: Simple makefile creation

Level 2: Advanced program on makefile

Experiment No 6: Working with automatic variables, pattern rules , make command

Level 1: Basic pattern rules, make command

Level 2: Advanced pattern rules

Experiment No 7: Building binary from source code

Level 1: basic binary from source code

Level 2: Advanced binary from source code

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

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.

Professionally Used Software: Red hat Linux Operating system, GIT

Besides these software tools Visual studio code also used

Project work/Assignment:

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.

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 .

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.

Text Book(s):

a. Running Linux – Book by Matthias Kalle Dalheimer, Matt Welsh
b. Mastering Linux Shell Scripting – Book by Andrew Mallett .

Reference(s):

Reference Book(s):

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

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

Coursera:

1. DevOps on AWS | Coursera
2. DevOps, Cloud, and Agile Foundations | Coursera
3.Introduction to DevOps | Coursera

E-books :
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":

Simple automation Scripts, Linux commands for **SKILL DEVELOPMENT** through **Experiential Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

[Text Wrapping Break]

Course Code: CSE 3043	**Course Title:** Automated Test Management **Type of Course: Integrated**	**L- P- C**	2	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:** • 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- P- C	3	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. 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 rovement Framework for Agile Requirements Engineering Practices, Journal of Software, Academy lishers, Vol 4, No 5 (2009), 422-435, Jul 2009.

2] Hazza& Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer nce, Springer 2009

3]Kevin C. Desouza, Agile information systems: conceptualization, construction, and nagement, 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.

[Text Wrapping Break]

Course Code: CSE227	**Course Title:** SOFTWARE ENGINEERING AND PROJECT MANAGEMENT **Type of Course:** Theory Only		**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Object Oriented Concepts, Basic programming knowledge, basic understanding of algorithms.					
Anti-requisites	Nil					
Course Description	The objective of this course is to help students understand the process and fundamental principles involved in software system development and software project management. The course covers software process models, software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course also covers project evaluation, planning, effort estimation and risk management aspects in software project planning. **Topics include:** Introduction to Software Engineering, Process Life Cycle Models, Requirement Analysis and Specification, User Interface Analysis and Design, Software Testing, Project Management, Project Planning, Effort Estimation Techniques, Project Scheduling, Project Metrics & Evaluation, Risk Management.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **SOFTWARE ENGINEERING AND PROJECT MANAGEMENT** and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: 1) Describe the software engineering principles, ethics and process models. 2) Identify the requirements and appropriate design models for a given application. 3) Discuss the various types of testing methods and Quality Assurance. 4) Apply project planning, scheduling, evaluation and risk management principles for a given project.					
Course Content:						
Module 1	**Introduction to Software Engineering & Process Models**	Knowledge level	SCRUM Models			**08 Sessions**
Software and Software Engineering: Nature of Software, Software Engineering Practice, Software Myths, SDLC, Software Processes: Generic Model, Prescriptive Process Model, Unified Process Model, Agile Development: Extreme Programming, Iterative Waterfall Model, Classical Waterfall Model						
Module 2	**Software Requirements and Design**	Comprehension level	Use Case Diagram			**09 Sessions**
Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, SRS, Requirements modelling: Developing Use Cases, Developing Activity diagram and Swimlane diagram, Design : Design concepts, Architectural design,, Introduction to Star UML tool						
Module 3	**Software Testing and Quality**	Comprehension level	Software Testing			**08 Sessions**
Introduction to Software Testing: verification and validation, Test Strategies for conventional Software, Validation Testing, White box Testing: Basis path testing, Black box Testing. Software Quality Assurance : Elements of software quality assurance, Software configuration management : SCM process. Introduction to JIRA and Selenium tools						
Module 4	**Software Project Management**	Application	CMM level			**13 Sessions**
Project Management Concepts, Project Planning, Overview of metrics, Estimation for Software projects, Project Scheduling, Risk Management, Maintenance and Reengineering, Introduction to DevOps						
Targeted Application & Tools that can be used: Star UML, Jira						

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, McGraw-Hill, 2018.

References

1. Ian Sommerville, “Software Engineering”, IX Edition, Pearson Education Asia, 2011.
2. Rajib Mall, “Fundamentals of Software Engineering”, VI Edition, PHI learning private limited, 2014.

E-Resources

- Library - Presidency University https://presidencyuniversity.in › library
- Practice UML based modeling using “Software Engineering Virtual Lab” made available by IIT-Kharaghpur (URL – https://vlabs.iitkgp.ernet.in/se/)

Topics relevant to “SKILL DEVELOPMENT”: Software Testing Problems for **Skill Development** through **Problem Solving methodologies**. 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- P- C**	**3**	**0**	**3**
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles. The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course covers software quality, configuration management and maintenance.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Software Engineering** 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 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			**09 Hours**
Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle **Models:** Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.					
Module 2	**Software Requirements, Analysis and Design (Comprehension level)**	Assignment	Development of SRS documents for a given scenario		**11 Hours**
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. **Design:** Design concepts, Architectural design, Component based design, User interface design.					
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 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, McGraw-2017.

2] Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-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.1st 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: CSE3145	**Course Title: Intrusion Detection and Prevention System** **Type of Course:1] Program Core** **2] Theory Only**	**L- P- C**	3	0	3
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: • 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**

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.

Assignment: Applying Intrusion detection in security applications.

Module 3	**Applications and tools**	Assignment	Programming/Data analysis task	**12 Sessions**

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

Assignment: Demonstrate the working with Snort Rules, Rule Headers, Rule Options and The Snort Configuration File.

Module 4	Legal issues and organizations standards	Assignment	Programming/Data analysis task	**9 Sessions**

Law Enforcement / Criminal Prosecutions – Standard of Due Care – Evidentiary Issues, Organizations and Standardizations.

Assignment: Addressing common legal concerns and myths about Intrusion Detection system

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.

References

R1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.

R2. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.

R3. Paul E. Proctor, "The Practical Intrusion Detection Handbook ",Prentice Hall , 2001.

Weblinks:

https://www.youtube.com/watch?v=RYB4cG8G2xo

https://www.coursera.org/lecture/detecting-cyber-attacks/intrusion-detection-systems-UeDqJ

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.

Course Code: CSE2040	**Course Title:** Cyber threats for IOT and Cloud **Type of Course:1] Program Core** **2] Theory Only**	**L- P- C**	3	0	3
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: • 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**	Assignment	Programming/Data	**10 Sessions**

	Internet of Things		analysis task	

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", 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 t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE 3097	Course Title: **Web Security** Type of Course: **Integrated**	L- P- C	2	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:** • 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.

References

R1 B. Sullivan, V. Liu, and M. Howard, “Web Application Security”, A B Guide. New York: McGraw-Hill Education, 2011.

R2 Web Application Security: Exploitation and Countermeasure for Modern Web Applications, by Andrew Hoffman

E book link R1: https://presiuniv.knimbus.com/user#/home

E book link R2 : https://presiuniv.knimbus.com/user#/home

Web resources:

NPTEL / Swayam Link : Introduction to Information Security I, IIT Madras https://nptel.ac.in/courses/106106129

PU Library Link : https://puniversity.informaticsglobal.com/login

Topics relevant to "EMPLOYABILITY SKILLS":
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.

Course Code: CSE2037	**Course Title:** Cyber Forensics **Type of Course:** Program Core	**L- P- C**	2	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 **Cyber Forensics** and attain **Skill Development** through **Experiential Learning** 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**
Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology -Steps taken by computer forensic specialists. 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. Assignment: Computer Crime					
Module 4	**Computer Forensic**	Assignment	Writing task		**No. of**

	Evidence and Data Recovery			Sessions: 09

Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data.
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.
Assignment: Data Recovery

List of Laboratory Tasks:

1. Case Studies of Opensource Forensic Tools
2. FTK Forensic Tool kit for taking mirror image

Disk Forensics-

3. Identify digital evidences
4. Acquire the evidence
5. Authenticate the evidence
6. Preserve the evidence
7. Analyze the evidence
8. Report the findings

Network Forensics:

9. Intrusion detection
10. Logging
11. Correlating intrusion detection and logging

Device Forensics

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

Targeted Application & Tools that can be used:

1. **FTK Forensic Toolkit**
2. **Encase**
3. **Kali Linux- Vinetto, galatta**
4. **Autopsy – Disk Forensics**

Project work/Assignment:

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.

Textbook(s):

1. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2019

References

1. Ravi Kumar & B Jain,2006,” Cyber Forensics - Concepts and Approaches”, icfai university press
2. ChristofPaar, 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: CSE2039	**Course Title:** Ethical Hacking **Type of Course:** Discipline Elective in Cyber Security Basket	**L- P- C**	**2**	**2**	**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**
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					
Module 4	**Target Enumeration and Port Scanning Techniques**	Assignment	Programming activity		**13 Hours**
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					

List of Laboratory Tasks:

Experiments:

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

Targeted Application & Tools that can be used: Application Software and open source tools

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Any appropriate tool can be given to demonstrate i.e Sql injections.

Text Book

1. Rafay Baloch, 2014: "Ethical Hacking and Penetration Testing Guide" Apple Academic Press Inc.

References

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.

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.

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**
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	Assignment	Programming activity	**10 Hours**
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	Assignment	Programming activity	**6 Hours**
Topics: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools (MATLAB wireless module, NS2, etc).				
Targeted Application & Tools that can be used: Case Study: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools -MATLAB wireless module, NS2, etc.				
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/				

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 : 0-13-007617-4Ivan Stojmenovic, Sheng Wen, "The Fog Computing Paradigm: Scenarios andSecurity 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.

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.

Last Modified: 25/05/2022

Course Code: CSE 262	**Course Title: CLIENT SERVER COMPUTING** **Type of Course: Theory Only**		**L-T-P- C**	3	0	0	3
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**		
Topics: 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.						
Module 4	**Client/Server Applications**	Assignment/Quiz2	Categories Of Client/Server	**12 Sessions**		

			Applications, DDE, OLE	

Topics:
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.

Targeted Application & Tools that can be used:
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.

Text Book

T1. Robert Orfali, Dan Harkey and Jerri Edwards: Essential Client/Server Survival Guide, John Wiley &Sons Edition 3 2019

T2. Patrick Smith & Steave Guengerich, "Client/Server Computing". PHI 2011 Edition 2

References

R1. Subhash Chandra Yadav : An Introduction to Client/Server Computing newagepublishers; First edition January 2009

E-Resources
NPTEL course –NPTEL :: Computer Science and Engineering - NOC:Cloud computing**IIT Kharagpur**, Prof. Sowmya Kanti Gosh.

https;//presiuniv.knimbus.com/user#/home

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.

Course Code: CSE240	**Course Title: Information Security** **Type of Course: Open Elective/ Theory Only Course**	**L- P-C**	3	0	3
Version No.	2.0				
Course Pre-requisites	**CSE-236** Principles of Data Communications and Computer Networks				
Anti-requisites	**NIL**				
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 **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:** • 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**	Assignment	Data Collection/Interpretation	**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**	Assignment	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.				
Targeted Application & Tools that can be used: 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.				
Project work/Assignment:				
Project Assignment: 1) Projects for students interested in thisAntivirus, Online Fund Transfers with DES Encryption, Firewall Web Application. Assignment: 1]What do you understand by Risk, Vulnerability & Threat in a network? 2] What are the response codes that can be received from a Web Application? 3] What is the difference between Symmetric and Asymmetric encryption?				
Text Book T1: Information Security: The Complete Reference, Second Edition, 2nd Edition. by Mark Rhodes-Ousley. Released April 2013. Publisher(s): McGraw-Hill. T2: William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson publication, ISBN: 978-93-325-8522-5 T3: Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003				
References R1: Cryptography & Network Security (Sie) 2E. Author, Forouzan. Publisher, McGraw-Hill Education				

(India) Pvt Limited.
R2: Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices. Nina Godbole.
R3: Information Security: Principles and Practices, 2nd Edition. Mark S. Merkow. Jim Breithaupt. 2014, Pearson
R4: Roadmap to Information Security: For IT and Infosec Managers, Michael E. Whitman, Herbert J. Mattord
e study
link:https://www.researchgate.net/publication/320960482_Information_Security_Management_Practices_Case_Studies_from_India
E book link R1:
https://d.cxcore.net/InfoSec/Information%20Security%20The%20Complete%20Reference,%202nd%20Edition/Information%20Security%20The%20Complete%20Reference,%202nd%20Edition.pdf
E book link R2:
https://engineering.futureuniversity.com/BOOKS%20FOR%20IT/Book%20Information%20Security%20Mangement%206th%20ed.pdf
Web resources: https://nptel.ac.in/courses/106106199- **IIT Madra,** Prof. Chester Rebeiro
Web resources: https://nptel.ac.in/courses/106106129 - **IIT Madras**Prof. V. Kamakoti.
ps://presiuniv.knimbus.com/user#/searchresult

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.

Course Code: CSE3034	**Course Title: BIG DATA SECURITY AND PRIVACY** **Type of Course: Elective in Big Data Basket** **Theory**	**L-P-C**	3	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, And Protection	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 DEVELOMENT": 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-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	CSE3032 -Big Data Analytics				
Anti-requisites	**NIL**				
Course Description	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. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills. With good knowledgeof 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.				
Course Objectives	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.				
Course Outcomes	On successful completion of the course the students shall be able to: • **Recognize** the characteristics of data streams that make it usefulto solve real-worldproblems. • **Identify and apply** appropriate algorithms for analyzing the data streams for a variety ofproblems. • **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**	
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					
Module4 7 classes					

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

List of Laboratory Tasks:

1.**Level 1:** Exploring stream processing engine STORM
Level 2: Exploring stream processing engine STREAM

2. Implementation of decision tree algorithms
Level 1: Implementation of VFDT decision tree algorithm
Level 2: Implementation of CVFDT decision tree algorithm

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 ClusteringAlgorithm.

4. Implementation of micro clustering on stream.
Level 1: Implementation of Fractal Clustering algorithmInitialization phase
Level 2: Implementation of Fractal Clustering algorithm Incremental phase

5.**Level 1:** Implementation of The ODAC Global Algorithm.
Level 2: Implementation of The ODAC: The TestSplit Algorithm

6. **Level 1**Implementation of the Apriori algorithm to find frequent itemsets
Level 2: Implementation of the Apriori algorithm to find association rules

7. **Level 1:** Frequent Itemsetsmining of data streams using LossyCounting algorithm
Level 2: Reservoir Sampling for Sequential Pattern Mining overData Streams.

Targeted Application & Tools that can be used:

- **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 AcademicPublishers, 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: CSE 212/2007	Course Title: Analysis of Algorithms Type of Course: THEORY Only	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Introduction to Pseudo code, Knowledge of Recursive and Non Recursive algorithms, Meaning of correctness.					
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. Classify the types of asymptotic notations. 2. Discuss the Brute Force Technique used for solving a problem. 3. Explain divide and conquer technique for searching and sorting problems. 4. Discuss the Dynamic Programming Algorithm used for solving a problem. 5. Discuss the Back tracking technique and limitations of Algorithms.					
Course Content:						
Module 1	**Introduction**	Assignment	Simulation/Data Analysis	**08 Sessions**		
Important Problem types, Asymptotic Notations and its properties, Mathematical analysis for Recursive and Non-recursive algorithms.						
Module 2	**Algorithm design techniques-Brute force**	Assignment	Numerical from E-Resources	**09 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	**08 Sessions**		
Master Theorem, Merge sort, Quick sort, Binary search.						
Module 4	**Dynamic programming and greedy technique**	Term paper/Assignment	Simulation/Data Analysis	**08 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	**06 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

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *"Introduction to Algorithms",* PHI Learning Private Limited.

References

1. AnanyLevitin, *"Introduction to the Design and Analysis of Algorithms",* Pearson Education.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "*Data Structures and Algorithms"*, Pearson.
3. Donald E. Knuth, "*The Art of Computer Programming",* Volumes 1and 3 Pearson.

E-Resources

NPTEL course –

https://onlinecourses.nptel.ac.in/noc19_cs47/preview https://www.coursera.org/learn/analysis-of-algorithms https://puuniversity.informaticsglobal.com
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: CSE3031	**Course Title:** Web Intelligence and Analytics **Type of Course:** Integrated	**L- P- C**	2	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.

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.

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.

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:

Text Book

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.

References

hristopher D. Manning, PrabhakarRaghavan, HinrichSchütze, "An Introduction to Information Retrieval", Cambridge University Press, 2019.

. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.

. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013. R3

b resources:

p://www.coursetalk.com/coursera/web-intelligence-and-big-data Course code Course Title L T

informatics.global,

ps://sm-nitk.vlabs.ac.in/

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: PG COURSE: CSE 2024	**Course Title:NoSQL Databases** **Type of Course:Program Core** **Theory and Laboratory Integrated**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	CSE2074-DBMS				
Anti-requisites	NIL				
Course Description	Introduction to non-relational (NoSQL) data models, such as Key-Value, Document, Column, Graph and Object-Oriented database models. Advantages and disadvantages of the different data architecture patterns will be discussed. Hands-on experience with a representative sample of open-source NoSQL databases will be provided. The rapid and efficient processing of data sets with a focus on performance, reliability, and agility will be covered.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **NoSQL Databases** 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**history, fundamentals,characteristics, and main benefits of NoSQL databases. [Knowledge] 2.**Comprehend**different types of NoSQL databases through case studies. [Comprehension] 3. **Design**different types of NoSQL databases, add content, and try queries on them. [Comprehension]				
Course Content:					
Module 1	NoSQL Database Architectures	Assignment	Knowledge		**No. of Classes:6**
Topics: Transactions: Concurrency and Integration, ACID, NoSQL emergence and its main features, BASE for reliable database transactions, Achieving horizontal scalability with data base sharding, Brewers CAP theorem. Main Data models of NoSQL: Document Data Model, Key-Value Data Model, Columnar Data Model, Graph Data Model.					
Module 2	Document data model	Assignment	Analysis		**No. of Classes:6**
Topics: Characteristics of Document Data Model, Collection, Naming, CRUD Operation, Querying, Indexing, Replication, Sharding, Consistency, Update Consistency, Read Consistency, Relaxing Consistency, Capped Collection.					
Module 3	Document Data Model Hands on: Mongo DB/Casandra	Assignment	Programming (Embedded Lab)		**No. of Classes:7**
Topics:Install, Perform CRUD (create, read, update and delete) Operations, Aggregations, Data Models, Transactions, Indexes, Security, Replication and Sharding.					
Module 4	**Basics of Columnar and Graph Data Models**	Assignment	Comprehend		**No. of Classes:7**
Topics: Columnar Data Model: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking. Graph Data Model: Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank-Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution.					
Learn MongoDB/Casandra by doing the following					

- Master the art of queries, CRUD, schema design, and data aggregation
- Understand scalability using sharding and replication
- Write code, build real-world projects and learn hands-on with Cloud Labs

List of Lab Experiments

Lab Experiments are to be conducted on the following topics
Topic 1: Install MongoDB
Topic 2: Do lab experiment to perform CRUD (create, read, update and delete).
Topic 2: Demonstrate Aggregations in NoSQL with a real-life application.
Topic 3: Demonstrate different aspect of transactions in NoSQL by taking suitable problem.
Topic 5: Show making indexes in NoSQL with a suitable application.
Topic 6: Illustrate security features of NoSQL with a suitable problem.
Topic 6: Explain Sharding concept practically through a suitable example.

Targeted Applications(few are as given below):

1.Content Management systems are pretty common. All the comments on posts on social media are contained in a separate database. In MongoDB, a model has been designed to store such comments and is known as "MetaData and Asset Management".
2.MongoDB is widely used for storing product information and details by finance and e-commerce companies. You can even store the product catalogue of your brand in it.
3. MongoDB can also be used to store and model machine-generated data. For this, you can learn the "Storing Log data" document. This is known as operational intelligence.

List of MongoDB Tools

- MongoDB Compass.
- Mongo Management Studio.
- MongoJS Query Analyzer.
- Nucleon Database Master.
- NoSQLBooster.
- Studio 3T.
- MongoDB Spark Connector.
- MongoDB Charts.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Project Works:

1. Create a database that stores road cars. Cars have a manufacturer, a type. Each car has a maximum performance and a maximum torque value. Do the following: Test Cassandras replication schema and Consistency models.

2. Shopping Mall case study using cassendra, where we have many customers ordering items from the mal land we have suppliers who deliver them their ordered items.

Text Books

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition,2019
   https://bigdata-ir.com/wp-content/uploads/2017/04/NoSQL-Distilled.pdf
2. Bradshaw &Chodorow. *MongoDB: The Definitive Guide: Powerful and Scalable Data Storage*, 3rd ed., O'Reilly, 2019
   https://www.oreilly.com/library/view/mongodb-the-definitive/9781491954454/

References

1. Pivert. *NoSQL Data Models: Trends and Challenges*, 1st ed. Wiley, 2018
   https://www.perlego.com/book/995563/nosql-data-models-trends-and-challenges-pdf

2. Amit Phaltankar, Juned Ahsan, Michael Harrison, LiviuNedov, MongoDB Fundamentals A hands-on guide to using MongoDB and Atlas in the real world: 1st edition, Packt publications, 2020
   https://www.perlego.com/book/2059687/mongodb-fundamentals-a-handson-guide-to-using-mongodb-and-atlas-in-the-real-world-pdf

More than 25% of changes are made from the earlier version. Changesare highlighted in bold.

Topics relevant to "SKILL DEVELOPMENT": Usage of un-structured data for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2011	**Course Title:** Data Communications and Computer Networks **Type of Course:** **Program Core - Theory**	**L- P-C**	3	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 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 networks 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 Operating Systems 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	O7 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:

1. Instant Messaging
2. Telnet
3. File Transfer Protocol
4. Video Conferencing

Project work/Assignment:

Project Assignment:

Assignment 1: Data Flow Directions

Assignment 2: Types of Topology

Textbooks:

T1. James F. Kurose, Keith W. Ross, "*Computer Networking A Top down Approach",* 8th Edition, Pearson, 2021.

T2. Behrouz A. Forouzan, "*Data Communications and Networking*", 6th Edition, Tata McGraw-Hill, 2021.

References:

R1. William Stallings: "*Data and Computer Communication*", 10th Edition, Pearson Education, 2017.

R2. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 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 the assessment component mentioned in the course handout.

Course Code: CSE 3028	**Course Title:Blockchain security and performances** **Type of Course:Program Core** **Theory and Laboratory Integrated**	**L-P-C**	2	2	3
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. *Mastering ethereum: building smart contracts and dapps*. 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. *Securing Blockchain Networks like Ethereum and Hyperledger Fabric: Learn advanced security configurations and design principles to safeguard Blockchain networks*. 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	CourseTitle:Distributed Ledger Technology TypeofCourse:Discipline Elective	L-P-C	2	2	3
Version No.	1.0				
Course Pre-requisites	Foundations of Blockchain Technology				
Anti-requisites	NIL				
CourseDescription	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. 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.				
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	On successful completion of this course the students shall be able to: 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

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

Module 2	Introduction to Hyperledger	Assignment	Writing Task	No. of Sessions: 09

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

Module 3	Designing a Data and Transaction Model	Assignment	Programming Task	No. of Sessions: 10

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.

Module 4	Applications of DLT	Case Study	Discussion	No. of Sessions: 08

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

List of Laboratory Tasks:

1. Level 1: Create a Simple Blockchain in any suitable programming language.
   Level 2: Create a complex Blockchain in any suitable programming language
2. Level 1: Deposit oneEther in your MetaMask accounts.
   Level 2: Deposit 10 Ether in your MetaMask accounts
3. Level 1: Create Single account.
   Level 2: Create multiple accounts and make a transaction between these accounts
4. Level 1: Test any one property of cryptographic hashing
   Level 2: Test all the properties of cryptographic hashing
5. Level 1: Add a transaction to a blockchain
   Level 2: Add multiple transaction to a blockchain
6. Level 1: Create a new file 'WorkingWithVariables.sol' in Solidity
   Level 2: Program to write a solidity program with required variables
7. Level 1: Create a new file 'SendMoney.sol' in solidity
   Level 2: Create new transaction with signing
8. Level 1: Single Error Handling using solidity
   Level 2: Complex exception Handling using solidity
9. Level 1:Use Geth to Implement Private Ethereum Block Chain.
   Level 2: Use Geth to Implement public Ethereum Block Chain.
10. Level 1: Build Hyperledger Fabric Client Application.
    Level 2: Build Hyperledger Fabric Server/network Application.
11. Level 1: Build Hyperledger Fabric with Smart Contract.
    Level 2: Case study on Hyperledger Fabric
12. 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

Targeted Application & Tools that can be used:

Meta mask, Docker and Docker compose, Go Programming language

Project work/Assignment:

Topics:

1. Permissioned Distributed Ledgers
2. Chaincode- Creation and interface

Textbook(s):

T1. Nitin Gaur, Hands-on blockchain with Hyperledger_ Building decentralized applications with Hyperledger Fabric and Composer, Packt,2020.

References

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).

Other Resources

- 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

E-Book Links:

T1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EXc_hRKtg1dOu6GuNvv0MZMBQ_Zo0lpNJyXsJ4IANfcJdQ?e=YAvywC

R1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EUMg4-zAc3dGgl1RWeDDJR8B4SCqMMeO0lIzun51qbDlTw?e=ObRwKr

R2. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EWrs6M9zaYpJhvf9RI2jRaUB9PIJhXmQfZC5vdg284oVlg?e=aD9RgX

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.

Course Code: CSE 3020	**Course Title:** Smart Contract and Solidity **Type of Course:** Integrated	**L- P- C**	2	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 **EMPLOYABILITY** through **Experiential Learning Techniques.**.				
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:** Implementuser-defined operations of arbitrary complexity that are not possible through plain cryptocurrency protocols **C.O 3:** Exhibitbest 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	Fundaments 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
T2Mastering Blockchain Programming with Solidity- Jitendra Chittoda

.

References

R1Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain

R2 Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment- Book by David H. Hoover, Kevin Solorio, and Randall Kanna

ook linkR1:NA

E book link R2: NA

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/

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.

Course Code: CSE3020	**CourseTitle:Blockchain Technology and Applications** **TypeofCourse:ProgramCore**	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Fundamentals of Blockchain Technology				
Anti-requisites	NIL				
CourseDescription	The purpose of the course is to provide an introduction to Blockchain technology with specific focus on industrial applicationslike 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	Onsuccessfulcompletionofthiscoursethestudentsshallbeableto: 1. Understand the concepts of Blockchain technology (Knowledge). 2. Explain the methods for verification and validation of Bitcoin transactions (Comprehension). 3. Explore the use the Ethereum programming (Application). 4. Illustrate the role ofblockchain in various domain (Comprehension).				
CourseContent:					
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 BaaS is adopted in industries.**	**No.of Classes:10**	
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:

- Etherum Remix online& Ganache
- Solidity programming language

Project work/Assignment:

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):

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:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.

Weblinks:

- Udemy: https://www.udemy.com/course/build-your-blockchain-az/
- NPTEL online course : https://nptel.ac.in/courses/106/104/106104220/#

Textbook(s):

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	**CourseTitle: Foundations of Blockchain Technology** **TypeofCourse:ProgramCore& Theory only**	**L-P-C**	3	0	3
Version No.	1.1				
Course Pre-requisites	Networks				
Anti-requisites	NIL				
CourseDescription	The purpose of the course is to provide the fundamental knowledge onBlockchaintechnologyand explore various aspects of Blockchain technology like types of Blockchain, Bitcoin and EthereumBlockchain 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 OutComes	Onsuccessfulcompletionofthiscoursethestudentsshallbeableto: 1. **Understand** the concepts of anemerging blockchain technology(Knowledge). 2. **Infer** the knowledge about consensus protocols (comprehension). 3. **Explore** Bitcoin payment methods(comprehension). 4. **Develop simple** smart contract(comprehension).				
CourseContent:					
Module 1	BlockchainBasics	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**	

Topics:History, Definition, Introduction to Ethereum,Ethereum network,Components of Ethereum ecosystem, Smart contracts.

Case Study: Create a simple smart contract for User identity management using Solidity language and show how to execute.

Targeted Application & Tools that can be used:

- Ethereum Remix
- MetaMask
- Truffle
- Ganache

Textbook

T1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
Weblinks: Mastering Blockchain - Google Books

References

R1. Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015.
R2. Blockchain by Melanie Swa, O'Reilly .

Weblinks:

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

Text book of Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained, 2nd Edition, Packt Publishing Ltd, March 2018.

https://www.google.co.in/books/edition/Mastering_Blockchain/3ZlUDwAAQBAJ?hl=en&gbpv=1

Topics relevant to "SKILL DEVELOPMENT":
Bitcoin and Smart Contracts for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3008	Course Title: Machine Learning Techniques Type of Course: 1] Discipline Elective 2] Laboratory integrated	L- P- C	2	2	3
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 ; Silhoutte coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) **Competitive Learning** - Clustering using Kohenen'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)**

List of Laboratory Tasks:

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.

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

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.

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.

Experiment No.5: Bayesian Learning
Level 1 Given a data set from UCI repository, implement a classification model using the Bayesian algorithm

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.

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

Experiment No. 8: Ensemble Learning
Level 1 : AdaBoost and Gradient Boosting, Stacking

Experiment No. 9: Perceptron Learning
Level 1 : Implement the Perceptron Classifier
Level 2 : – An Image Classifier Using the Sequential API of Keras

Experiment No. 10: Unsupervised Learning

Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhoutte 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++

Experiment No. 11: Density Based Clustering

Level 1 Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.

Experiment No. 12: Outlier Detection

Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor

Targeted Application & Tools that can be used :

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.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

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.

Text Book

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.

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.

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.**

1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining"*,** 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

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.

Course Code: CSE254	**Course Title: Microprocessor and Microcontroller Laboratory** **Type of Course: Laboratory Only**	**L-P-C**	0	2	1
Version No.	2.0				
Course Pre-requisites	**NIL**				
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 and Microcontroller Laboratory** and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques.				
Course Outcome	After successful completion of course, students shall be able to (i) Learn 80x86 instruction sets and gain the knowledge on how assembly language works. (ii) Implement programs written in 80x86 assembly language. (iii) Explore functioning of hardware devices and interfacing them to x86 family. (iv) Implement basic 8051 microcontroller programs.				
Course Content:					

1.	:	Write an Assembly Language Program (ALP) to perform Arithmetic operations like Addition, subtraction, Multiplication and Division on two numbers
2.	:	Write an ALP to add two Binary Coded Decimal (BCD) numbers
3.	:	Write an ALP To move 8-bit contents of array from one memory location to another memory location
4.	:	Write an ALP to find the sum of N consecutive numbers
5.	:	a. Write an ALP to sort N numbers in ascending/descending order using Bubble sort technique b. Write an ALP to print N Fibonacci numbers.
6.	:	Write an ALP to search a key element in a list of numbers using linear search
7.	:	a. Write an ALP to read the current time from the system and display on screen b. Write an ALP to check whether a string is Palindrome or not
8.	:	Write an ALP to search a key element in a list of numbers using binary search
9.	:	Write an ALP to read the current date from the system and display on screen
10	:	Write an ALP to read two strings from the keyboard and check whether they are equal or not.
8255 Interfacing Experiments		
11	:	Design and develop an ALP to drive a Stepper Motor interface and rotate the rotor

		in specified direction (clockwise or anti-clockwise) by N steps
12	:	Design and develop an ALP program using Logic Controller to multiply (X*Y)
8051 Microcontroller Experiments		
13	:	Design and develop 8051 ALP program to store values in registers and swap the contents of Registers
14	:	Design and develop 8051 ALP program to perform arithmetic operations
15	:	Design and develop 8051 ALP program to perform FIBONACCI series
16	:	Design and develop an 8051 ALP to drive a Stepper Motor interface and rotate the rotor in specified direction (clockwise or anti-clockwise) by N steps

Targeted Application & Tools that can be used: **MASM,**

Professionally used software - **KEIL software**

Text Book

1. Douglas V Hall SSSP Rao, “Microprocessor and Interfacing”, 3rd editon, Mc Graw Hill , Higer Education, 2012.
2. Barry B Brey, “ The Intel Microprocessors”, 8th edition, Pearson , 2014.

References

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Danny Causey, “The x86 PC Assembly Language Design and Interfacing”, 5th Edition, Pearson, 2013.
2. Muhammad Ali Mazidi, “Microprocessors and Microcontrollers”, First Impression, Pearson Education.
3. https://nptel.ac.in/courses/108105102
4. https://nptel.ac.in/courses/117104072

Course Code: CSE3016	**Course Title:** CSE3016 Neural Networks and Fuzzy Logic **Type of Course:** Discipline Elective in AI & ML Basket Theory Course	**L-P-C**	3	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**	Assignment	Developing Fuzzy Logic		**10Classes**

	Fuzzy Logic Controller		Controller	

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:

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. "*Neural networks and learning machines*", 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, "*Fuzzy Sets and Fuzzy Logic- Theory and Applications*", 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, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html
2. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374
3. Kumar S., "*Neural Networks - A Classroom Approach*", 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. "*Soft computing and intelligent systems design: theory, tools, and applications*". 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 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.

Course Code: CSE 3005	**Course Title: APPLIED ARTIFICIAL INTELLIGENCE** **Type of Course: Integrated**	**L- P- C**	2	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:** • **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:

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

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. *Artificial intelligence: A Modern Approach*, 4th Edition. Pearson.

References

R1.Elaine Rich, Kevin Knight and Shivashankar B Nair. 2009. *Artificial Intelligence*, 3rd Edition. Tata McGraw-Hill.

ɔok linkT1: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- P-C**	3	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	Assignment	Theory	**No. of Classes:12**

	Network & Selecting Routing Protocols			

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:

1. CISCO Packet Tracer.
2. SDN Open flow

Suggested List of Hands-on Activities self study

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

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

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.

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Course Code: CSE 6001	**Course Title:Deep Learning** **Type of Course:Program Core Theory and Laboratory Integrated**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	• 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, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2017

References

1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 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** **Type of Course: Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	[1] CSE 3001 – Artificial Intelligence and Machine Learning				
Anti-requisites	NIL				
Course Description	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: 1. Programming Assignments 2. Regular Quiz Tests (once a week and once after every module)				
Course Objective	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.				
Course Out Comes	**On successful completion of the course the students shall be able to:** • **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: 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."*Speech and Language Processing*" (3rd edition draft, 2022)
References **1**Chris Manning and HinrichSchutze, "*Foundations of Statistical Natural Language Processing*", 1st Edition, MIT Press. 1999. **2**PawanGoyal, "*Natural Language Processing*". 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: CSE 3014	**Course Title: FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING** **Type of Course: Theory Only Course**	**L- P- C**	3	0	3
Version No.	1.0				
Course Pre-requisites	[1] CSE 3001 – Artificial Intelligence and Machine Learning				
Anti-requisites	NIL				
Course Description	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: 1. Programming Assignments 2. Regular Quiz Tests (once a week and once after every module)				
Course Objective	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.				
Course Out Comes	**On successful completion of the course the students shall be able to:** • **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: 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."*Speech and Language Processing*" (3rd edition draft, 2022)
References **1**Chris Manning and HinrichSchutze, "*Foundations of Statistical Natural Language Processing*", 1st Edition, MIT Press. 1999. **2**PawanGoyal, "*Natural Language Processing*". 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- P- C**	2	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. **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, "*Front-end Fundamentals",* Leanpub, 2015

T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.

References

R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021.

R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017.

R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018.

R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, 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.

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Course Code: CSE391	Course Title: Java Full Stack Development	L- P- C	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	The objective of the course is to familiarize the learners with the concepts of **Java 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:** **Practice the use of Java for full stack development [Application]** **Show web applications using Java EE. [Application]** **Solve simple applications using Java Persistence and Hibernate [Application]** **Apply concepts of Spring to develop a Full Stack application. [Application]** **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 using JPA and Hibernate	Project	Programming	**06 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	**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.

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015

References
1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017. in https://presiuniv.knimbus.com/user#/home
R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."*, Apress, 2015
Weblinks:
https://www.javatpoint.com/java-full-stack
https://nptel.ac.in/courses/106105191

Topics relevant to development of "Employability": Hibernate, Eclipse & Spring for developing Employability Skills 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- P- C**	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, "*Front-end Fundamentals",* Leanpub, 2015
Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer",* APress, 2018

References:

R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020.
Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials",* Packt Publishing, 2016

3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development.";* Wiley; 2014.

Web Reference: /www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_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 367	**Course Title: Data Visualization** **Type of Course: Integrated**	**L- P- C**	1	4	3
Version No.	1.0				
Course Pre-requisites	Fundamental knowledge of data structures, statistics, database concepts and Python.				
Anti-requisites	Nil				
Course Description	This course provides an introduction to turning data into presentable graphics. Data Visualization is important today as the usage of data is growing in many different fields. Data visualization techniques help people to better understand this data. The goal of this course is to introduce students to data visualization including principles, techniques and algorithms, to create effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science. Students will learn the value of visualization, specific techniques in data visualization, grammar of graphics and how to leverage visualization tools.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data visualization** and attain EMPLOYABILITY SKILLS through EXPERIENTIAL LEARNING techniques				
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Understand the visual representation of data (Knowledge). 2. Analyze the one, two and multi-dimensional data for the data visualization process and evaluate the visualization of groups, trees, graphs, clusters, networks and software (Application). 3. Construct the effective model for data visualization by using various techniques (Application).				
Course Content:					
Module 1	**A Conceptual Framework for Data Visualization**	Quiz / Assignment	Data Collection/Interpretation		**L – 2 sessions, P – 4 sessions,**
Topics: Data, information, knowledge, and insight; The transformation of data; Data visualization history; How does visualization help decision-making; Visualization plots.					
Module 2	**Visualization**	Quiz /	Data Collection/Interpretation		**L – 5**

	Techniques for Spatial Data	Assignment		**sessions, Lab – 10 sessions**
Topics: One Dimensional Data; Two-Dimensional Data; Three-Dimensional Data; Dynamic Data; Combining Techniques. **Visualization Techniques for Time-Oriented Data:** Characterizing Time-Oriented Data; Visualizing Time-Oriented Data. **Visualization Techniques for Multivariate Data:** Point-Based Techniques; Line-Based Techniques; Region-Based Techniques; Combinations of Techniques.				
Module 3	**Visualization Techniques for Trees, Graphs and Networks**	Group Project	Case studies / Case let	**L – 2 sessions, Lab – 8 sessions**
Topics: Displaying Hierarchical Structures; Displaying Arbitrary Graphs / Networks, **Text and Document Visualization:** Levels of Text Representations; Vector Space Model; Single Document Visualizations; Document Collection Visualizations; Extended Text Visualizations.				
Module 4	**Visualization Techniques for Geospatial Data**	Group Project	Case studies / Case let	**L – 4 session, Lab – 8 sessions**
Topics: Visualizing Spatial Data; Visualization of Point Data; Visualization of Line Data; Visualization of Area Data. **Interaction Concepts:** Interaction Operators; Interaction Operands and Spaces; A Unified Framework. **Designing Effective Visualizations:** Steps in Designing Visualizations; Problems in Designing Effective Visualizations. **Comparing and Evaluating Visualization Techniques:** User Tasks; User Characteristics; Data Characteristics; Visualization Characteristics; Structures for Evaluating Visualizations; Benchmarking Procedures.				
List of Laboratory Tasks: Introduction to Data Visualization, Introduction to Python Packages (pandas), Visualization Tools, Time Series Data Visualization, Advanced Visualizations, Visualization Techniques for Geospatial Data, Interaction Concepts				
Targeted Application & Tools that can be used:				
Text Book T1: Ward, Matthew O., Georges Grinstein, and Daniel Keim. *Interactive data visualization: foundations, techniques, and applications*. CRC Press, 2010. T2: Madhavan, Samir. *Mastering Python for Data Science*. Packt Publishing Ltd, 2015. T3: Wilkinson, Leland, *The Grammar of Graphics*, Springer-Verlag New York,2015				
References R1: Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019. R2: Tamara Munzner, Visualization Analysis and Design (VAD), CRC press, 2014 R3: Show Me the Numbers: Designing Tables and Graphs to Enlighten, Few, Stephen. 2nd Edition. Analytics Press. R4: Interactive Data Visualization for the Web by Scott Murray 2nd Edition (2017) R5: Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016 R6: Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010. R7: Semiology of Graphics by Jacques Bertin (2010) R8: Sosulski, K. (2018). Data Visualization Made Simple: Insights into Becoming Visual. New York: Routledge. R9: (Information Science and Statistics). Springer-Verlag, Berlin, Heidelberg. **E book link R1:** **https://data.vk.edu.ee/PowerBI/Opikud/Fundamentals_of_Data_Visualization.pdf** **E book link R2:** **https://www.cs.ubc.ca/~tmm/vadbook/**				

E book link R3:
https://courses.washington.edu/info424/2007/readings/Show_Me_the_Numbers_v2.pdf

Web resources:
1. https://www.coursera.org/specializations/data-visualization?utm_source=gg&utm_medium=sem&campaignid=18216928764&adgroupid=141296025752&device=c&keyword=coursera%20website&matchtype=b&network=g&devicemodel=&adpostion=&creativeid=619458216881&hide_mobile_promo=
2. https://www.udemy.com/course/learning-python-for-data-analysis-and-visualization/?gclid=CjwKCAiAvK2bBhB8EiwAZUbP1AMoQv7rzjp8XYIdXw1d5bz2VQs6GvhLcB7z6a3WxnDo_Gwq4NbYlBoCQUgQAvD_BwE&matchtype=b&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_84769191288_._ad_533157478534_._kw_%2Bdata+%2Bvisualization+%2Bcourse_._de_c_._dm__._pl__._ti_kwd-143520005604_._li_9062050_._pd__._
3. https://www.youtube.com/watch?v=iPPGfEA2s2M
4. https://www.youtube.com/watch?v=PSeRjy7y9yE
5. http://www.ifs.tuwien.ac.at/~silvia/wien/vu-infovis/articles/Chapter8_VisualizationTechniquesForTreesGraphsAndNetworks_271-290.pdf
6. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjY-56U5KD7AhUq7TgGHRPxBXYQtwJ6BAgIEAI&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3D1k7sryECatk&usg=AOvVaw2ZyMwaMdBZiF4cH2YqXmYc

Topics relevant to development of "Employablity": Visualization Techniques for Spatial Data, Trees, Graphs, Networks and Geospatial Data 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- P- C**	3	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

W3. GO document: https://go.dev/doc/

Online tool for program execution:

- GO Play Ground - https://go.dev/play/
- Download and install: https://go.dev/doc/install

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.

Course Code: CSE2015	**Course Title:** Data Analysis and Visualization **Type of Course:1] Program core** **2] Lab Integrated Course**	**L- P-C**	**2**	**4**	**4**
Version No.	1.0				
Course Pre-requisites	**Python Programming**				
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 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. The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization. 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.				
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:** 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	**10 Hours**	
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. **Python Libraries**: NumPy, pandas, matplotlib, GGplot,Introduction to pandas Data Structures					
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

1. Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard.
2. Programming: Implementation of the chosen dashboard

Text Book

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)

References

R1. Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.

R2. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020 3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.

R3. García Salvador, LuengoJulián, & Herrera, F. "Data preprocessing in Data Mining", Springer,(2015)

R4. Stephen Few, "Information Dashboard Design: the effective visual communication of data", Oreilly, 2006

R5. Belorkar, A, "Interactive Data Visualization with Python" - [S.l.]: Packt Publishing, Second Edition. (2018)

Web links

R1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/

R2. Google Data Analytics Professional Certificate | Coursera

R3. Learning Python for Data Analysis and Visualization Ver 1 | Udemy

R4. Data Science, Analytics and Visualization (DS) Courses | Chaminade University - PROD [Integrated] Catalog

R5. Data Visualization Training and Certification Courses | Koenig Solutions (koenig-solutions.com)

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.

Decision	**Course Title: Innovation Project-Raspberry Pi Using Python**	**L- P- C**	0	4 This includes few lecture sessions	2
Version No.	0.9				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	In this course the students will learn fundamental concepts of 'Python' and Python for Raspberry Pi through problem solving using Python in a systematic way to read and write the Python code and to implement them on Raspberry Pi prototype board. The course will also demonstrate how to assemble various sensory devices and program them using Raspberry 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 Raspberry Pi projects.				
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques.				
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Develop beginner level python code. [**Application**] 2. Explain the main features of the Raspberry Pi board. [**Comprehension**] 3. Demonstrate the hardware interfacing of the peripherals to Raspberry Pi system. [**Application**] 4. Demonstrate the functioning of live various projects carried out using Raspberry Pi system. [**Application**]				
Course Content:					
Module 1	**Basics of Python**	Quiz	Problem Solving		**4 Sessions**
Topics: Introduction, Getting started with Python, Variables and Literals, Print function, input function, Data Types Type Conversions, Operations on Strings, Arithmetic and logical Operators, Boolean expression, Data sequence, lists, tuples, sets, dictionary. **Concepts will be taught by solving problems through programs.**					
Module 2	**Decision Making and Iterations**	Quiz	Problem Solving		**4 Sessions**
Topics: Conditional coding and Control statements-if, elif, else, while loop, for loop, nested for loop, range function, break and continue, pass. **Concepts will be taught by solving problems through programs.**					
Module 3	**Functions, Files**	Project Development	Problem Solving		**4 Sessions**
Topics: Introduction to functions, syntax, variables scope and lifetime, function parameters and arguments, importing modules. **Concepts will be taught by solving problems through programs.**					
Module 4	**Interaction with**	Project Development	Modeling and Simulation		**3 Sessions**

	API Services		task	

Topics:
Raspberry Pi interact with online API services through the use of public APIs and SDKs using Firebase, Gspread API.
Node-RED – a programming tool for wiring together hardware devices, MQTT.
Android/Case study.

Targeted Application & Tools that can be used:
Making it a reality (Raspberry Pi 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: Raspberry Pi.

Project work/Python Lab Test:

Project work
Python test.

Text Book(s):
Ashok Namdev Kamthane, Amit Ashok Kamthane, "Problem Solving and Python Programming", Mc Graw Hill Education, 2018.

Reference(s):
1. https://github.com/thibmaek/awesome-raspberry-pi
2. **MagPi magazine**

Topics relevant to development of "Skill Development": Basic Concepts of Python-Programming, and Raspberry Pi for Skill Development through Experiential Learning Techniques. This is attained through assessment component mentioned in course handout.

Evaluation:	Review-1-20%, Review-2-25%, Python test-25%, Project Expo-30%

[Text Wrapping Break]

Course Code: **CSE253**	**Course Title: Database Management Systems Lab** **Type of Course: Practical**	**L- T-P- C**	0	0	4	2
Version No.	2.0					
Course Pre-requisites	Basic elements of programming language, set theory, Modular approach, Operating system basics					
Anti-requisites	-					
Course Description	Database management lab is designed to have a real feel of database design using structured query languages, which includes use of various data definition, data manipulation commands, functions, joins, sub-queries, views ,set operations, procedures and triggers.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems Lab and attain **SKILL DEVELOPMENT** through E **EXPERIENTIAL LEARNING** techniques					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply the various data models and ER modeling concepts used in database design. (Application) 2. Demonstrate SQL commands for structured database management. (Application) 3. Develop the solutions for solving database problems through case studies. (Application)					
Course Content:	Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model, constraints, SQL Query Language, insert, delete, and update statements in SQL, Schema change statements (alter, drop),in, Exists, not exists clause, Implement					

	different types of aggregate functions (min, max, sum, count etc.),math functions, commit, rollback, Triggers, Views, Functions, Procedure and cursor.

List of Laboratory Tasks

Draw E-R diagram and convert entities and relationships to relation table for a given scenario. a. Two assignments shall be carried out i.e. consider two different scenarios (eg. bank, college)

2. To study and implement Data Definition Language commands of SQL.
3. To study and implement Data Manipulation Language of SQL.
4. To study and implement SQL data retrieval using SELECT, FROM and WHERE clause.

Perform the following: a. Viewing all databases, creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)

6. To Retrieve Data from Database using different types of special operators.
7. To study and implement aggregating Data using Group by Clause and HAVING clause and sort data using Order By.
8. To study and implement different types of Set Operations.
9. To study and implement different types of Joins in SQL.

Subqueries- With IN clause, With EXISTS and Not Exists clause

To study and implement different types Math Functions

12. To Retrieve Data from a given Database using Nested queries, Correlated queries.
13. To study and implement Views, Triggers in SQL.
14. To study and implement Functions and Procedures.

Write a SQL program using FOR loop to insert ten rows into a database table

16. To design and implement the DDL, DML and Retrieval for the BANK DATABASE.
17. Given the table EMPLOYEE (EmpNo, Name, Salary, Designation, DeptID) write a cursor to select the five highest paid employees from the table

Targeted Application & Tools that can be used:

Data base management applications and Oracle-Mysql

Text Book

Elmasri R and Navathe S B, “Fundamentals of Database System”, Pearson Education.

References

Silberschatz A, Korth H F and Sudarshan S, “Database System Concepts”,McGraw Hill Education.

E-Resources

NPTEL course:

- https://onlinecourses.nptel.ac.in/noc22_cs51/preview
- https://onlinecourses.swayam2.ac.in/cec22_cs08/preview

Topics relevant to “SKILL DEVELOPMENT”: Aggregates, Join, Views and Triggers for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3085	Course Title: Real Time Operating Systems Type of Course : Theory	L- P- C	3	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:** • 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**
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

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

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

Course Code: CSE 3080	Course Title: Quantum Computing Type of Course: Integrated	L- P-C	2	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:** • 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:
   - Quantum Circuits
   - Quantum Gates
   - Quantum Machine Learning Algorithms

Project work/Assignment:

Assignment:

- 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:

- 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 $|01101\rangle$ 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:

- 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”

- 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- P- C	2	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 **EMPLOYBILITY SKILLS** through **EXPERIENTIAL LEARNING** techniques				
Course Outcomes	On successful completion of the course the students shall be able to: CO1: To apply mathematical modeling methods for low-, intermediate- and high-level image processing tasks. CO2: To perform software experiments on computer vision problems and compare their performance with the state of the art. CO3: To gather a basic understanding about the geometric relationships between 2D images and the 3D world.				
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)
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 Smoothening 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:

Text Book

T1 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

T2 Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004.

References

R1. R. Bishop; Pattern Recognition and Machine Learning, Springer,2006

R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Web references:

https://onlinecourses.swayam2.ac.in/cec20_cs08/preview

.

Library reference: https://presiuniv.knimbus.com/user#/home

Topics relevant to development of "Employability": Image Smoothening Filters, Image sharpening filters for developing Employability Skills through Experiential Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3019	**Course Title: Stochastic Decision making** **Type of Course: Theory**	**L- T-P-C**	3	0	0	3
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- P-C	3	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- P- C	2	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 E**xperiential Learning** techniques.				
Course Out Comes	**On successful completion of this course the students shall be able to:** • 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. 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, 3rd,2016. **T2** Software Testing: A Craftsman's Approach, Paul C. Jorgenson, CRC Press, 4th, 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- P- C**	3	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:** • 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 networks • Understand 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 Harderning, 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 network Vulnerability analysis**	Quiz	Theory	**11 Sessions**	
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

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

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- P- C	3	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: **CSE 1003**	**Course Title: Innovation Project-Raspberry Pi Using Python** **Type of Course: School Core & Practical Only.**	**L- P- C**	0	4 This includes few lecture sessions	2
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	The Raspberry Pi is an amazing single board computer (SBC) capable of running Linus and a whole host of applications. Python is a beginner-friendly programming language that is used in schools, web development, scientific research, and in many other industries. This course will enable students in writing own programs with Python to blink lights, respond to button pushes, read sensors, log data on the Raspberry Pi and many more. The course also offers in-depth knowledge of designing, developing, coding and implementing projects using Raspberry Pi.				
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Write a program in Python. 2. Explain the main features of the Raspberry Pi board 3. Demonstrate the hardware interfacing of the peripherals to Raspberry Pi system. 4. Demonstrate the functioning of live various projects carried out using Raspberry Pi system.				
Course Content:					
Module 1	Basics of Python, functions	Quiz	Problem Solving		**4 Lab Sessions**
Topics: Introduction, Structure of Python Program, Data Types and Variables, Input and Output, Operators, Importing libraries, Functions, Development Tool. **Concepts will be taught by solving problems through programs.**					
Module 2	**Python Programming**	Quiz	Problem Solving		**4 Lab Sessions**
Control statements, Lists and Dictionaries, Problem solving using Python. **Concepts will be taught by solving problems through programs.**					
Module 3	**Overview of Raspberry Pi**	Project Development	System Design Task and Analysis		**4 Lab Sessions**
Topics: An exploration of GPIO pins, LED and switch control. Installation of libraries, PuTTY SSH. Raspberry Pi to interface with more complicated sensors and actuators like Pi Camera, servo motor ADS51115 through PIP libraries. Arduino with Raspberry-pi					
Module 4	**Interaction with API Services**	Project Development	Modeling and Simulation task		**3 Lab Sessions**
Topics: Raspberry Pi interact with online API services through the use of public APIs and SDKs using Firebase, Gspread API. Node-RED – a programming tool for wiring together hardware devices, MQTT. Android/Case study.					
Targeted Application & Tools that can be used: Making it a reality (Raspberry Pi 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: Raspberry Pi.**	
Project work/Python Lab Test:	
Project work **Python test.**	
Text Book(s): **1) Ashok Namdev Kamthane, Amit Ashok Kamthane, *"Problem Solving and Python Programming"*, Mc Graw Hill Education, 2018.**	
Reference(s): 1. **https://github.com/thibmaek/awesome-raspberry-pi** 2. MagPi magazine	
Topics relevant to development of "Foundation Skills": Basic Concepts of Python-Programming, and Raspberry Pi. Topics related to development of "Employability Skills": Problem solving, Creative Thinking, Team work, Prototype Development. Topics related to development of "Entrepreneurship": Effective Communication, Strategic Thinking, Creative Thinking.	
Evaluation:	Review-1-20%, Review-2-25%, Python test-25%, Project Expo-30%

Course Code: CSE2029	**Course Title: Web Data Analytics** **Type of Course: Discipline Elective in data Science basket** **Theory & Integrated Laboratory**	**L- P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	Python programming				
Anti-requisites	**NIL**				
Course Description	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. 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.				
Course Objective	**This course is designed to improve the learners' EMPLOYABILITY SKILLS by web analytics and improving business.**				
Course Outcomes	**Upon successful completion of this course the students shall be able to:** 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]** **(2)** Identify key tools and diagnostics associated with Web analytics. **[Application level]** **(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]** **(4). Understand web site data optimization.[Application level].**				
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]

Experiment No. 2:
Level 1:

1. Delivering reports based on collected data

Level 2:

2. Implement the concept of web analytics ecosystem
3. Creation of segmentation in web analytics

Lab Sheet 3[4 practical Sessions]
Level 1:

1. Visualization, acquisition and conversions of web analytics data
2. Performing site search analytics

Level 2:

3. Analyze the web analytic reports and visualizations

Lab Sheet 4[4 practical Sessions]

Experiment No. 4:

Level 1:

1. Performing visual web analytics
2. Assignments and final discussions

Level 2:

3. Web Analytics case studies .

Targeted Application & Tools that can be used: Google analytics

Project work/Assignment:

Web data analytics for website data

Textbook(s):

1.Beasley M, (2013), Practical web analytics for user experience: How analytics can help you understand your users. Newnes, 1st edition, Morgan Kaufmann.

References

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.

Topics related to development of "FOUNDATION": **Web data Analytics, Google analytics reports.**

Topics related to development of "EMPLOYABILITY": performing web data analytics for website data.

Topics related to development of "HUMAN VALUES AND PROFESSIONAL ETHICS": Data collection

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					
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 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:

1. **Cay S Horstmann and Cary Gornell, *"CORE JAVA volume I-Fundamentals"*, Pearson 2016.**

2. **Cay S Horstmann and Cary Gornell, *"CORE JAVA volume II-Advanced Features"*, Pearson 2017.**

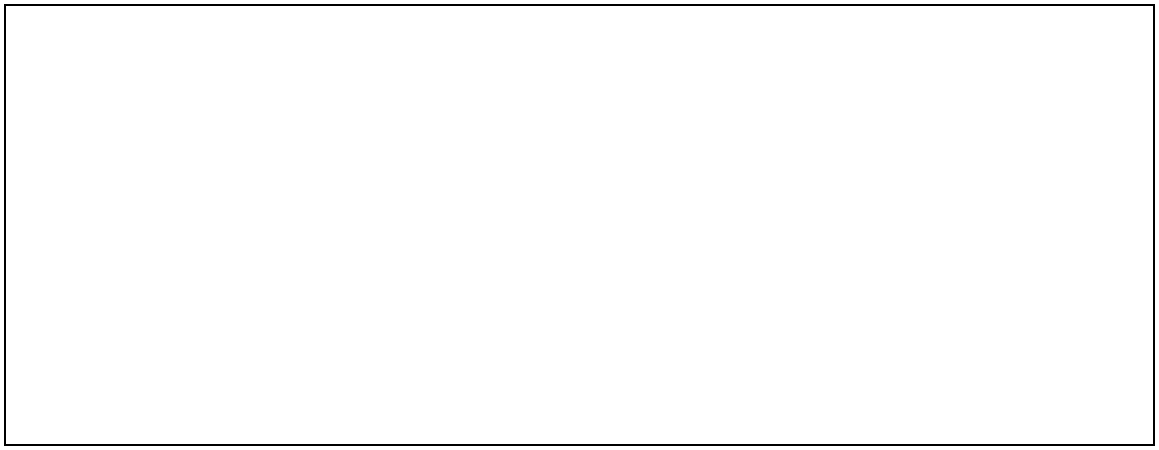
References

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-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,Quiz1						

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: CSE 1004	Course Title: Problem Solving Using C Type of Course: School Core Lab Integrated.	L- T-P-C	1	0	4	3

Version No.	1.0
Course Pre-requisites	**NIL**
Anti-requisites	**NIL**
Course Description	The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.
Course Object	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using C and attain Employability through Problem Solving Methodologies.
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Write algorithms and to draw flowcharts for solving problems 2. Demonstrate knowledge and develop simple applications in C programming constructs 3. Develop and implement applications using arrays and strings 4. Decompose a problem into functions and develop modular reusable code 5. Solve applications in C using structures and Union 6. Design applications using Sequential and Random Access File Processing.
Course Content:	

Module 1	Introduction to C Language	Quiz	Problem Solving	**9 Hrs.**
Topics: Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping.				
Module 2	Introduction to Arrays and Strings	Quiz	Problem Solving	**9 Hrs.**
Topics: **Arrays:** Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. **Strings:** Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions.				
Module 3	Functions and Pointers	Quiz	Problem Solving	**9 Hrs.**
Topics: **Functions:** Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. **Pointers:** Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.				
Module 4	Structures and Union	Quiz	Problem Solving	**9 Hrs.**
Topics: **Structures:** Introduction – Defining a Structure – Declaring Structure Variable – Accessing				

Structure Members – Array of Structures – Arrays within Structures – **Union:** Introduction – Defining and Declaring Union – Difference Between Union and Structure.				
Module 5	File handling	Case Study	Problem Solving	**9 Hrs.**
Topics: Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files				
List of Practical Tasks **Lab Sheet 1 (Module I)** Programs using IO Statements, Conditional Statements and Looping Statements **Lab Sheet 2 (Module II)** Programs using Arrays and Strings **Lab Sheet 3 (Module III)** Programs using Functions and Pointers **Lab Sheet 4 (Module IV)** Programs using Structures and Unions **Lab Sheet 5 (Module V)** Programs using Files				
Text Book(s): 1. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316-513-0. By				
Reference Book(s): 1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020. 2. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016. 3. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015 4. Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014. 5. Stephen G. Kochan, "Programming in C", Addison-Wesley Professional, 4th Edition, 2014.				
Web Links and Video Lectures: 1. https://nptel.ac.in/courses/106/105/106105171/ 2. https://archive.nptel.ac.in/courses/106/104/106104128/				

Course Code: CSE1005	**Course Title:** Programming in Python **Type of Course:** School Core Lab Integrated	**L- T-P- C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	Basic knowledge of Computers and Mathematics					
Anti-requisites	**NIL**					
Course Description	The purpose of this course is to enable the students to develop python scripts using its basic programming features and also to familiarize the Python IDLE and other software's. This course develops analytical skills to enhance the programming abilities. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to build real time applications.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Programming in Python and attain **Employability** through **Problem Solving** Methodologies.					

Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Summarize the basic Concepts of python. 2. Demonstrate proficiency in using data structures. 3. Illustrate user-defined functions and exception handling. 4. Identify the various python libraries.			
Course Content:				
Module 1	Basics of Python programming	Assignment	Programming	**14 Classes**
Topics: Data types, operators and Expressions, Input and Output Statements. Control Structures – Selective and Repetitive structures				
Module 2	Indexed and Associative Data Structures	Simple applications	Programming	**20 Classes**
Topics: Strings, Lists, Sets, Tuples, Dictionaries				
Module 3	Functions, Exception handling and libraries	Case study	Programming	**10 Classes**
Topics: User defined functions, exception handling, Introduction to python built-in libraries				
List of Laboratory Tasks:				

Sl. No.	Experiment Name
1	PROGRAMS ON OPERATORS AND EXPRESSIONS Level - 1 : Basic programs on Operators and Expressions Level - 2 : Develop applications to solve mathematical equations
2	PROGRAMS ON CONTROL STRUCTURES Level - 1 : Basic programs on Control structures Level - 2 : Create applications to solve the real time problems
3	PROGRAMS ON SELECTIVE AND REPETITIVE STRUCTURES Level - 1 : Basic programs on Selective and Repetitive structures Level - 2 : Create applications to solve the real time problems
4	PROGRAMS ON STRINGS Level - 1 : Basic programs on Strings and its manipulation Level - 2 : Develop Real world applications that involves string matching
5	PROGRAMS ON LISTS, TUPLES and SETS Level - 1 : Basic programs on lists, Tuples and Sets Level - 2 : Create applications that involves sequential and Random access of data
6	PROGRAMS ON DICTIONARIES Level - 1 : Basic programs on dictionaries Level - 2 : Create applications that involves structuring of data.
7	PROGRAMS ON FUNCTIONS Level - 1 : Basic programs on Functions Level - 2 : Develop Real world applications using functions
8	PROGRAMS ON EXCEPTION HANDLING Level - 1 : Basic programs on exception handling

	Level - 2 : Develop applications that involves exception handling
9	BASIC PROGRAMS ON BUILT-IN LIBRARIES Level - 1 : Basic programs on python modules Level – 2: Develop applications using python libraries

Targeted Application & Tools that can be used:

Targeted Application : Web application development, AI, Operating systems

Tools: Python IDLE, ANACONDA

- **Application Areas:**
- Web Development
- Game Development
- Scientific and Numeric Applications
- Artificial Intelligence and Machine Learning
- Software Development
- Enterprise-level/Business Applications
- Education programs and training courses
- Language Development
- Operating Systems
- Web Scrapping Applications
- Image Processing and Graphic Design Applications

Professionally Used Software: Python IDLE, Spyder, Jupyter Notebook, Google Colab

Project work/Assignment:

Project Assignment: Developing python scripts using built in methods and functions

Text Books:

- Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education, Forth edition (20 March 2018).
- Alex Campbell, "Python for Beginners: Comprehensive Guide to the Basics of Programming, Machine Learning, Data Science and Analysis with Python", August 29, 2021.
- Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India Edition,2015.

References:

1. E. Balagurusamy, "Introduction to Computing and Problem Solving Using Python", Tata McGraw-Hill, 2016
2. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 2017
3. Brady Ellison, "Python for Beginners: A crash course to learn Python Programming in 1 Week (Programming Languages for Beginners)", August 25, 2021.
4. Python Tutor - Visualize Python, Java, C, C++, JavaScript, TypeScript, and Ruby code execution
5. https://practice.geeksforgeeks.org/courses/Python-Foundation

Topics relevant to development of "FOUNDATIONS SKILLS"- Solve the real time problems by analyzing and visualizing the data.

Topics relevant to "HUMAN VALUES & PROFESSIONAL ETHICS"- Data collection and its arrangement

Course Code: CSE2010_v02	**Course Title: Operating Systems** **Type of Course: Program Core and Theory Only**	**L-T- P- C**	3	0	0	3
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		**11 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		**11 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	**10 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

Course Code: CSE2069	Course Title: Cloud Computing Type of Course: Theory and Lab Integrated	L- T-P- C	2	0	2	3
Version No.	2.0					
Course Pre-requisites	[1] Data Communication and Computer Networks (CSE2011)					
Anti-requisites	NIL					
Course Description	This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.					
Course Objective	The course aims to impart knowledge to students that can provide easy, scalable access to computing resources and IT services. This course is designed to improve the learner's EMPLOYABILITY SKILLS using EXPERIENTIAL LEARNING techniques.					
Course Outcomes	Upon successful completion of the course, the students shall be able to: 1. Comprehend the significance of Cloud computing technologies 2. Describe appropriate Virtualization techniques to virtualize infrastructures 3. Apply Cloud mechanisms to optimize the QoS parameters 4. Interpret recent technologies on Cloud					

Course Content:

Module 1	Introduction to Cloud Services	Assignment	Theory	**No. of Hours:10 (Theory: 6, Lab:4)**
Topics: A Facility for Flexible Computing, The Start of Cloud: The Power Wall and Multiple Cores, From Multiple Cores to Multiple Machines, From Clusters to Web Sites and Load Balancing, Racks of Server Computers, The Economic Motivation for a Centralized Data Center, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, and Cloud Computing Environments.				
Module 2	Virtualization Techniques	Lab-based Assignments	Theory	**No. of Hours:10 (Theory: 6, Lab:4)**
Topics: Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization.				
Module 3	QoS and Management	Application Development	Theory	**No. of Hours:10 (Theory: 6, Lab:4)**
Topics: Quality of Service (QoS) in the Cloud, Cloud Infrastructure Mechanisms, Service Level Agreements (SLAs), Specialized Cloud Mechanisms, Cloud Management Mechanisms, Application development in the Cloud				
Module 4	Security and advancements	Case Study	Case Study	**No. of Hours:10 (Theory: 6, Lab:4)**
Topics: The Zero Trust Security Model, Identity Management, Privileged Access Management, AI Technologies And Their Effect on Security, Protecting Remote Access, Privacy in a Cloud Environment, Application development in Cloud, Latest trends in Cloud Computing, Fog Computing, Dew Computing, Case Studies, and Recent Advancements				

Targeted Applications & Tools that can be used:

Targeted Applications:

Developing applications on Cloud Platforms via Virtual machines

Cloud Tools:

- VMWare
- Amazon EC2
- Google Compute Engine
- Microsoft Azure
- Cloudsim

Project work/Assignment:

1. Automation of performance analysis of students through the Cloud
2. Chatbots development using Cloud resources
3. Blog creation using Cloud computing

Analysis of Case Studies: When deciding to adopt cloud computing architecture, decide if the cloud is right for your requirements (for the application identified).

Suggested List of Hands-on Activities:

Sl. No	Title
1	Install Virtualbox/VMware Workstation with different flavors of Linux or Windows OS on top of windows 11
2	Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.
3	Install Google App Engine (GAE). Create a “hello world” application and other simple web applications using python/java
4	Use GAE launcher to launch the web applications.
5	Simulate a cloud scenario using CloudSim and run a scheduling algorithm
6	Find a procedure to transfer the files from one virtual machine to another virtual machine.
7	Find a procedure to launch a virtual machine using Openstack
8	Demonstrate Migration, Cloning, and Snapshots within and across VMs
9	Demonstrate on the Virtual Environment on hypervisor. a) Communication between the VM’s. b) The backup and restore mechanism.
10	Implement and Evaluate the performance of MapReduce program on word count for different file size.

Text Book(s)

1. Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", Chapman and Hall/CRC; 1st edition, July 2021.

References

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, 2013 edition.
2. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, “Cloud Computing Concepts, Technology & Architecture”, PHI publisher 2013 edition.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill, 2010 edition.
4. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press, 2018 edition.
5. Manvi, Sunilkumar, and Gopal K. Shyam. “Cloud Computing: Concepts and Technologies”. CRC Press, 2021.

Web Resources and Research Articles links:

6. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519

7. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc

8. CloudSim Resources- https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html

9. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer-applications

Course Code: CSE3035	**Course Title: R Programming for Data Science** **Type of Course: Program Core** **Lab Integrated Course**	**L- P- C**	1	4	3
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:

a. create a new variable called `my.num` that contains 6 numbers
b. multiply `my.num` by 4
c. create a second variable called `my.char` that contains 5 character strings
d. combine the two variables `my.num` and `my.char` into a variable called `both`
e. what is the length of `both`?
f. what class is `both`?
g. divide `both` by 3, what happens?

Level 2:

a. create a vector with elements 1 2 3 4 5 6 and call it `x`
b. create another vector with elements 10 20 30 40 50 and call it `y`
c. what happens if you try to add `x` and `y` together? why?
d. append the value 60 onto the vector `y` (hint: you can use the `c()` function)
e. add `x` and `y` together
f. multiply `x` and `y` together. pay attention to how R performs operations on vectors of the same length.

Exp 2.

Level 1:

a. Read in the Youth Tobacco study, Youth_Tobacco_Survey_YTS_Data.csv and name it youth.
b. 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:

a. 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.
b. Write out the mon R object as a CSV file using readr::write_csv and call the file "monuments.csv".
c. Write out the mon R object as an RDS file using readr::write_rds and call it "monuments.rds".

Exp 3:

Level 1:

a. Check to see if you have the mtcars dataset by entering the command mtcars.
b. What class is mtcars?
c. How many observations (rows) and variables (columns) are in the mtcars dataset?
d. Copy mtcars into an object called cars and rename mpg in cars to MPG. Use rename().
e. Convert the column names of cars to all upper case. Use rename_all, and the toupper command (or colnames).
f. Convert the rownames of cars to a column called car using rownames_to_column. Subset the columns from cars that end in "p" and call it pvars using ends_with().
g. Create a subset cars that only contains the columns: wt, qsec, and hp and assign this object to carsSub. What are the dimensions of carsSub? (Use select() and dim().)

Level 2:

a. Convert the column names of carsSub to all upper case. Use rename_all(), and toupper() (or colnames()).
b. Subset the rows of cars that get more than 20 miles per gallon (mpg) of fuel efficiency. How many are there? (Use filter().)
c. Subset the rows that get less than 16 miles per gallon (mpg) of fuel efficiency and have more than 100 horsepower (hp). How many are there? (Use filter().)
d. Create a subset of the cars data that only contains the columns: wt, qsec, and hp for cars with 8 cylinders (cyl) and reassign this object to carsSub. What are the dimensions of this dataset?
e. Re-order the rows of carsSub by weight (wt) in increasing order. (Use arrange().)
f. Create a new variable in carsSub called wt2, which is equal to wt^2, using mutate() and piping %>%.

Exp 4:
Level 1:

a. How many bike lanes are currently in Baltimore? You can assume that each observation/row is a different bike lane.
b. How many (a) feet and (b) miles of total bike lanes are currently in Baltimore? (The `length` variable provides the length in feet.)
c. How many types (`type`) bike lanes are there? Which type (a) occurs the most and (b) has the longest average bike lane length?

Level 2:

a. How many different projects (`project`) do the bike lanes fall into? Which `project` category has the longest average bike lane length?
b. What was the average bike lane length per year that they were installed? (Be sure to first set `dateInstalled` to `NA` if it is equal to zero.)
c. Numerically and graphically describe the distribution of bike lane lengths (`length`).
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`).

Exp 5:

Level 1:

a. Get all the different types of bike lanes from the `type` column. Use `sort(unique())`. Assign this to an object `btypes`. Type `dput(btypes)`.
b. By rearranging vector `btypes` and using `dput`, recode `type` as a factor that has `SIDEPATH` as the first level. Print `head(bike$type)`. Note what you see. Run `table(bike$type)` afterwards and note the order.
c. Make a column called `type2`, which is a factor of the `type` column, with the levels: `c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE")`. Run `table(bike$type2)`, with the options `useNA = "always"`. Note, we do not have to make type a character again before doing this.

Level 2:

a. • Reassign `dateInstalled` into a character using `as.character`. Run `head(bike$dateInstalled)`.
b. Reassign `dateInstalled` as a factor, using the default levels. Run `head(bike$dateInstalled)`.
c. Do not reassign `dateInstalled`, but simply run

`head(as.numeric(bike$dateInstalled))`. We are looking to see what happens when we try to go from factor to numeric.

d. Do not reassign `dateInstalled`, but simply run `head(as.numeric(as.character(bike$dateInstalled)))`. This is how you get a "numeric" value back if they were incorrectly converted to factors.

- Convert `type` back to a character vector. Make a column `type2` (replacing the old one), where if the type is one of these categories `c("CONTRAFLOW", "SHARED BUS BIKE", "SHARROW", "SIGNED ROUTE")` call it `"OTHER"`. Use `%in%` and `ifelse`. Make `type2` a factor with the levels `c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE", "OTHER")`.
- Parse the following dates using the correct `lubridate` functions:
  a. "2014/02-14"
  b. "04/22/14 03:20" assume `mdy`
  c. "4/5/2016 03:2:22" assume `mdy`

Exp 6:

Level 1:

a. Count the number of rows of the bike data and count the number of complete cases of the bike data. Use `sum` and `complete.cases`.

b. Create a data set called namat which is equal to `is.na(bike)`. What is the class of `namat`? Run `rowSums` and `colSums` on `namat`. These represent the number of missing values in the rows and columns of bike. Don't print `rowSums`, but do a table of the `rowSums`.

c. Filter rows of bike that are NOT missing the `route` variable, assign this to the object `have_route`. Do a table of the `subType` variable using table, including the missing `subTypes`. Get the same frequency distribution using `group_by(subType)` and `tally()` or `count()`.

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 is `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 `NA`s. 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`).
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 `logfit_cars` and display the summary table. Use summary or `tidy(logfit_cars, conf.int = TRUE, exponentiate = TRUE)` or `tidy(logfit_cars, conf.int = TRUE, exponentiate = FALSE)` for log odds ratios

Exp 10

Level 1:

- Write a function, sqdif, that does the following:
  a. takes two numbers x and y with default values of 2 and 3.
  b. takes the difference
  c. squares this difference
  d. then returns the final value
  e. checks that x and y are numeric and stops with an error message otherwise

Level 2:

- Try to write a function called top() that takes a matrix or data.frame and a number n, and returns the first n rows and columns, with the default value of n=5.
- Write a function that will calculate a 95% one sample t 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 t interval is $\bar{x} \pm 1.96 * s/\sqrt{n}$.

Exp 11

Level 1:

Simulate a random sample of size $n=100$

- from
  a. a normal distribution with mean 0 and variance 1. (see `rnorm`)
  b. a normal distribution with mean 1 and variance 1. (see `rnorm`)
  c. a uniform distribution over the interval [-2, 2]. (see `runif`)
- Run a simulation experiment to see how the type I error rate behaves for a two sided one sample t-test when the true population follows a Uniform distribution over [-10,10]. Modify the function `t.test.sim` that we wrote to run this simulation by
  - changing our random samples of size `n` to come from a uniform distribution over [-10,10] (see `runif`).
  - performing a two sided t-test instead of a one sided t-test.
  - performing the test at the 0.01 significance level.
  - choosing an appropriate value for the null value in the t-test. Note that the true mean in this case is 0 for a Uniform(-10,10) population. Try this experiment for `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?

Level 2:

- From introductory statistics, we know that the sampling distribution of a sample mean will be approximately normal with mean μ and standard error $\sigma/\sqrt{n}$ 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.
    a. Generate `N=500` samples of size `n=50` from a Uniform[-5,5] distribution.
    b. For each of the `N=500` samples, calculate the sample mean, so that you now have a vector of 500 sample means.
    c. Plot a histogram of these 500 sample means. Does it look normally distributed and centered at 0?
    d. 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.

Text Book

1. Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020

References

1. 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.
2. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet, Springer 2013.

Topics relevant to Development skills
Topics relevant to development of "Employability": Real time application development using R Programming Tools.
Topics relevant to "Human Values & Professional Ethics"

Course Code: CSE3087	Course Title: Applied Machine Learning Type of Course: 1] Program Core 2] Laboratory integrated	L- P-C	2	2	3
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 'EMPLOYABILITY SKILLS' by using EXPERIENTIAL LEARNING 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 ; Silhoutte coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) **Competitive Learning** - Clustering using Kohenen'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)**

List of Laboratory Tasks:

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.

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

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.

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.

Experiment No.5: Bayesian Learning
Level 1 Given a data set from UCI repository, implement a classification model using the Bayesian algorithm

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.

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

Experiment No. 8: Ensemble Learning
Level 1 : AdaBoost and Gradient Boosting, Stacking

Experiment No. 9: Perceptron Learning
Level 1 : Implement the Perceptron Classifier
Level 2 : – An Image Classifier Using the Sequential API of Keras

Experiment No. 10: Unsupervised Learning
Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhoutte 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++
Experiment No. 11: Density Based Clustering
Level 1 Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.
Experiment No. 12: Outlier Detection
Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor

Targeted Application & Tools that can be used :

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.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

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.

Text Book

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.

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.

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.

1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining*", ** 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-P-C	2	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

Lab Experiments are to be conducted on the following topics:-

Lab Sheet 1:

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale._____**(One Lab Session)**
   a) Red Blue and Green and Gray Components _____**(Level 1)**
   b) Display color Image, find its complement and convert to gray scale _____**(Level 1)**
   c) Simulation of an Image (Arithmetic & Logic Operation)._____**(Level 2)**
2. Implementation of Relationships between Pixels._____**(One Lab Session)**
   a. find Neighbour of a given Pixel _____**(Level 1)**
   b. 4 Point Neighbour _____**(Level 1)**
   c. 8 Point Neighbour _____**(Level 2)**
   d. Diagonal Neighbour _____**(Level 2)**

Lab Sheet 2:

3. Implementation of Transformations of an Image._____**(One Lab Session)**
   a. Scaling & Rotation _____**(Level 1)**
   b. Gray level transformations, power law, logarithmic, negative._____**(Level 2)**
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization. **(One Lab Session) (Level 2)**
5. Display of bit planes of an Image. _____**(One Lab Session) (Level 2)**
6. Implementation of Image Intensity slicing technique for image enhancement._**(One Lab Session) (Level 2)**

Lab Sheet 3:

7. Display of FFT (1-D & 2-D) of an image. _____**(One Lab Session) (Level 2)**
8. Computation of mean, Standard Deviation, Correlation coefficient of the given Image. **(One Lab Session) (Level 2)**
9. Implementation of Image Smoothening Filters(Mean, Median and MinMax filtering of an Image) **(One Lab Session) (Level 2)**
10. Implementation of image sharpening filters and Edge Detection using Gradient Filters. **(One Lab Session) (Level 2)**

Lab Sheet 4:

11. Canny edge detection Algorithm._____**(One Lab Session) (Level 2)**
12. Image morphological operations opening closing erosion dilation._____**(Two Lab Sessions) (Level 2)**
13. Image segmentation by region growing split and merge algorithm._____**(Two Lab Sessions) (Level 2)**

Tools/Software Required:

1. OpenCV 4
2. Python 3.7
3. MATLAB

Text Books

1. Rafael C. Gonzalez and Richard E. Woods' "Digital Image Processing", Fourth Edition, Global Edition 2018.

References

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: CSE3155	Course Title: Data Communications and Computer Networks Type of Course: Program Core Theory–Laboratory integrated	L-T-P-C 3-0-2-4	3	0	2	4
Version No.	1.0					
Course Pre-requisites	Digital Design					
Anti-requisites	NIL					
Course Description	The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. . The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course, the students shall be able to: 1] I llustrate the Basic Concepts Of Data Communication and Computer Networks. 2] Analyze the functionalities of the Data Link Layer. 3] Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks. 4] Demonstrate the working principles of the Transport layer and Application Layer.					
Course Content:						

Module 1	Introduction and Physical Layer-CO1	Assignment	Problem Solving	07 Classes

Introduction to Computer Networks and Data communications, Network Components – Topologies, Transmission Media –Reference Models -OSI Model – TCP/IP Suite.
Physical Layer -Analog and Digital Signals – Digital and Analog Signals – Transmission - Multiplexing and Spread Spectrum.

Module 2	Reference Models and Data Link Layer – CO2	Assignment	Problem Solving	**7 Classes**

Data Link Layer - Error Detection and Correction – Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and Wait, ARQ, Sliding Window, Multiple Access Protocols, CSMA/CD,CSMA/CA, IEEE 802.3, IEEE 802.11 Ethernet.

Module 3	Network Layer – CO 3	Assignment	Problem Solving	**10 Classes**
Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods- IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing – RIP-BGP-Link State Routing –OSPF-Multi cast Routing-MOSPF- DVMRP – Broad Cast Routing. EVPN-VXLAN, VPLS, ELAN.				
Module 4	Transport and Application Layer -CO3	Assignment	Problem Solving	**10 Classes**
Transport Layers - Connection management – Flow control – Retransmission, UDP, TCP, congestion control, – Congestion avoidance (DECbit, RED) The Application Layer: Domain Name System (DNS), Domain Name Space, SSH, FTP, Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – – SNMP, Web Services, Virtual Networking.				
List of Laboratory Tasks: Lab sheet -1, M-1, 3 [2 Hours] Experiment No 1: Level 1: Study of basic network commands and network configuration commands. Lab sheet -2, M-1[2 Hours] Experiment No 1: Level 1: Identify and explore Network devices, models and cables. Introduction to Cisco packet tracer. Experiment No. 2: Level 2 – Create various network topologies using a cisco packet tracer. Lab sheet -3, M-2,3 [2 Hours] Experiment No. 1: Level 2 - Basic Configuration of switch/router using Cisco packet tracer. Experiment No. 2: Level 2 -Configure the privilege level password and user authentication in the switch/router. Lab sheet – 4, M-3 [2 Hours] Experiment No. 1: Level 2 - Configure the DHCP server and wireless router and check the connectivity Lab sheet – 5, M-3 [2 Hours] Experiment No. 1: Level 2 - Configure the static routing in the Cisco packet tracer. Experiment No. 2: Level 2 - Configure the dynamic routing protocol in the Cisco packet tracer. Lab sheet – 6, M-4 [2 Hours] Experiment No. 1: Configuration of DNS Server with Recursive & Integrative approach in Cisco packet tracer. Lab sheet – 7, M-4 [2 Hours] Experiment No. 1: Configure the telnet protocol in the router using the Cisco packet tracer. Lab sheet – 8, M-4[2 Hours]				

Experiment No. 1:
Level1- Introduction to NS2 and basic TCL program.
Lab sheet – 9, M-4 [2 Hours]
Experiment No. 1:
Level 1: Simulate three node Point to point network using UDP in NS2.
Experiment No. 2:
Simulate transmission of Ping message using NS2.
Lab sheet – 10, M-4[2 Hours]
Experiment No. 1:
Simulate Ethernet LAN using N-node in NS2.
Experiment No. 2:
Simulate Ethernet LAN using N-node using multiple traffic in NS2
Lab sheet –11, M-3,4 [2 Hours]
Experiment No. 1:
Level 1- Introduction to Wire Shark.
Experiment No. 2:
Level 2- Demonstration of packet analysis using wire shark.

Lab sheet –12, M-1,2,3 [2 Hours]
Experiment No. 1:
Level 2- Demonstration of switch and router configuration using real devices

Targeted Application & Tools that can be used: Cisco Packet Tracer, Wireshark, and NS2.

Case Study/Assignment: Choose and analyze a network from any organization/Assignment proposed for this course in CO1-CO4

1. **Problem Solving: Choose and appropriate devices and implement various network concepts.**
2. **Programming: Simulation of any network using NS2.**

Text Book

1. **Behrouz A. Forouzan, "Data Communications and Networking 5E", 5th Edition, Tata McGraw-Hill, 2017.**
2. **Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022**

References

1. **"Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.**
2. **William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.**
3. **Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.**

E-Resources:

1.https://archive.nptel.ac.in/courses/106/105/106105183/
2. http://www.nptelvideos.com/course.php?id=393
3.https://www.youtube.com/watch?v=3DZLItfbqtQ
4.https://www.youtube.com/watch?v=_fIdQ4yfsfM
5. https://www.digimat.in/keyword/106.html
https://puniversity.informaticsglobal.com/login

Course Code: CSE3156	Course Title: Database Management Systems Type of Course: 1) School Core 2) Laboratory Integrated	L-T-P-C	3	0	2	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve information efficiently. It helps the students to learn and practice data modeling and database designs. The course also introduces the concept of object oriented and object relational databases. The associated laboratory is designed to implement database design using MySQL DATABASE in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Demonstrate a database system using ER model and relational algebra. [Understanding] 2] Build databases using SQL queries query processing. [Applying] 3] Apply the functional dependencies and design the database using normalization. [Applying] 4] Interpret the concept of object-oriented databases and object-relational databases. [Understanding]					
Course Content:						

Module 1	**Introduction to Database Modelling and Relational Algebra (Understanding)**	Assignment	**Problem Solving**	**8 Classes**

Topics:
Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model.
Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.

Module 2	**Fundamentals of SQL and Query Optimization (Applying)**	Assignment	**Programming**	**8 Classes**

Topics: **SQL Database Querying,** DDL, DML, Constraints, Operators, Set Operators, Aggregate Functions, Joins, Views, Procedures, Functions and Triggers. **Database programming issues and techniques:** Embedded SQL, Dynamic SQL; SQL / PSM and NoSQL. **Query Optimization:** Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.				
Module 3	**Relational Database Design & Transaction Management (Applying)**	Assignment	**Problem Solving**	**12 Classes**
Topics: **Relational database design:** Problems in schema design, redundancy and anomalies, Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), Join Dependencies (Fifth Normal Form), lossy and lossless decompositions, Database De-normalization. **Transaction Management:** The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; The write-ahead log protocol; Check pointing; Recovering from a System Crash; Media Recovery; Other approaches and interaction with concurrency control.				
Module 4	**Advanced DBMS Topics (Understanding)**	Assignment	**Case Study**	**8 Classes**
Topics: **Advanced topics:** Object oriented database management systems, Deductive database management systems, Spatial database management systems, Temporal database management systems, Constraint database management systems. **New database applications and architectures** such as Data warehousing, Multimedia, Mobility, NoSQL, Native XML databases (NXD), Document-oriented databases, Statistical databases.				
List of Laboratory Tasks: **Create Employee, Student, Banking and Library databases and populate them with required data. Do the following experiments of different lab sheets on those databases.** **Labsheet-1 [3 Practical Sessions]** **Experiment No 1: [1 Session]** 1. **To study and implement the different language of Structured Query Language.** **Level 1:** Perform operations using Data Definition Language and Data Manipulation Language commands including different variants of SELECT on Student DB. **Level 2:** Identify the given requirements; valid attributes and data types and Perform DDL and DML operations on a given scenario. [Banking Databases] **Experiment No. 2: [2 Sessions]**				

2. **To study and implement the concept of integrity constraints in SQL.**

Level 1: Create tables on Banking database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Student Database.

Level 2: Enforce different types of data and referential integrity constraints. Then try queries with special operators based on the student database. [Banking Database].

Labsheet-2 [3 Practical Sessions]

Experiment No. 3: [1 Session]

3. **Implement complex queries in SQL.**

Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database**.**

Level 2: Implement MySQL DB queries on library database using appropriate clauses and aggregate functions**.** Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4: [2 Session]

4. **To study and implement different types of Set and Join Operations [2 Slots]**

Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Airline Database.

Level 2: Use Set and Join operations to retrieve the data from two or more relations(tables) as per the given scenario. [Airline Database]

Labsheet-3 [2 Practical Sessions]

Experiment No. 5: [2 sessions]

5. **To study and implement Views, and Procedures in MySQL DB.**

Level 1: Implement MySQL Views, and Procedures in ORACLE DB on Employee database.

Level 2: Analyze the requirement and construct views, and Procedures on Mini Project Domain. [Banking Database]

Labsheet-4 [2 Practical Sessions]

Experiment No. 6: [2 Sessions]

6. **To study and implement Functions, and Triggers in MySQL DB.**

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.

Level 2: Analyze the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-5 [2 Practical Sessions]

Experiment No. 7: [2 Sessions]

To implement the concept of forms and reports.

Level 1: Implement the concept of forms and reports.

Level 2: Analyze the schema relationship.

Labsheet-6 [2 Practical Sessions]

Experiment No. 8: [2 Sessions]

Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.

Level 1: Implement the real time database.

Level 2: Analyze the working of database in real time.

Targeted Application & Tools that can be used:

Application Area: Relational database systems for Business, Scientific and Engineering Applications.

Tools/Simulator used: MySQL DB for student practice.

Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

Percentage of changes in this version: 50% of changes from earlier version. New topics are highlighted in italic.

1. Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra.
2. Programming: Implementation of any given scenario using MySQL.

Text Book

1] RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.
2] Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.
3] W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.

References

1] Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.
2] M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.

Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB.
Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications
Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil

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	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. 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. 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
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		On successful completion of this course the students shall be able to: 1. Describe the basic understanding of the AI and concepts of searching for AI problems. (KNOWLEDGE) 2. Develop knowledge base for representing the given real world data using logic and reasoning methods. (Application) 3. Apply concept learning and Artificial Neural Network techniques for the given problems. (Application) 4. Articulate Machine Learning model using Supervised and Unsupervised learning algorithms. (Application) 5. Develop solutions / mini project on real world problems using AIML domain, either individually or as a part of the team and report the results. (Application)
Course Content:		

Module 1	**Introduction to Artificial Intelligence and Searching**	Assignment	Programming Activity	**15 Hours**
	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.			
Module 2	**Knowledge Representation**	Assignment	Programming activity	**15 Hours**
	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 & Neural Network**	Assignment	Programming activity	**15 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. Neural and Belief networks - Perceptron - Multi-layer feed forward networks - Bayesian belief networks, Back propagation algorithm.			
Module 4	**Supervised & Unsupervised Learning**	Mini Project	Programming activity	**15 Hours**
	Topics: Supervised Learning – Classification & Regression - Decision Tree Learning, Random Forest - Support Vector Machines ; Simple Linear Regression Algorithm, Multivariate Regression Algorithm Unsupervised Learning – Clustering & Association - K-Means Clustering algorithm , Mean-shift			

	algorithm , Apriori Algorithm, FP-growth algorithm **List of Laboratory Tasks:** **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 **Lab sheet -2** Introduction to Numpy, Pandas, Scikit-learn and Visualization techniques. Dictionaries, dictionary comprehension , Data Frames using Pandas and working with frames **Lab sheet - 3** **Search Algorithms** – A* & SMA * **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. **Lab sheet -5** Find-S Algorithm Candidate Elimination Algorithm Back Propagation Algorithm **Lab sheet -6** Support Vector Machines ; Simple Linear Regression Algorithm Multivariate Regression Algorithm **Lab sheet -7** K-Means Clustering algorithm Mean-shift algorithm Apriori Algorithm **Mini Project / Case Study –** Real Time Project
	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.
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	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**
	Text Book 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 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: 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	• 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 imge retrieval	**10 Sessions**
Soft computing techniques: Fuzzy-based techniques, Neural network-based techniques ,genetic algorithm-based techniques. **Content-based image retrieval:** 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: • 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' EMPLOYABILITY SKILLS 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**

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.

Targeted Application & Tools that can be used:
MongoDB is to be installed and used.

Project work/Assignment:

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.

Sample Mini Projects:

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.

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.

Textbook(s):

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).**

References

1. **Elmasri R and Navathe S B, "Fundamentals of Database System",7th Edition, 2017(Pearson Publication).**
2. **Pivert. *NoSQL Data Models: Trends and Challenges*, 1st edition(Wiley).**

Topics related to development of “FOUNDATION”:Transaction, CRUD Operations, Replication, and Sharding Topics related to development of “EMPLOYABILITY”: Project implementations in software, batch wise presentations Topics related to development of “HUMAN VALUES AND PROFESSIONAL ETHICS”: Team Dynamics during Mini Project Development.

Course Code: CSE3070	**Course Title:** Advanced Computer Networks	**L- P- C**	3	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: 1. **CISCO Packet Tracer,** 2. **Whireshark**				
Project work/Assignment:				
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: 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 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 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				

Course Code: CSE 3071	Course Title: Computer Vision Type of Course: Program Core Theory and Lab Integrated Course	L- P- C	2	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	On successful completion of the course the students shall be able to: CO1: Apply mathematical modeling methods for low-, intermediate- and high-level image processing tasks. CO2: Perform software experiments on computer vision problems and compare their performance with the state of the art. CO3: Describe the geometric relationships between 2D images and the 3D world.				
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 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 Smoothening 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

Targeted Application & Tools that can be used: Matlab

Project work/Assignment:

Text Book

T1 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

T2 Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004.

References

R1. R. Bishop; Pattern Recognition and Machine Learning, Springer,2006

R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Web references:

https://onlinecourses.swayam2.ac.in/cec20_cs08/preview

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Library reference: https://presiuniv.knimbus.com/user#/home

Topics relevant to development of “Employability”:

Topics relevant to “HUMAN VALUES &PROFESSIONAL ETHICS””:

Course Code: CSE3005	Course Title: Applied Artificial Intelligence Type of Course: Program Core & Theory Only	L- P- C	3	0	3
Version No.	1.0				
Course Pre-requisites	CSE3001: Artificial Intelligence and Machine Learning				
Anti-requisites	Nil				
Course Description	Applied Artificial Intelligence 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 AI techniques, algorithms, and emerging trends that are shaping the future of AI-driven engineering systems. Through theoretical concepts, practical examples, and case studies, students will explore cutting-edge AI methodologies and their application in solving complex engineering problems.				
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. Explain AI techniques and algorithms in engineering domains. [Understand] 2. Solve problems in AI using search methods and constraint satisfaction. [Apply] 3. Apply logic methods for problem-solving using Resolution. [Apply] 4. Describe solutions for problems involving uncertainty in AI. [Apply]				
Course Content:					
Module 1	**Search**	Quiz Tests	Programming Assignment		**L : 12**
Introduction: Solving Problems by Searching. Problem-solving agents. Formulating problems. **Uninformed Search Algorithms:** Breadth-first search. Depth-first search. Uniform cost search. Applications in pathfinding in games. **Heuristic Search Algorithms:** Heuristics. Greedy best-first search. A* search. Difference between Uniform cost search and A* search. **Adversarial Search Algorithms:** Game tree. Minimax algorithm. Alpha-beta pruning. Ideal ordering and worst ordering. Extensions of Minimax algorithm for multiplayer games (MaxN) and stochastic games (Expectimax)					
Module 2	**Knowledge-Based Logic Representation**	Quiz Tests			**L: 12**
Representation, Reasoning, and Logic. Prepositional Logic. First-Order Logic. Syntax and Semantics. Inference Rules. Propositional and First-Order Resolution. Applications for solving story problems using Resolution.					
Module 3	**Constraint Satisfaction Problems**	Quiz Tests	Programming Assignment		**L:7**
Constraints. Definition of a CSP. Examples of Constraint Satisfaction Problems. Arc consistency. Problem structure and problem decomposition. Backtracking. Backtracking heuristics. Local search. Timetable scheduling as a real-world example.					
Module 4	**Uncertainty in AI**	Quiz Tests	Programming Assignments		**L: 7**
Uncertainty in AI. Revision of Probability Basics and Bayes Theorem. Bayesian Networks. Hidden Markov Models. Sub-problems in HMM and their solutions – Forward probability and Viterbi Algorithm. Case study of sequence labeling using HMM for part-of-speech tagging and named entity					

recognition.

Targeted Application & Tools that can be used :

Applications:

Game playing, knowledge representation, solving story problems, timetable scheduling, sequence labeling in NLP.

Tools:

1. Google Colab
2. IDEs (in case they are solving them using C/C++ or Java) like Visual Studio, Netbeans, Eclipse, etc.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1. Students will be given programming assignments to implement AI algorithms
2. 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.
3. Students are also recommended to watch NPTEL videos, register for corresponding NPTEL courses, etc.

Text Book

1. Stuart J. Russell and Peter Norvig, "Artificial intelligence: A Modern Approach", 4th edition, 2022. Pearson Education.
2. Lavika Goel, "Artificial Intelligence: Concepts and Applications", 1st Edition. 2021.Wiley.

References

1. Deepak Khemani, "A First Course in Artificial Intelligence", First Edition Sixth Reprint (2018). Tata McGraw Hill.

NPTEL Courses (and other video links):

1. Mausam (IIT Delhi), "An Introduction to Artificial Intelligence". – Link: https://nptel.ac.in/courses/106102220. Useful for the full course.
2. Deepak Khemani (IIT Madras), "Artificial Intelligence: Search Methods for Problem-Solving". – Link: https://nptel.ac.in/courses/106106226. Useful for Module 1.
3. Deepak Khemani (IIT Madras), "Artificial Intelligence: Knowledge Representation and Reasoning". – Link: https://nptel.ac.in/courses/106106140. Useful for Module 2.
4. Deepak Khemani (IIT Madras), "AI: Constraint Satisfaction" – Link: https://nptel.ac.in/courses/106106158. Useful for Module 3.
5. IJCAI 2020 Talk by Eugene Freuder. Link: https://ijcai20.org/excellence-research-award-session/. This will serve as a motivation for the Module 3.

Course Code: CSE3009	**Course Title:** Optimization Techniques for Machine Learning **Type of Course:** Program Core& Theory Only	**L-P-C**	3	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 preferrable.				
Anti-requisites	**NIL**				
Course Description	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). 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).				
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 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]				
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**

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.

Targeted Application & Tools that can be used:

Google Colab

Project work/Assignment:

Creating a classification system using Machine Learning methods (Stochastic Gradient Descent, Naïve bayes Classifier, etc.) using standard datasets like Iris Recognition Dataset etc.

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.

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.

http://192.168.1.10/cgi-bin/koha/opac-detail.pl?biblionumber=11708&query_desc=ti%2Cwrdl%3A%20MACHINE%20LEARNING

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

Course Code: CSE3011	Course Title: Reinforcement Learning Type of Course: 1] Program Core 2] Laboratory integrated	L- P- C	2	2	3
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:

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 :

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

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

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- P- C**	2	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:** • 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:

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:

- HealthCare Industries.
- Manufacturing Industries.
- Cyber Security.
- Smart Intelligent systems.

Tools:

- Python
- R
- MATLAB
- XLSTAT
- Tableau
- Qlik Sense

Project work/Assignment:

Assignment:

- 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

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

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

T3 John Wiley & Sons , Time Series Analysis And Forecasting By Example ,Technical University

Of
Denmark, 2021.
https://b-ok.cc/book/1183901/9be7ed

References

R1 Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).

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.

R3 Time Series Analysis by James D Hamilton Copyright © 2020 by prince town university press.

E book link R1: https://b-ok.cc/book/2802612/149485

E book link R2: https://b-ok.cc/book/3704316/872fbf

E book link R3: https://b-ok.cc/book/3685042/275c71

Web resources:

1. https://www.coursera.org/learn/practical-time-series-analysis
2. https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/
3. https://swayam.gov.in/nd1_noc19_mg46/preview

Topics relevant to development of "Skill Development":

1. Systematic variation in time series data
2. Autoregressive Models
3. Exponential smoothing models or esms
4. Generating forecasts on time series

Topics relevant to development of "Employability Skills"

1. Time series analysis to Monitor and access water resources.
2. Remote Sensing time series analysis for Crop Monitoring.
3. Satellite Image Time series Analysis.
4. Waste Monitoring and Analysis.

Course Code: CSE3017	**Course Title: Autonomous Navigation and Vehicles** **Type of Course : Theory**	**L- P- C**	3	0	3
Version No.	1.1				
Course Pre-requisites	• Real-time embedded programming • Optimal estimation and control • Linear algebra				
Anti-requisites	NIL				
Course Description	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. **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
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 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**
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	**8 Sessions**
Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Sterio, 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 2nd 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- P- C**	3	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: CSE3019	**Course Title:** Stochastic Decision Making **Type of Course: Program Core& Theory Only**	**L- P- C**	3	0	3
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**
Dynamic Programming - Decision Trees - Deterministic Decision Trees , Stochastic Decision Trees scenario tree , Stochastic Dynamic Programming, Markowitz' model Comparing the Deterministic and Stochastic Objective values. **Recourse Problems** - Outline of Structure - Knowledge Engineering - The Electronic Circuits Domain - General Ontology - The Grocery Shopping World. **Problem Reduction:** Finding a Frame, Removing Unnecessary Columns, Removing Unnecessary Rows, Reducing the Complexity of Feasibility Tests				
Module 3	**Detection and decisions**	Assignment /Quiz	Researching and reviewing academic papers or industry publications on specific AI applications	**L:10**
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 **Hypothesis testing** : Sufficient statistics with M ≥ 2 hypotheses, More general minimum-cost tests, Binary hypotheses with IID observations, **Feasibility in Networks:** The un-capacitated case, Generating Relatively Complete Recourse, An Investment Example				
Module 4	**Project Estimation and Scheduling**	Assignment	Students may work with real or simulated datasets and be asked to explore	**L: 10**

			and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.	

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
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,

Targeted Application & Tools that can be used:
Applications: Object detection, image classification, Sentiment analysis, language translation, Speech recognition, speaker identification, emotion recognition, Personalized product recommendations etc.
Tools: OpenCV, TensorFlow, PyTorch, NLTK (Natural Language Toolkit), OpenAI Gym

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. Peter Kall, Stein W. Wallace, "Stochastic Programming," Springer 2020
2. Robert G. Gallager, "Stochastic Processes Theory for Applications", Cambridge University Press 2019

References

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- P- C**	**3**	**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:** 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				
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

1. 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

References

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

R2. Jose, J. and Lal, S.P. :Introduction to Computing & problem solving with Python, Khanna Book Publishing First edition 2019

R3. B. Mt Wan " Data Analytics using Python ", 9th Edition, published by Pearson Education 2020.

R4. Ramesh Sharda "Business Intelligence Analytics And Data Science A Managerial Perspective" 4Th Edition , Pearson India, April 2019.

Web links

R1. http://owl.english.purdue.edu/owl/resource/560/01/

R2. http://myregisapp.regis.edu/Citrix/StoreWeb/

R3. https://in.coursera.org/courses?query=business%20intelligence

R4. https://www.coursera.org/learn/business-intelligence-data-analytics

R5. https://www.udemy.com/course/business-intelligence-and-data-analytics/

Topics relevant to development of "Employability": Business Intelligence, Big Data Analytics, Data Scientist.

Course Code: CSE3103	Course Title: Cognitive Science & Analytics Type of Course : Theory	L- P- C	3	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, *Depolarization of the neuron,* **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 AN D TOO LS : 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 l Publishers 3rd Edition, Cambridge University Press,2020 **T2:** Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, COGNITIVE SCIENCE Publishers 3rd Edition, Cambridge University Press,2020
References R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 2nd Edition, 2019 R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 12n Edition, 2020 R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 2nd 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-P-C**	3	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**	
Introduction to Expert Systems, Architecture of expert system, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems. Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems.					
Module 3	Building an expert systems	Assignment	Programming	**16 Sessions**	

Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process.
Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development.

Targeted Application & Tools that can be used:

AI related tools and knowledge based tools for expert system.

Project work/Assignment:

Assignment 1:Task on FuzzyCLIPS.
Assignment 2: Back-propagation algorithm for training Neural Networks (NN)

Text Book

T1.Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi.
T2. Introduction to Expert Systems, Jackson P. , 3rd edition, Addison Wesley, ISBN 0-201-87686-8
T2.Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman

References

R1. Stuart Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice-Hall,
R2.Patrick Henry Winston, "Artificial Intelligence", Addison Wesley,
R3.Patterson, Artificial Intelligence & Expert System, Prentice Hall India,1999.
R4.Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley,
R5.Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman &Allanheld, New Jersey

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Weblinks:

https://onlinelibrary.wiley.com/journal/14680394
https://www.youtube.com/watch?v=11nzrNkn9D8

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

Course Code: CSE3072	Course Title: **Wireless Sensor Networks**	L- P- C	3	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:** • 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
3: https://networksimulationtools.com/glomosim-simulator-projects/
R4 : http://vlabs.iitkgp.ac.in/ant/8/
Case study
link:https://www.academia.edu/33109763/A_Case_Study_on_Mobile_Adhoc_Network_Security_for_Hostile_Environment
E book link : http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w03.pdf
E book link : https://referenceglobe.com/CollegeLibrary/library_books/20180301073312adhoc2-ilovepdf-compressed.pdf
Web resources: https://archive.nptel.ac.in/courses/106/105/106105160/- **IIT KGP,** Prof. SUDIP MISHRA
Web resources: https://www.digimat.in/nptel/courses/video/106105160/L22.html - **IIT KGP,** Prof. SUDIP MISHRA

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.

Course Code: CSE3073	**Course Title:** Game design and Development **Type of Course:** Program Core	**L-P-C**	2	2	3
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. 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. 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: CSE3083	**Course Title: Advanced Computer Architecture** **Type of Course: Discipline Elective**	**L- P- C**	3	0	3
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	On successful completion of the course the students shall be able to: 1] Discuss the concept of parallelism, virtualization, and memory optimization. 2] Interpret the practices to explore Instruction level parallelism with pipe lining and reducing the cost & hazards using dynamic scheduling. 3] Explain the intuition behind multiprocessing & thread level parallelism using shared, distributed and directory-based memory models for synchronization and consistency. 4] Discuss internal architecture of SIMD systems like Vector processors and GPUs.				
Course Content:					

Module 1	Flynn's classification and Memory Hierarchy	Assignment	Data Analysis task	**10 Classes**

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.

Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8.

Module 2	Instruction Level Parallelism	Assignment	Analysis, Data Collection	**9 Classes**

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.
Case Study: Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8.

Module 3	Thread Level Parallelism	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 Level Parallelism	Assignment	Analysis, Data Collection	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:

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

Project work/Assignment:

Case Study:

- Memory Hierarchies in Intel Core i7 and ARM Cortex-A8
- Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8

Term Assignments:

- **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", 6th Edition, Morgan Kauffmann Publishers, November 2021.

References

1. J.P. Shen and M.H. Lipasti, "Modern Processor Design: Fundamentals of Superscalar Processors", 2nd Edition paperback imprint, McGraw-Hill Higher Education, 2013.
2. D.B. Kirk and W.W. Hwu, "Programming Massively Parallel Processors", 3rd 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- P- C	3	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:** • 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 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

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: CSE3089	Course Title: Software Architecture Type of Course: Theory Only	L-T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Software Engineering and Object-oriented Analysis and design					
Anti-requisites	NIL					
Course Description	This course deals with basic concepts and principles regarding software architecture and software design. It starts with discussion on importance of Architectures, design issues, followed by coverage on design patterns. It then gives an overview of architectural structures and styles. Practical approaches and methods for creating and analysing software architecture is presented. The emphasis is on the interaction between quality attributes and software architecture. Students will also gain experience with examples in design pattern application and case studies in software architecture.					
Course Objective	**This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PARTICIPATIVE LEARNING techniques**					
Course Out Comes	**COURSE OUTCOMES: On successful completion of the course the students shall be able to:** CO1. Describe the importance of software architecture in large-scale software systems. CO2.Understand the major software architectural-styles, design-patterns, and frameworks. CO3.Distinguish the quality attributes of a System Architecture. CO4.Identify the appropriate architectural pattern(s) for a given scenario					
Course Content:						
Module 1	Introduction	Quiz	Introduction on S/W A	**08 Sessions**		
Topics: The Architecture Business Cycle: Software processes and the architecture business cycle; What makes a “good” architecture. Influence of software architecture on organization-both business and technical, Architectural patterns, reference models and reference architectures; Architectural structures and views.						
Module 2	Architectural Styles and Case Studies	Quiz	Design	**07 Sessions**		
Topics: Architectural styles; Four Architectural Designs for the KWIC System; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Service oriented architecture, Hypertext style, Repositories; Interpreters; Heterogeneous architectures. Case Studies: Keyword in Context, Mobile Robot system.						
Module 3	Quality: Functionality and architecture	Quiz	Quality Attributes	**09 Sessions**		
Topics: Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Business qualities; Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics, Security tactics. Quality Model, Application of The Customized Quality Model to a Case Study						
Module 4	Architectural patterns and styles	Seminar	Architectural styles	**17 Sessions**		
Topics: Architectural Patterns: Introduction; From Mud to Structure: Layers, Pipes and Filters, Blackboard, Distributed Systems: Broker. Design Patterns: Structural decomposition: Whole – Part; Organization of work: Master – Slave; Model View Controller and Reflection patterns. Introduction to Service Oriented Architecture,Three Types of Service-Oriented Architecture						
Targeted Application & Tools that can be used: Multiple integrations with other major architecture software (ArchX, Archisoft, Build software, Astena, Bouwsoft, Teamleader, Total Synergy, etc.) and export opportunities with google drive, dropbox, and CSV formats allow this tool to be widely and comfortably used in the industry. **Professionally used software–**Slack**,** Google calendar**,** outlook email**, and others.**						
Quiz and Seminar						

Quiz on topics from the module 1,2 and 3. Seminar topics will be given to students to present in the class

Text Book

1. T1.Software Architecture in Practice–LenBass,PaulClements,RickKazman,2ndEdition,Pearson Education, 2019.
T2.Pattern-OrientedSoftwareArchitecture,ASystemofPatterns-Volume1–FrankBuschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, John Wiley and Sons, 2019.
T3.MaryShawandDavidGarlan:SoftwareArchitecture-PerspectivesonanEmergingDiscipline, Prentice-Hall of India, 2007.

References

R1.DesignPatterns-ElementsofReusableObject-OrientedSoftware–E.Gamma,R.Helm,R.Johnson,J. Vlissides:, Addison- Wesley, 1995.

E-Resources

W1. WebsiteforPatterns:http://www.hillside.net/patterns/

Topics relevant to the development of SKILLS:

CasestudyonArchitecturalstyles
ModelViewPresenter(MVP) Architecture

Course Code: CSE 2028	Course Title: Statistical Foundation of Data Science Type of Course: Integrated	L- P- C	2	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 **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. 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 Machin					
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.

List of Laboratory Tasks:

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

Experiment No. 2: Working with Pandas data frames

Level 1: Descriptive Statistics, Basic statistical functions

Level 2: Statistical functions, Aggregations

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

Experiment No. 4: Develop python program for Frequency distributions

Level 1: student dataset , pollution dataset

Level 2: stack market dataset

Experiment No. 5: Develop python program for Variability

Level 1: Statistical values

Level 2: Probability Distributions and Pipes

Experiment No. 6: Develop python program for Normal Curves

Experiment No. 7: Develop python program for Correlation and scatter plots

Experiment No. 8: Develop python program for Correlation coefficient

Experiment No. 9 : Develop python program for Simple Linear Regression

Experiment No. 10 : Apply and explore various plotting functions on UCI data sets, Normal curves, Density and contour plots, Correlation and scatter plots

Targeted Applications & Tools that can be used:

- Data Analysis
- Data classification
- Data Exploration
- Data Clustering

Tools:

Python with statistical packages

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.
- A scenario will be given to the students to be developed as a series of Program/ Application.
- On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using python.

Text Book

T1 Fan, Jianqing, Runze Li, Cun-Hui Zhang, and Hui Zou. *Statistical foundations of data science*. CRC press, 2020.

T2 Alan Agresti, Maria Kateri "Foundations of Statistics for Data Scientists With R and Python" 2021

References

Books

R1. James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An Introduction to Statistical Learning with Applications in R* . Springer, New York.

R2. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

R3. Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

E book link

1.W. N. Venables, D. M. Smith and the R Core Team,
https://www.ebooksdirectory.com/details.php?ebook=1791

Web link:

1. **https://www.udemy.com/course/statistics-for-data-science-and-business-analysis(Udemy)**
2. **https://www.coursera.org/learn/foundations-of-data-science(Coursera)**

Topics relevant to the development of "Foundation Skills":

- Data Exploration using Python and R Programming.

Topics relevant to the development of "Employability Skills":

Statistical Data Analysis and exploration using Python and R Programming.

Course Code: UG COURSE: CSE3013	Course Title: Machine Vision Type of Course: Discipline elective Theory with embedded lab	L-P-C	2	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	**On successful completion of the course the students shall be able to:** 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	Assignment	Practical	No. of	

	Preprocessing			Classes:14

Image formation and acquisition methods, Image enhancement techniques, Noise reduction and image denoising.

Image Segmentation and Feature Extraction: Thresholding techniques

- 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

- Industrial machine vision systems
- Robotics and autonomous systems
- Medical imaging and healthcare applications
- Surveillance and security systems
- Augmented reality and virtual reality applications

Lab Experiments are to be conducted on the following topics:-

Lab Sheet 1:

1. Image Loading and Display:
   - Load an image from a file using the `imread` function.
   - Display the loaded image using the `imshow` function.._____**(One Lab Session)**
2. Image Arithmetic Operations:
   - Perform addition, subtraction, and multiplication of images using basic arithmetic operations.
   - Display the results of each operation using the `imshow` function ._____**(One Lab Session)**

3. Implementation of Transformations of an Image._____**(One Lab Session)**
   a. Scaling & Rotation
   b. Gray level transformations, power law, logarithmic, negative.
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.___**(One Lab Session)**

Lab Sheet 2:

5. Edge Detection:
   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)**
6. Image Restoration:
   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)**
7. Image Segmentation:
   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)**

Lab Sheet 3:

8. Feature Extraction:

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)**

Lab Sheet 4: (Group Project)

9. Object Detection and Recognition:
   - o Haar cascade object detection (e.g., face detection or object detection using pre-trained classifiers).
   - o Feature-based object detection using techniques like Speeded-Up Robust Features (SURF) or Scale-Invariant Feature Transform (SIFT).
   - o Deep learning-based object detection using Convolutional Neural Networks (CNNs) or You Only Look Once (YOLO) algorithm.
10. Optical Character Recognition (OCR):
    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).
11. Gesture Recognition:
    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 :

1. OpenCV 4
2. Python 3.7
3. MATLAB

Text Books

1. "Machine Vision: Theory, Algorithms, Practicalities" by E.R. Davies 4th edition 2005

References

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: CSE 3038	**Course Title: Applied Data Science** **Type of Course: Program Core** **Theory and Laboratory Integrated**	**L-P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	knowledge of statistics and Machine learning				
Anti-	-				

requisites	
Course Description	This course introduces the core concepts of Data Science followed by programming using R. This course has the theory and lab component which emphasizes on understanding and programming right from Basics to Visualization, and analysis in R. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.
Course Objectives	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. Discuss the process involved in Data Science (Knowledge) 2. Apply suitable models using machine learning techniques and analyze their performance (Application) 3. Analyze the performance of the model and the quality of the results (Application) 4. Demonstrate the different methodologies and evaluation strategies to real-world problems (Application)
Course Content:	

Module 1	Introduction to Data Science	Assignment	Case Studies	**10 Sessions**

Data Science: Basics – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework
Data Preprocessing - Data Quality Assessment, Feature Aggregation, Feature Sampling, Dimensionality Reduction, Feature Encoding.
Concept Learning: Formulation of Hypothesis – Probabilistic Approximately Correct Learning - VC Dimension – Hypothesis elimination – Candidate Elimination Algorithm

Module 2	PREPARING MODEL USING R	Assignment	Programming	**10 Sessions**

Topics:
Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering

Module 3	**Performance Evaluation**	Assignment	Programming	**8 Sessions**

Model Evaluation Techniques: Hold out, cross-validation - Prediction Errors: Type I, Type II - Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, F1 score – Sensitivity – Specificity – AUC

Module 4	**Applications of Data Science**	**Case Study**	Programming	**8 Sessions**

Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation.

List of Laboratory Tasks:
Experiment No 1: Create an array and perform the following operations on it
Level 1: Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing,
Level 2: Sorting, Swapping, and Dealing with Missing Values
Experiment No. 2: Create an R Data frame and perform the following operations on it

Level 1: Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Dealing with Missing Data

Level 2: Statistical functions, Window functions, Aggregations

Experiment No. 3: Create an R Data frame and perform the following operations on it

Level 1: Group by Operations, Merging/Joining, Concatenation,

Level 2: Time Series, Categorical Data, and Text Data

Experiment No. 4: Using R graphics perform the following

Level 1: Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots,

Level 2: 3D Pie Charts, 3D Scatter Plot, GG Plot

Experiment No. 5: Using R Statistics perform the following

Level 1: Max & Min, Mean Median Mode, Subgroup Analyses,

Level 2: Probability Distributions and Pipes

Experiment No. 6: House rent prediction using linear regression

Experiment No. 7: Analysis of tweet and retweet data to identify the spread of fake news

Experiment No. 8: Perform analysis of power consumption data to suggest minimizing the usage

Experiment No. 9 : Agricultural data analysis for yield prediction and crop selection on Indian terrain data set

Experiment No. 10 : Behavioural analysis of customers for any online purchase model

Targeted Applications & Tools that can be used:

- Data Exploration
- Data classification
- Data Analysis

Tools:

- R Studio

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.
- A scenario will be given to the students to be developed as a series of Program/ Application.
- On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using R.

Text Book

1. The Essentials of Data Science, Knowledge Discovery Using R, Graham J Williams, CRC Press, 2017
2. HadleyWickhmen, Garrette Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data, OReilly, 2017
3. Build A Career in Data Science**, March 2020,** by Emily Robinson, Jacqueline Nolis

References

Books

1. R for Data Science by Hadley Wickham & Garrett Grolemund, Reference, 2017
2. Practical Data Science CookBook, APRESS Publications, 2018

Web Links:

1. https://www.coursera.org/learn/introducton-r-programming-data-science (Coursera)
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_1773 (E-Library Resource)
3. https://onlinecourses.nptel.ac.in/noc22_cs32/preview (NPTEL)

Topics relevant to the development of "Foundation Skills":

- Data Exploration R Programming.

Topics relevant to the development of "Employability Skills":

- Data Analysis and Visualization using R Programming.

Course Code: CSE3076	**Course Title:** Artificial Intelligence for Robotics **Type of Course:** Theory Only Course	**L- P-C**	3	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- P-C**	3	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' EMPLOYABILITY SKILLS by using EXPERIENTIAL 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 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 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill Education, July 2021. 2. Roland L Krutz and Russell Dean Vines, "*Cloud Security - A Comprehensive Guide to Secure Cloud Computing*", Wiley Publishing, Inc. 2019.					

References

1. Sushil Jajodia, Krishna Kant, Pierangela Samarati, Anoop Singhal, Vipin Swarup, Cliff Wang, "*Secure Cloud Computing*", Springer, ISBN 978-1-4614-9278-8 (eBook).
2. John Rittinghouse and James Ransome, "*Cloud Computing, Implementation, Management and Security*", 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- P-C**	3	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. 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-P-C**	3	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-BUSNESS 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

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

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

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

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 Type of Course: Discipline Elective	L-P-C	3	0	3
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. **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. Indurkhya, 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. Indurkhya, 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- P- C	2	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					
List Of Laboratory Tasks (30 Hours)					
Lab Sheet 1: (6 Hrs)					

Setup and Configure a RPA tool and understand the user interface of the tool:

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.

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

1. Browse through the log files related to a RPA Project

Suggested List of Hands-on Activities:

1. 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)

1. 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:

1. 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
4. Automation: A Primer.
5. EMC education services. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments, Wiley, 2012.

Web Resources and Research Articles links:

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

Course Code: CSA2003	Course Title: Software Metrics and Quality Management Type of Course: Integrated	L- P- C	2	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 E**xperiential Learning** techniques.				
Course Out Comes	**On successful completion of this course the students shall be able to:** • 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. 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, 3rd,2016. **T2** Software Testing: A Craftsman's Approach, Paul C. Jorgenson, CRC Press, 4th, 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: 2054	**Course Title:** Storage Area Networks **Type of Course:** Program Core	**L-P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	Basics of Computer Networks				
Anti-requisites	NIL				
Course Description	The objective of this course is to help students understand the knowledge gap in understanding varied components of modern information storage infrastructure, including virtual environments. It provides comprehensive learning of storage technology, which will enable you to make more informed decisions in an increasingly complex IT environment. ISM builds a strong understanding of underlying storage technologies and prepares you to learn advanced concepts, technologies, and products. You will learn about the architectures, features, and benefits of Intelligent Storage Systems; storage networking technologies such as FC-SAN,IP-SAN, NAS, Object-based and unified storage; business continuity solutions such as backup, replication, and archive; the increasingly critical area of information security; and the emerging field of cloud computing. This unique, open course focuses on concepts and principles which are further illustrated and reinforced with EMC examples.				
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Identify key challenges in managing information and analyze different storage networking technologies and virtualization Knowledge 2. Illustrate the storage infrastructure, Storage network Technologies and management activities Comprehension 3. Define backup, recovery, disaster recovery, business continuity, and replication. Knowledge 4. Define information security and identify different storage virtualization technologies. Knowledge				
Course Content:					
Version No.	1.0				

Module 1	**Introduction to Storage System**	**Assignment**	**Comprehension, Quizzes**	**No. of Classes:8**

Topics:

Introduction to Information Storage: Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. **Data Center Environment**: Application, Host (Compute), Connectivity, Storage. **Data Protection**: RAID: RAID Implementation Methods, RAID Techniques, RAID Levels, RAID Impact on Disk Performance. **Intelligent Storage Systems**: Components of Intelligent Storage System, Storage Provisioning

Module 2	**Storage Networking Technologies**	**Assignment**	**Comprehension, Quizzes**	**No. of Classes:8**

Topics:

Fibre Channel Storage Area Networks: Components of FC SAN, FC connectivity, Fibre Channel Architecture, Zoning, FC SAN Topologies, Virtualization in SAN.IP SAN and FCoE: iSCSI, FCIP, FCoE. Network Attached Storage: Components of NAS, NAS I/O Operation, NAS File-Sharing Protocols, File-Level Virtualization

Module 3	**Backup, Archive and Replication**	**Assignment**	**Application, Quizzes**	**No. of Classes:8**

Topics:

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, BC Technology Solutions. **Backup and Archive:** Backup Methods, Backup Topologies, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive. **Local Replication:** Replication Terminology, Uses of Local Replicas, Local Replication Technologies, Local Replication in a Virtualized Environment**. Remote Replication:** Remote Replication Technologies, Three-Site Replication, Remote Replication and Migration in a Virtualized Environment.

Module 4	Cloud Computing	Assignment	Comprehension, Quizzes	No. of Classes:8

Topics:

Cloud Enabling Technologies, Characteristics of Cloud Computing, Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure, Cloud Challenges and Cloud Adoption Considerations. Virtualization Appliances: Black Box Virtualization, In-Band Virtualization Appliances, Outof-Band Virtualization Appliances, High Availability for Virtualization Appliances, Appliances for Mass Consumption. Storage Automation and Virtualization: Policy-Based Storage Management, Application-Aware Storage Virtualization, Virtualization-Aware Applications

Module 5	Securing and Managing Storage Infrastructure	Assignment	Knowledge, Quizzes	No. of Classes:8

Topics:

Securing and Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments**. Managing the Storage Infrastructure** : Monitoring the Storage Infrastructure, Storage Infrastructure Management activities, Storage Infrastructure Management Challenges, Information Lifecycle management, Storage Tiering

List of Laboratory Tasks:

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Targeted Application & Tools that can be used:

SID Tool(Cisco SAN Insights Discovery Tool)

SAN Congestion Innovation with Cisco DIRL(Dynamic Ingress Rate Limiting)

Project work/Assignment:

1.Cloud storage for accessing file over internet though SAN

2.Creating and storing daily backup of multiple machine over SAN. Or creating disk-less clients and use one server for processing and one server for storage and access all over network

Textbook(s):

1. Information Storage and Management, Author :EMC Education Services, Publisher: Wiley ISBN: 9781118094839
2. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company ISBN : 9780321262516

References

1. Robert Spalding: “Storage Networks The Complete Reference”, Tata McGraw-Hill, 2011.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Richard Barker and Paul Massiglia: “Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs”, Wiley India, 2006.

- Udemy: https://www.udemy.com/course/storageintro/ c;
- SANFOUNDRY Online training : https://www.sanfoundry.com/san-storage-area-networks-training/

Course Code: CSE3016	**Course Title:** CSE3016 Neural Networks and Fuzzy Logic **Type of Course:** Discipline Elective in AI & ML Basket Theory Course	L-P-C	3	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:** 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:

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. "*Neural networks and learning machines*", 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, "*Fuzzy Sets and Fuzzy Logic- Theory and Applications*", 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, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018. https://www.wileyindia.com/principles-of-soft-computing-3ed.html
2. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374
3. Kumar S., "*Neural Networks - A Classroom Approach*", 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. "*Soft computing and intelligent systems design: theory, tools, and applications*". 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 3050	**Course Title: Software Project Management** **Type of Course: School Core**	**L- P- C**	**3**	**0**	**3**
Version No.	2.0				
Course Pre-requisites	Software Engineering				
Anti-requisites	NIL				

Course Description	The objective of this course is to provide the fundamentals concepts of Software Project planning approaches and methodologies. The objective of this course is to provide the fundamentals standards of software development and management. This course covers the roles and functions of project management and the process of project life cycle. The objective of the course is to understand the need and techniques for managing users and user.			
Course Out Comes	On successful completion of this course the students shall be able to: 1] Describe the Software Project Management, Software Project Effort and Cost Estimation. (Knowledge) 2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension) 3] Understand People management (Knowledge) 4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application)			
Course Objectives	The objective of this course are the successful development of the project's procedures of initiation, planning, execution, regulation and closure as well as the guidance of the project team's operations towards achieving all the agreed upon goals within the set scope, time, quality and budget standards.			
Module 1	**Project Management Fundamentals**	Assignment	Identification of Cost Estimation	**12 Sessions**
Introduction to Software Project Management – all life cycle activities, Project Initiation Management – scope, objective, size and factors. Software Project Effort and Cost Estimation – cocomo, artifacts. Risk Management : Perform The risk analysis for the given case study. Configuration Management – techniques. Project Monitoring and Control – measuring task, status report, evm. Project Closure – closure steps				
Module 2	**Software Life Cycle Management**	Assignment	Apply the testing concepts using Programing	**10 Sessions**
Introduction to Software Life-Cycle Management – life cycle process. Software Requirement Management – requirement and management. Software Design Management – standards, techniques. Software Construction – reviews, walkthrough, inspections. Software Testing – Verification, validation, strategy, automation and monitoring. Product Release and Maintenance – types and techniques				
Module 3	**People Management**		Comparison of CMO, ISO, IEEE standards	**08 Sessions**
Introduction to People Management – people, team and supplier management. Team Management – organizational structure, team effectiveness. Customer Management – expectation and negotiation. Supplier Management – agreement and communication.				
Module 4	**Software Engineering Management and Tools**	Assignment	Apply the testing concepts using Programing	**10 Sessions**
Introduction to Software Process Standards and Process Improvement – CMM, ISO, IEEE. Software Project Management Tools Introduction – tools application, cost and effectiveness. Project Management and Software Life-Cycle Tools – life cycle and project management templates. Software Project Templates – WBS and monitoring tools. Software configuration management- SCM process, SCM Tools (GitHub).				
Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this				

course
1. Identification of Cost Estimation 2. Apply the testing concepts using Programing 3. Comparison of CMO, ISO, IEEE standards 4. Installing Selenium/GitHub software and exploring the functionality
Text Book 1] Bob Hughes, Mike Cottere, Rajib Mall, "Software Project Management", 5th Ed, Tata McGraw Hill,
References 1] Ashfaque Ahmed, "Software Project Management: a process-driven approach",Boca on, Fla. : CRC Press, 2012 2] Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2005.
Foundation Skills: Students can able to learn the fundamental foundation skills in this course such as initiation, planning, execution, regulation and closure as well as the guidance of the project team's operations.

Course Code: CSE 3051	**Course Title:** System Monitoring **Type of Course: Theory only**	**L- P- C**	3	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:** • 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**		**8essions**

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

1. Building a Monitoring Infrastructure with Nagios - by David Josephsen. 2016
2. 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 Type of Course: Discipline Elective	L-P-C	2	2	3
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 and Practical components for Preproduction	**No. of Classes:8**
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				
Lab Experiments are to be conducted on the following topics: -				

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

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

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: CSE3126	**Course Title:** E-Commerce **Type of Course:** Program Core	**L-P-C**	2	2	3
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: 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:

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
   Level 2: Develop a web page for registration
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.
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.
5. **Level 1:** Build multiple web pages and link them to home page.
   Level 2: Embed relevant videos of recommended in home page.
6. **Level 1**: Create a small website for online grocery.
   Level 2: Create a cart of products and navigate to pay portal.
7. **Level 1:** Build a small B2B website (Shopify)
   Level 2: Build a small B2B website (eBay)
8. **Level 1:** Build a small B2C business transaction (Amazon).
   Level 2: Build a small B2C business transaction (Flipkart).
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).
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.

Targeted Application & Tools that can be used:

Xamp server, Notepad, Visual studio, MySQL
Project work/Assignment:
Design a website to showcase working of 4 types of e-commerce (B2B, B2C, C2B and C2C business transactions.
Textbook(s): 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 Educatin). 4. Awad, Elias M. (2007), Electronic Commerce: From Vision to Fulfillment (New Delhi: Pearson Education).
References 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), eMarketingeXcellence; The Heart ofeBusiness (UK: Elsevier Ltd.)
• 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=kw%2Cwrdl%3A%20e%20commerce • http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14338&query_desc=kw%2Cwrdl%3A%20e%20commerce

Course Code: CSE3146	**Course Title: Advanced Java Programming** **Type of Course:1] School Core** **2] Laboratory integrated**	**L- P- C**	**1**	**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. w*ith* 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	**11 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	**11 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	**12 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	**11 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	**11 Hours**

Topics:

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.
Spring JPA, JPA Specification, Classes and Interfaces, Object Relational Mapping using JPA, JPA implementation with Hibernate, Simple JPA-Hibernate program to Create Database schemas.

List of Laboratory Tasks:

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.
Labsheet -2 [3 +1 Practical Sessions]
Experiment No. 1:
Level 1 – Usages of Java.io.* package.
Level 2 – File operations with a case study.

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]

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]

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]

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, 9th Edition.

References

1. Herbert Schildt, *"Java 2: The Complete Reference"*, Tata McGraw-Hill Education,6th Edition.
2. Y.Daniel Liang, "Introduction to Java programming Comprehensive Version", Pearson Education, 10th Edition.
3. Core and Advanced Java Black Book, Dream Tech Press.
4. Spring in Action , Graig Walls, 5th Edition
5. Java Persistence with Hibernate , Christian Bauer & Gavin King, 2nd Edition
6. https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

Course Code: CSE3150	Course Title: Front-end Full Stack Development	L- P- C	2	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:

1. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using Java.**

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015
T2. Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer",* APress, 2018

References:

R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020.
R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials",* Packt Publishing, 2016
R3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development.";* Wiley; 2014.
R4. Greg Sidelnikov, *"React.js Book_ Learning React JavaScript Library"*, 1 edition, Scratch-River Tigris LLC 2016
R5. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

Course Code: CSE3151	Course Title: Java Full Stack Development	L- P- C	2	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 using JPA and Hibernate	Project	Programming	**06 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	**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. **Problem Solving: Design of Algorithms and implementation of programs.** 2. **Programming: Implementation of given scenario using Java.**				
Text Book: T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015				
References R1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017. R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."*, Apress, 2015				

Course Code: CSE3152	Course Title: .NET Full Stack Development	L- P- C	2	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. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using .NET.**

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015

T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.

References

R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021.

R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017.

R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018.

R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017.

Course Code: CSE390	Course Title: Front-end Full Stack Development	L- P- C	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:

1. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using Java.**

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015

T2. Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer",* APress, 2018

References:

R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020.

R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials",* Packt Publishing, 2016

R3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development.";* Wiley; 2014.

R4. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

Course Code: CSE391	Course Title: Java Full Stack Development	L- P- C	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 using JPA and Hibernate	Project	Programming	**06 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	**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. **Problem Solving: Design of Algorithms and implementation of programs.** 2. **Programming: Implementation of given scenario using Java.**				
Text Book: T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015				
References R1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017. R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."*, Apress, 2015				

Course Code: CSE392	Course Title: .NET Full Stack Development	L- P- C	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. **Problem Solving: Design of Algorithms and implementation of programs.**
2. **Programming: Implementation of given scenario using .NET.**

Text Book:

T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015

T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.

References

R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021.

R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017.

R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018.

R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017.

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