PRESIDENCY UNIVERSITY

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PROGRAMME REGULATIONS & CURRICULUM

2023-27

PRESIDENCY SCHOOL OF COMPUTER SCIENCE & ENGINEERING

BACHELOR OF TECHNOLOGY (B.TECH.)

INFORMATION SCIENCE AND TECHNOLOGY - IST

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

2023-2027

BACHELOR OF TECHNOLOGY (B.Tech.) in

INFORMATION SCIENCE AND TECHNOLOGY - IST

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 2023. This document supersedes all previous guidelines)

Regulations No.: PU/AC-24.05/SOCSE04/IST/2023-27

Resolution No. 05 of the 24th Meeting of the Academic Council held on 03rd August 2024, and ratified by the Board of Management in its 24th Meeting held on 05th August, 2024

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 computing-based pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the realm of Computing Sciences.
- Establish state-of-the-art computing facilities, for effective Teaching and Learning experiences.
- Promote Interdisciplinary Studies to nurture talent for global impact.
- Instil Entrepreneurial and Leadership Skills to address Social, Environmental and Community-needs.

2. Preamble to the Program Regulations and Curriculum

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

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

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

3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2023-2027.

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 2023-2027 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 2023-2024.

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, 2023-2027;*

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;*

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 2023-2027 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 2023-2027 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as B.Tech. Computer Science and Engineering;
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as B.Tech. Computer Science and Technology (Big Data);
3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as B.Tech. Computer Science and Engineering (Block Chain);
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as B.Tech. Computer Science and Technology (Dev Ops);
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as B.Tech. Computer Science and Engineering (Cyber Security);

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

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

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

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

6. Minimum and Maximum Duration

6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.

6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause **Error! Reference source not found.** of Academic

Regulations), shall be counted in the permissible maximum duration for completion of a Program.

6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.**Error! Reference source not found.** of Academic Regulations) in the prescribed maximum duration (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

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

PEO01. Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values

PEO02. Engage in lifelong learning through research and professional development

PEO03. Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship

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 modelling 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:

PSO01: Use and develop cloud software, administrative features Infrastructure services and architectural patterns: ethical hacking and forensic security technologies

PSO02: Gain knowledge on design and control strategy; techniques to secure information and adapt to the fast-changing world of information

PSO03: Acquire 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 concerned B.Tech Program through Lateral Entry. Further, the *Minimum Credit Requirements* for the award of the B.Tech. Degree in the concerned Program shall be prescribed / calculated as follows:

The ***Minimum Credit Requirements*** for the award of the Bachelor of Technology (B.Tech.) Degree prescribed by the concerned Bachelor of Technology Degree Program Regulations and Curriculum, 2023-2027, 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. (Information Science and Technology) 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 Information Science and Technology 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 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. / B.E. / B.S., 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 12.5 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 **Error! Reference source not found.** 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	25	-	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 **Error! Reference source not found.** 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 12.6.1 and 12.6.2 of Academic Regulations) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

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

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

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer **Error! Reference source not found.** of Academic Regulations) and approved by the Dean - Academics.

13.2 Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.

13.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

13.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 13.3 (as per Academic Regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

13.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 13.3 (as per Academic Regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

13.3.3 Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.

13.3.4 Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.

13.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.

13.3.6 SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.

13.3.7 A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.

13.3.8 The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table **Error! Reference source not found.** 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.**Error! Reference source not found.**), 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. (Information Science and Technology) Program Structure (2023-2027) 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. (Information Science and Technology) 2023-2027: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	School Core	65
4	Program Core	68
5	Discipline Elective	18
6	Open Elective	09
	Total Credits	**160 (Minimum)**

In the entire Program, the practical and skill based course component contribute to an extent of approximately 58% out of the total credits of 160 for B.Tech. (Information Science and Technology) 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 a of Academic Regulations**;**

c. No dues to the University, Departments, Hostels, Library, and any other such Centres/ 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 School Core Courses					
S.No	Course Name	L	T	P	C
1	Technical English	1	0	2	2
2	Introduction to soft skills	0	0	2	1
3	Introduction to Verbal Ability	0	1	0	0
4	Advanced English	1	0	2	2
5	Soft Skills for Engineers	0	0	2	1
6	Introduction to Aptitude	0	0	2	1
7	Aptitutde Training Intermediate	0	0	2	1
8	Calculus and Linear Algebra	3	0	2	4
9	Optoelectronics and Device Physics	2	0	2	3
10	Applied Statistics	1	0	2	2
11	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3
12	Discrete Mathematical Structures	3	0	0	3
13	Numerical Methods for Engineers	3	0	0	3
14	Elements of Electronics Engineering	3	0	2	4
15	Digital Design	2	0	2	3
16	Basic Engineering Sciences	2	0	0	2
17	Engineering Graphics	2	0	0	2
18	Problem Solving using JAVA	1	0	4	3
19	Innovative Projects Using Arduino	-	-	-	1
20	Data Structures and Algorithms	3	0	2	4
21	Innovative Projects Using Raspberry Pi	-	-	-	1
22	Mastering Object-Oriented Concepts in Python	0	0	2	1
23	Competitive Programming and Problem Solving	0	0	4	2
24	Internship	0	0	0	2
25	Mini-Project	0	0	0	4
26	Capstone Project	0	0	0	10
	Total No. of Credits				**65**

Table 3.2 : List of Program Core Courses					
S. No	Course Name	L	T	P	C
1	Problem Solving Using C	1	0	4	3
2	Data Communications and Computer Networks	3	0	2	4
3	Computer Organization and Architecture	3	0	0	3
4	Fundamentals of Data Analytics	2	0	2	3
5	Software Engineering	3	0	0	3
6	Programming in Python	1	0	4	3
7	Design and Analysis of Algorithms	3	0	0	3
8	Database Management Systems	3	0	2	4
9	Operating Systems	3	0	0	3
10	Artificial Intelligence and Machine Learning	3	0	2	4
11	Information Security and management	3	0	0	3
12	Business continuity and risk analysis	3	0	0	3
13	Theory of Computation	3	0	0	3
14	Web Technologies	2	0	0	2
15	Web Technologies Lab	0	0	2	1
16	Mobile Application Development	2	0	0	2
17	Mobile Application Development Lab	0	0	4	2
18	Fundamentals of Natural Language Processing	3	0	0	3
19	Fundamentals of Data Analytics	2	0	0	2
20	Fundamentals of Data Analytics Lab	0	0	2	1
21	Neural Networks and Fuzzy Logic	3	0	0	3
22	Predictive Analytics	2	0	0	2
23	Cloud Computing	2	0	0	2
24	Cloud Computing Lab	0	0	2	1
25	Optimization Techniques for machine learning	3	0	0	3
26	Reinforcement Learning Techniques	2	0	0	2
				Total No. of Credits	**68**

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

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfil 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 4-6 weeks in an industry / company or academic / research institution during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters, 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 Mini Project

A student may opt to do a Mini Project Work for a period of 08-10 weeks in an Industry / Company or academic / research institution or the University Department(s) during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters or during the 5th / 6th / 7th Semester as applicable, subject to the following conditions:

18.2.1 The Mini Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

18.2.2 The student may do the mini project work in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.2.1). Provided further, that the Industry / Company or academic / research institution offering such mini project work confirms to the University that the mini project work will be conducted in accordance with the Program Regulations and requirements of the University.

18.3 Capstone Project

A student may undergo a Capstone Project for a period of 12-14 weeks in an industry / company or academic / research institution in the 7th / 8th Semester as applicable, subject to the following conditions:

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

18.3.2 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;

18.3.3 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 18.3.2 above.

18.3.4 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 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 Capstone Project Policy of the University.

18.3.5 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.

18.4 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:

18.4.1 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 18.4.1). 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 3.3: Discipline Electives Courses/Specialization Tracks

Track 1 – Artificial Intelligence and Machine Learning					
S.No	Course Name	L	T	P	C
1	Applied Machine Learning	3	0	0	3
2	Optimization Techniques for Machine Learning	3	0	0	3
3	Business Intelligence and Analytics	3	0	0	3
4	Generative AI	3	0	0	3
Track 2 – Big Data and Data Science					
S.No	Course Name	L	T	P	C
1	Big Data Technologies	3	0	0	3
2	Statistical Foundations of Data Science	3	0	0	3
3	Web Data Analytics	3	0	0	3
4	Predictive Analytics	3	0	0	3
5	E-Business and Marketing Analytics	3	0	0	3
6	Data Handling and Visualization	3	0	0	3
7	Data Mining and Warehousing	3	0	0	3
Track 3 – Block Chain and Cyber Security					
S.No	Course Name	L	T	P	C
1	Cyber Forensics	3	0	0	3
2	Privacy and Security in Online Social Media	3	0	0	3
3	Ethical Hacking	3	0	0	3
4	Cyber Threats for IoT and Cloud	3	0	0	3
5	Intrusion Detection and Prevention System	3	0	0	3
6	Cyber Security	3	0	0	3
7	Vulnerability Assessment and Penetration Testing	3	0	0	3
8	Digital and Mobile Forensics	3	0	0	3
9	Security Assessment and Testing	3	0	0	3
10	Malware Analysis	3	0	0	3
Track 4 – Cloud Computing and Networks					
S.No	Course Name	L	T	P	C
1	Edge and Fog Computing	3	0	0	3

2	Cloud Security and Governance	3	0	0	3
3	Firewall and Internet Security	3	0	0	3
4	5G Networking	3	0	0	3
5	Network Management Systems	3	0	0	3
6	Mobile Networking	3	0	0	3
7	Network Security and Auditing	3	0	0	3

Track 5 – Information Science & Technology

S.No	Course Name	L	T	P	C
1	Operating System with Linux Internals	3	0	0	3
2	Search Engine Optimization	3	0	0	3
3	Service Oriented Architecture	3	0	0	3
4	Information System Audit	3	0	0	3
5	Information Security and Management	3	0	0	3
6	Human Computer Interaction	3	0	0	3
7	Infrastructure Management	3	0	0	3
8	UI UX Design	3	0	0	3

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

Table 3.4: Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 09

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 (not to be offered for Computer Science and Engineering students)											
1	CSE2002	Programming in Java	2	0	2	3	S/E M	-	-	-	-
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											
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	-	-	MEC2008	-
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/EN	-	-	-	-
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/EN	-	-	-	-
14	MGT2010	Managing People and Performance	3	0	0	3	S/EM/EN	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 for Information Science and Technology Program of 12 weeks

Sl. No	Course Code	Course Name	Total Credits	L-T-P-C
1	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	3-0-0-3
2	CSE3112	Privacy And Security In Online Social Media	3	3-0-0-3
3	CSE3113	Computational Complexity	3	3-0-0-3
4	CSE3114	Deep Learning for Computer Vision	3	3-0-0-3
5	CSE3115	Learning Analytics Tools	3	3-0-0-3
6	CSE502	Technical Skills in JAVA	3	0-0-6-3
7	CSE503	Technical Skills in Python	3	0-0-6-3
8	CSE504	Comprehensive Technical Skills	5	0-0-10-5
9	CSE505	The Joy Of Computing Using Python	3	3-0-0-3
10	CSE3119	Coding Skills in Python	3	3-0-0-3
11	CSE3121	Parallel Computer Architecture	3	3-0-0-3
12	CSE3124	Games and Information	3	3-0-0-3
13	CSE3140	Introduction To Industry 4.0 And Industrial Internet Of Things	3	3-0-0-3
14	CSE3142	Affective Computing	3	3-0-0-3
15	CSE3112	Privacy and Security in Online Social Media	3	3-0-0-3
16	CSE3196	Foundations of Cyber Physical Systems	3	3-0-0-3
17	CSE3197	Getting Started with Competitive Programming	3	3-0-0-3
18	CSE3198	GPU Architectures And Programming	3	3-0-0-3
19	CSE3199	Artificial Intelligence: Knowledge Representation And Reasoning	3	3-0-0-3
20	CSE3200	Programming in Modern C++	3	3-0-0-3
21	CSE3201	Circuit Complexity Theory	3	3-0-0-3
22	CSE3202	Basics of Computational Complexity	3	3-0-0-3
23	CSE3212	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 Wise Course Grids/ Tables: First year - CYCLE 1

Sl. No.	Course Code	Course Name	L	T	P	Credits	Type of Skill/ Focus	Course Caters to	Basket
Semester 1 - Physics Cycle						**17**			

1	MAT1001	Calculus and Linear Algebra	3	0	2	4	F		School Core
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	F		School Core
3	ECE1001	Elements of Electronics Engineering	3	0	2	4	F		School Core
4	ENG1002	Technical English	1	0	2	2	S		School Core
5	PPS1001	Introduction to soft skills	0	0	2	1	S	HP	School Core
6	CSE1004	Problem Solving Using C	1	0	4	3	S		Program Core
7	CHE1018	Environmental Science	1	0	2	0	F	ES	School Core
8	PPS1011	Introduction to Verbal Ability	0	1	0	0	S/ EM		School Core
Semester 2 - Engineering Science Cycle						**16**			
1	MAT1003	Applied Statistics	1	0	2	2	EM		School Core
2	ECE2007	Digital Design	2	0	2	3	F / S		School Core
3	CIV1008	Basic Engineering Sciences	2	0	0	2	S		School Core
4	MEC1006	Engineering Graphics	2	0	0	2	S		School Core
5	CSE1006	Problem Solving using JAVA	1	0	4	3	S		School Core
6	ENG2001	Advanced English	1	0	2	2	S		School Core
7	PPS1002	Soft Skills for Engineers	0	0	2	1	S	HP	School Core
8	ECE2010	Innovative Projects Using Arduino	-	-	-	1	S		School Core

First year - CYCLE 2

Sl. No.	Course Code	Course Name	L	T	P	Credits	Type of Skill/ Focus	Course Caters to	Basket
Semester 1 - Engineering Science Cycle						**18**			
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	F		School Core
2	ECE1001	Elements of Electronics Engineering	3	0	2	4	F		School Core
3	ENG1002	Technical English	1	0	2	2	S		School Core
4	PPS1001	Introduction to soft skills	0	0	2	1	S	HP	School Core
5	CSE1004	Problem Solving Using C	1	0	4	3	S		Program Core
6	PPS1011	Introduction to Verbal Ability	0	1	0	0	S/ EM		School Core
7	CIV1008	Basic Engineering Sciences	2	0	0	2	S		School Core
8	MEC1006	Engineering Graphics	2	0	0	2	S		School Core

Semester 2 – Physics Cycle						**15**			
1	MAT1003	Applied Statistics	1	0	2	2	EM		School Core
2	ECE2007	Digital Design	2	0	2	3	F / S		School Core
3	CSE1006	Problem Solving using JAVA	1	0	4	3	S		School Core
4	ENG2001	Advanced English	1	0	2	2	S		School Core
5	PPS1002	Soft Skills for Engineers	0	0	2	1	S	HP	School Core
6	CHE1018	Environmental Science	1	0	2	0	F	ES	School Core
7	PHY1002	Optoelectronics and Device Physics	2	0	2	3	F		School Core
8	ECE2010	Innovative Projects Using Arduino	-	-	-	1	S		School Core

Sl. No.	Course Code	Course Name	L	T	P	Credits	Type of Skill/ Focus	Course Caters to	Basket
Semester 3						**28**			
1	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	F		School Core
2	CSE2001	Data Structures and Algorithms	3	0	2	4	S		Program Core
3	CSE3155	Data Communications and Computer Networks	3	0	2	4	S		Program Core
4	CSE2009	Computer Organization and Architecture	3	0	0	3	S		Program Core
5	MAT2004	Discrete Mathematical Structures	3	0	0	3	EM		School Core
6	CSE3190	Fundamentals of Data Analytics	2	0	2	3	S		Program Core
7	CSE2014	Software Engineering	3	0	0	3	S		Program Core
8	ECE2011	Innovative Projects Using Raspberry Pi	-	-	-	1	S		School Core
9	CSE1005	Programming in Python	1	0	4	3	S		Program Core
10	PPS4002	Introduction to Aptitude	0	0	2	1	S/EM	HP	School Core
Semester 4						**25**			
1	MAT2003	Numerical Methods for Engineers	3	0	0	3	S		School Core
2	CSE2007	Design and Analysis of Algorithms	3	0	0	3	S		Program Core
3	CSE3156	Database Management Systems	3	0	2	4	S		Program Core

4	CSE3351	Operating Systems	3	0	0	3	S		Program Core
5	CSE3157	Artificial Intelligence and Machine Learning	3	0	2	4	S		Program Core
6	CSEXXXX	Discipline Elective - I	3	0	0	3			PEC
7	XXXXXXX	Open Elective – I (Management Basket)	3	0	0	3			OEC
8	PPS4004	Aptitude Training Intermediate	0	0	2	1	S/EM	HP	School Core
9	CSE3216	Mastering Object-Oriented Concepts in Python	0	0	2	1			School Core
Semester 5						**27**			
1	IST2500	Information Security and management	3	0	0	3			Program Core
2	IST2000	Business continuity and risk analysis	3	0	0	3	S		Program Core
3	CSEXXXX	Discipline Elective - II	3	0	0	3			PEC
4	CSE2500	Theory of Computation	3	0	0	3	S		Program Core
5	CSE1504	Web Technologies	2	0	0	2	S		Program Core
6	CSE1505	Web Technologies Lab	0	0	2	1	S		Program Core
7	CSE2508	Mobile Application Development	2	0	0	2			Program Core
8	CSE2509	Mobile Application Development Lab	0	0	4	2			Program Core
9	IST2502	Fundamentals of Natural Language Processing	3	0	0	3			Program Core
10	IST2503	Deep Learning Techniques	3	0	0	3			Program Core
11	CSE7000	Internship	-	-	-	2			School Core
Semester 6						**21**			
1	CSN2508	Neural Networks and Fuzzy Logic	3	0	0	3			Program Core
2	CSD1714	Predictive Analytics	2	0	0	2			Program Core
4	CSE2506	Cloud Computing	2	0	0	2			Program Core
5	CSE2507	Cloud Computing Lab	0	0	2	1			Program Core
6	CSE3009	Optimization Techniques for Machine Learning	3	0	0	3			Program Core
7	IST2504	Reinforcement Learning techniques	2	0	0	2			Program Core
8	CSEXXXX	Discipline Elective - III	3	0	0	3			PEC
9	XXXXXXX	Open Elective – II	3	0	0	3			OEC

10	PPSXXXX	Industry Preparedness Program	2	0	0	0			School Core
11	CSE2510	Competitive Programming and Problem Solving	0	0	4	2			School Core

Semester 7						**16**			
1	XXXXXXX	Open Elective – III (Management Basket)	3	0	0	3		OEC	
2	CSEXXXX	Discipline Elective - IV	3	0	0	3		Discipline Elective	
3	CSEXXXX	Discipline Elective - V	3	0	0	3		Discipline Elective	
4	CSEXXXX	Discipline Elective - VI	3	0	0	3		Discipline Elective	
5	CSE7100	Mini Project	-	-	-	4		School Core	
Semester 8						**10**			
1	CSE7300	Capstone Project	-	-	-	10	S/ EM/ EN	School Core	

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.

BCC

Course Code: PHY1002	**Course Title: Optoelectronics and Device Physics** **Type of Course: 1] School Core & Laboratory integrated**	L-T-P-C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**NIL**		
Anti-requisites	**NIL**		
Course Description	The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: **An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.**		
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the concepts of semiconductors, magnetic materials and superconductors.		

	CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices. CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers. CO4: Explain the applications of lasers and optical fibers in various technological fields. CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. **[Lab oriented].**			
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Optoelectronics and device physics "and attain **Skill Development** through **Experiential Learning** techniques			
Course Content:				
Module 1	**Fundamentals of Materials.**	Assignment	Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software.	**No. of Classes: 07**
Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Magnetic materials, Superconductors:				
Module 2	**Advanced Devices and applications**	Assignment	Data collection on efficiency of solar cells.	**No. of Classes: 8**
Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs				
Module 3	**Quantum concepts and Applications**	Term paper	Seminar on quantum computers.	**No. of classes: 8**
Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron. Heisenberg's uncertainty principle. Schrodinger time independent wave equation. Particle in a box				
Module 4	**Lasers and Optical fibers**	Term paper	Case study on medical applications of Lasers.	**No. of classes :07**

Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling.
Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.

List of Laboratory Tasks:

Experiment No. 1: Experimental errors and uncertainty using excel
Level 1: Calculation of accuracy and precision of a given data
Level 2: propagation of errors in addition, subtraction, multiplication and division.

Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction.
Level 1: Determination of Wavelength of Laser
Level 2: Finding the particle size of lycopodium powder.

Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier.
Level 1: To determine the proportionality of Hall Voltage and magnetic flux density
Level 2: To determine the polarity of Charge carrier.

Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions.
Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage.
Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance.

Experiment No. 5: To study input and output characteristics of a given Transistor.
Level 1: To determine the input resistance of a given transistor.
Level 2: To determine current transfer characteristics and transistor parameters of a given transistor.

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

Level 1: Determination of Fermi energy and Fermi temperature of given metal wire.
Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.

Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage.
Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.
Level 2: To measure the photo-current as a function of the irradiance at constant voltage.

Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.
Level 1: To study the I-V characteristics
Level 2: I-R characteristics of a solar cell as a function of the irradiance.

Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .
Level 1: Calculate the numerical aperture.
Level 2: study the losses that occur in optical fiber cable.

Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.
Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.
Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.

Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage.
Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs
Level 2: Determination of knee voltage.

Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.
Level 1: Determination of Stefan's constant
Level 2: Verification of Stefan-Boltzmann Law.

Targeted Application & Tools that can be used:

1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM.
2. Origin, excel and Mat lab soft wares for programming and data analysis.

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

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)
- Quiz
- End Term Exam
- Self-Learning

1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons.
2. Write a report on importance of quantum entanglement in supercomputers.

Text Book

1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2018.

References: 1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002.
2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011.
3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017.
4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012.
5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019

E-Resourses: 1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live 2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live 3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live 4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live 5. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live
Topics relevant to "SKILL DEVELOPMENT": Fundamentals of materials, Lasers and optical fibers. for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout.

Course Code: **MAT1003**	**Course Title:** **Applied Statistics** **Type of Course:** School Core	**L T P C**	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "**Applied Statistics" and attain **Skill Development Through Problem Solving techniques**.					
Expected Outcome:	At the end of this course, students will be in a position to 1. apply the techniques of descriptive statistics effectively 2. interpret the ideas of probability and conditional probability 3. demonstrate the knowledge of probability distributions 4. Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.					
Module 1	**Descriptive Statistics**	Assignment	Coding needed			**10 classes**
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression **.**						
Module 2	**Probability**					**6 classes**

Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples				
Module 3	**Random Variables and Probability Distributions**		Coding needed	**14 classes**
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, **Negative Binominal (Self Study)**, Poisson, Normal and Exponential distributions				
Module 4	**Sampling Theory**		Coding needed	**15 classes**
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and **Difference of Means (Self Study)**, Small Sample Tests: Student's t-Test for Single Mean and **Difference of Means,** F-Test, Chi-Square Test.				
Targeted Application & Tools that can be used: The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems. Tools used: R Software / MS-Excel				
Text Book 1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.				
References 1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018. 2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020. 3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019. 4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018. 5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018. 6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.				
Topics relevant to SKILL DEVELOPMENT: The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous				

probability distributions for **Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.

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

Numerical Interpolation: Newton's forward and backward interpolation method, Newton's divided difference method, Lagrange's method, numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's Rule.
Area between the two curves.

Module 3	**Numerical solution of ODEs and PDEs**			**15 Classes**

Solution of ordinary differential equations: Initial Value problems: Taylor's series method, Picard's method, Euler's Method, Modified Euler's method, Runge-Kutta method, Milne's predictor-corrector formula. Adams -Bashforth method**,** Boundary value problems - Finite difference methods for ODE. Numerical solution for LCR & damped forced oscillatory equations.

Solution of partial differential equations: Schmidt Explicit Formula for Heat Equation, Crank-Nicolson method. Numerical solution to Wave, Laplace & Heat Equation.

Targeted Application & Tools that can be used:

The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics so as to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.

Assignment:

Gauss-Jacobi iteration method.
Numerical differentiation.
Gaussian quadrature rule for numerical integration.
Taylor series method for ODEs.
Implicit and explicit schemes for PDEs.

Text Books

T1: M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, 6th Edition, New age Publishing House, 2015.

T2: Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley& Sons (India), 2014.

References:

R1: B.S. Grewal, Numerical methods in engineering and science, 10th Edition, Khanna publishers, 2016.

R2: B.S. Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publishers.

R3: Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers," 7th Ed., McGraw-Hill Edition, 2015.

R4: C. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill, 2012.

Topics relevant to SKILL DEVELOPMENT: This course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration with numerical solution of ordinary differential equations by means of Taylor's series

method, modified Euler's method and Runge-Kutta methods for **Skill Development through Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

ESC

Course Code: CSE1004	**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. ACAlso 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.**
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: ECE2007	**Course Title:** Digital Design **Type of Course:** Theory &Integrated Laboratory	**L- T-P- C**	**2**	**0**	**2**	**3**
Version No.	2.0					
Course Pre-requisites	**[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra**					
Anti-requisites	**NIL**					
Course Description	**The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.** The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.					
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through** EXPERIENTIAL **LEARNING.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** i.**Describe** the concepts of number systems, Boolean algebra and logic gates. ii.**Apply** minimization techniques to simplify Boolean expressions. iii.**Demonstrate** the Combinational circuits for a given logic iv.Demonstrate the Sequential and programmable logic circuits v.**Implement** various combinational and sequential logic circuits using gates.					
Course Content:						

Module 1	**Fundamentals of Number systems- Boolean algebra and digital logic**	Application Assignment	Data Analysis task	**06 classes**
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations. Introduction to HDL.				
Module 2	**Boolean function simplification**	Application Assignment	Data Analysis task	**08 Classes**
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.				
Module 3	**Combinational Logic circuits:**	Application Assignment	Programming Task & Data Analysis task	**08 Classes**
Topics: Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters. HDL Models of Sequential circuits.				

List of Laboratory Tasks:

Experiment N0 1: Verify the Logic Gates truth table
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 2: Verify the Boolean Function and Rules
Level 1: By using Digital Logic Trainer kit
Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs

Experiment No. 3: Design and Implementations of HA/FA
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 4: Design and Implementations of HS/FS
Level 1: By using basic logic gates and Trainer Kit
Level 2: By using Universal logic gates and Trainer Kit

Experiment No. 5: Design and Implementations of combinational logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No. 6: Study of Flip flops

Experiment No. 7: Design and Implementations of sequential logic circuit for specifications
Level 1: Specifications given in the form of Truth table
Level 2: Specification should be extracted from the given scenario

Experiment No.8: HDL coding for basic combinational logic circuits
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Experiment No.9: HDL coding for basic sequential logic circuit
Level 1: Gate level Modeling
Level 2: Behavioral Modeling

Targeted Application & Tools that can be used:

Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, Home Automation, Communication in systems in industries

Professionally Used Software: HDL/VHDL/Verilog HDL/ OOPS

Text Book(s):

1. Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education, 6th edition
2. Thomas L. Floyd "DIGITAL LOGIC DESIGN" , Pearson Education, fourth edition.

Reference(s):

Reference Book(s):

R1. Jain, R. P., *"Modern Digital Electronics",* McGraw Hill Education (India), 4th Edition

R2. Roth, Charles H., Jr and Kinney Larry L., *"Fundamentals of logic Design"*, Cengage Learning, 7th Edition

Online Resources (e-books, notes, ppts, video lectures etc.): Book Free Download (studymaterialz.in)

1. **eBook1**: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download }
3. **eBook2:**Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.
4. NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
5. Digital Logic Design PPT Slide 1 (iare.ac.in)
6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video

CircuitVerse - Digital Circuit Simulator online

Learn Logisim➠ Beginners Tutorial | Easy Explanation! - Bing video

Digital Design 5: LOGISIM Tutorial & Demo

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

E-content:

1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168.
2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase2010 13th International Conference on Computer and Information Technology (ICCIT)
3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029.
4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," *2019 IEEE East-West Design & Test Symposium (EWDTS)*, 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.

Topics relevant to "SKILL DEVELOPMENT": Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: CIV1008	**Course Title:** Basic Engineering Sciences **Type of Course:** Theory Only	**L-T-P-C**	2	0	0	2
Version No.	1.0					

Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.			
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering 2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.			
Course Content:				
Module 1	**Introduction to various fields in Civil Engineering**	Assignment	Case studies on different Civil Engineering Projects	**6 Sessions**
Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.				
Module 2	**Current Trends and Evolution in Civil Engineering**	Assignment	Article Review	**6 Sessions**
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.				
Module 3	**Power Production and Consumption Machinery**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.				
Module 4	**Overview of Petroleum Engineering**	Assignment & Quiz	Article Review	**6 Sessions**
Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	**Industry 4.0**	Assignment & Quiz	Data Collection	**6 Sessions**
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				

Project work/Assignment:

Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering
Assignment 2: Review Articles on current evolutions in Civil Engineering.
Assignment 3: Collect data related to renewable energy generation (Wind, Solar)
Assignment 4: Prepare an energy consumption chart for a compressor or pumps.
Assignment 5: Prepare a report on role of 3D printing across various industries.
Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.

Text Book:

T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers
T2. Elements of Mechanical Engineering, by VK Manglik
T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition

References

1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters and Publishers Pvt Ltd, Mumbai.
2. Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production by Norman J. Hyne, PennWell Books; 3rd Revised edition

Web-resources:

1. Basic Civil Engineering
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live
2. Post-parametric Automation in Design and Construction
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live
3. Smart Cities : Introducing Digital Innovation to Cities
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live
4. Innovation Energy: Trends and Perspectives or Challenges of Energy Innovation
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2323766&site=ehost-live
5. Mechanical Engineering
   https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705
6. Additive Manufacturing: Opportunities, Challenges, Implications
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live
7. Society of Petroleum Engineers (SPE)
   https://www.spe.org/en/
8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering.
   https://petrowiki.spe.org/PetroWiki
9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends.
   https://www.rigzone.com/

Topics relevant to the development of SKILLS:

Engines-Turbines and their applications.
Mechanization in Construction.
Digitization in Petroleum Industries

Course Code: **MEC1006**	**Course Title:** **Engineering Graphics** **Type of Course:** **School Core & Theory Only**	**L-T- P-C**	2-0-0-2
Version No.	1.2		

Course Pre-requisites	**NIL**
Anti-requisites	**NIL**
Course Description	**The course is designed with the objective of giving an overview of engineering graphics. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings. The course emphasizes on projection of points, lines, planes and solids and isometric projections.**
Course Objective	**The objective of the course is to familiarize the learners with the concepts of "Engineering Graphics" and attain SKILL DEVELOPMENT through Problem solving methodologies.**
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Demonstrate competency of Engineering Graphics as per BIS conventions and standards.** 2. **Comprehend the theory of projection for drawing projections of Points, Lines and Planes under different conditions.** 3. **Prepare multiview orthographic projections of Solids by visualizing them in different positions.** 4. **Prepare pictorial drawings using the principles of isometric projections to visualize objects in three dimensions.**

Course Content:

Module 1	Introduction to Drawing	Assignment	Standard technical drawing	**02 Sessions**
Topics: **Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Line conventions, dimensioning, Selection of drawing sheet size and scale.** **[02 Hours: Comprehension Level]**				
Module 2	Orthographic projections of Points, Straight Lines and Plane Surfaces	Assignment	Projection methods Analysis	**10 Sessions**
Topics: **Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points in all 4 quadrants.** **Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.** **[10 Hours: Application Level]**				
Module 3	Orthographic Projections of Solids	Assignment	Multi-view drawing Analysis	**10 Sessions**

Topics: **Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection).** **[10 Hours: Application Level]**				
Module 4	Isometric Projections of Solids (Using isometric scale only)	Assignment	Spatial Visualization	**8 Sessions**
Topics: **Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.** **[8 Hours: Application Level]**				
Text Book: **1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.**				
References: 1. **K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.** 2. **D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.** 3. **D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.** **Web resources:** **https://nptel.ac.in/courses/112103019**				
Topics relevant to "SKILL DEVELOPMENT": Projection in first and third angle for **SKILL DEVELOPMENT** through **Problem Solving methodologies**. This is attained through the assessment component mentioned in the course handout.				

Course Code: CSE1006	**Course Title:** Problem Solving using JAVA **Type of Course: Integrated**	**L- T-P- C**	1-0-4-3
Version No.	2.0		
Course Pre-requisites	CSE1004 – Problem Solving Using C		
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: ECE2010	**Course Title: Innovative Projects using Arduino**	**L- T-P- C**	-	-	-	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide an in-depth understanding of Arduino microcontrollers and their application in various real time projects involving sensors. Throughout the course, students will learn the fundamentals of Arduino programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Arduino boards, read sensor data, and use it to control various output devices This course is suitable for beginners who are interested in exploring the world of electronics and developing practical applications using Arduino and sensors.					
Course Objective	The objective of the course is **Employability Skills** of student by using **PARTICIPATIVE LEARNING** techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to** 1. Explain the main features of the Arduino prototype board 2. Demonstrate the hardware interfacing of the peripherals to Arduino system. 3. Understand the types of sensors and its functions 4. Demonstrate the functioning of live projects carried out using Arduino system.					
Course Content:						
Module 1	**Basic concepts of Arduino**	Hands-on	Interfacing Task and Analysis	**4 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.

Module 2	**Sensory Devices**	Hands-on	Interfacing Task and Analysis	**4 Sessions**

Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino.
Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications.
Introduction to online Simulators: Working with Tinkercad Simulator.

Topics: Types of Arduino boards, sensors, 3D Printer

Targeted Application & Tools that can be used:

Application Area:

Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: students can use open SOURCE Softwares Arduino IDE and Tincker CAD

Project work/Assignment:

1. Projects: At the end of the course students will be completing the project work on solving many real time issues.

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 presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same

Textbook(s):
Monk Simon "Programming Arduino: Getting Started with Sketches", Mc Graw Hill Publications Second Edition

References
Reference Book(s)
1. Neerparaj Rai "Arduino Projects for Engineers" BPB publishers,first edition, 2016.

2. Ryan Turner "Arduino Programming " Nelly B.L. International Consulting Ltd. first edition,2019.

Online Resources (e-books, notes, ppts, video lectures etc.):
1. Arduino trending Projects < https://www. https://projecthub.arduino.cc/>
2. Introduction to Arduino < https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>
3. Case studies on Wearable technology< https://www.hticiitm.org/wearables>

E-content:

1. Cattle Health Monitoring System Using Arduino and IOT (April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002)

2. M H Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, Pragya Singh" IOT BASED SMART SECURITY SYSTEM USING ARDUINO" 2021 JETIR August 2021, Volume 8, Issue 8.

3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. **https://ieeexplore.ieee.org/document/8494144**.

4. Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.

Topics relevant to development of "SKILL": System design for achieving Sustainable Development Goals.

Course Code: CSE2001	**Course Title: Data Structures and Algorithms** **Type of Course: School Core** **Theory-Integrated Laboratory**		**L- T-P-C**	3-0-2-4
Version No.	1.0			
Course Pre-requisites	**Java or Python**			
Anti-requisites	**NIL**			
Course Description	**The purpose of the course is to provide the fundamental concepts of data structures and algorithm, to emphasize the importance of choosing an appropriate data structure and algorithm for program development.** **The student should have basic programming skills, to solve engineering/computational problems.** **The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.** **With a good knowledge in the fundamental concepts of data structures and algorithm the student can gain practical experience in implementing them, enabling the student to be an effective designer, developer for new software applications.**			
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. **Implement modularized solutions for given problem using fundamental data structures.** 2. **Apply an appropriate linear data structure for a given computation.** 3. **Apply an appropriate non-linear data structure for a given computation** 4. **Analyze complexity of given searching and sorting algorithms.**			
Course Content:				
Module 1	Fundamentals of Data Structure (Comprehension)	Assignment	Programming Task	**06 Classes**
Topics: Data Management concepts, Data types – primitive and non-primitive, Types of Data Structures- Linear & Non Linear Data Structures. Recursion: Recursive Definition and Processes, Programming examples. Fundamentals of Algorithmic problem solving, Important Problem types.				
Module 2	Linear Data Structure Stack, Queues & Linked List (Application)	Case Study	Programming Task	**08 Classes**
Topics: Stack- Concepts and representation, Stack operations, stack implementation using array. Applications of Stack. Queues- Representation of queue, Queue Operations, Queue implementation using array, Types of Queue, Applications of Queue. Linked List- Singly Linked List, Operation on linear list using singly linked storage structures, Doubly Linked List, Circular List, Applications of Linked list.				
Module 3	Non-linear Data Structures – Trees (Application)	Assignment	Programming Task	**04 Classes**
Topics: Introduction to Trees, Binary tree: Terminology and Properties, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post-Order traversal.				

Module-4	Non-linear Data Structures –Graphs (Comprehension)	Assignment	Programming Task	**03 Classes**
Topics: Graph – Basic Concept of Graph Theory and its Properties, Representation Of Graphs.				
Module-5	Searching & Sorting Performance Analysis and Management (Comprehension)	Assignment	Programming Task	**06 Classes**
Topics: Sorting & Searching: Performance Analysis and Management - Time and space analysis of algorithms – Average, best and worst case analysis. Searching – Sequential Search and Binary Search, Sorting – Bubble Sort, Selection Sort.				

List of Laboratory Tasks:

Lab sheet 1: **[02 Classes]**

To implement the Programs on User define functions

Level 1: Implement a program to compute factorial using functions.
Level 2: Implement a program to pass array to a function and manipulate the data in array.

Lab sheet 2: **[02 Classes]**

To implement the Programs on User define functions

Level 1: Implement a program to compute factorial using recursion.
Level 2: Implement a program to solve towers of Hanoi using recursion.

Lab sheet 3: **[04 Classes]**

To implement the Programs on Stack.

Level 1: Implement the operations of the Stack.
Level 2: Implement the evaluation of postfix expression

Lab sheet 4: **[04 Classes]**

To implement the programs on Queue.

Level 1: Implement all the operations of the Queue
Level 2: Issuing token for doctor appointment.

Lab sheet 5: **[06 Classes]**

To implement the Programs on Linked List.

Level 1: Implement all the operations of the Singly Linked List
Level 2: Implement Stack and Queue with Linked List.

Lab sheet 6: **[04 Classes]**

To implement the Programs on Trees and Traversals

Level 1: Implement construction of the Binary tree.
Level 2: Implement tree traversals.

Lab sheet 7: **[2 Classes]**
To study and implement the Programs on Graphs.
Level 1: Program to implement graph

Lab sheet 8: **[6 Classes]**
To analyze time complexity and implement the Programs on searching and sorting.
Level 1: Program on searching and sorting.
Level 2: To analyze the time complexity.

Targeted Application & Tools that can be used:

System software and Application software Programming
Professionally Used Software : Eclipse / Jupyter notebook IDE

Project work/Assignment:

1. **Problem Solving: Choose an appropriate data structure and implementation of programs.**
2. **Programming: Implementation of given scenario using Java or python**

REFERENCE MATERIALS: Text Book(s):

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures" Wiley, Second edition, January 2019.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education.

References

1. Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI Learning Private Limited.

Topics relevant to development of **"Foundation Skills":** Fundamentals of Data structure, **"Skill Development" –** Implementation Linear and nonlinear data structure, **"Employability"**-Linear & Nonlinear Data Structure

HSMC

Course Code: ENG1002	**Course Title: Technical English** **Type of Course: 1] School Core** **2] Laboratory integrated**	**L-T-P-C**	1-0-2-2
Version No.	1. V. 3		
Course Pre-requisites	Intermediate Level English		
Course Anti-requisites	NIL		
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.		
Course Objectives	The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.**		
Course	**On successful completion of the course, the students shall be able to:**		

Outcomes	1. Develop proficiency in using technical vocabulary and terminology. 2. Apply language skills for better speaking skills in technical fields. 3. Write technical descriptions 4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles.			
Course Content:				
Module 1	**Fundamentals of Technical Communication**	**Worksheets& Quiz**	**Vocabulary building**	**9 Classes**
Introduction to Technical English Differences between Technical English and General English Technical Writing Basics Technical Vocabulary				
Module 2	**Technical Presentation**	**Presentations**	**Speaking Skills**	**12 Classes**
Introduction Planning the Presentation Creating the Presentation Giving the Presentation				
Module 3	**Technical Description**	**Assignment**	**Group Presentation**	**12 Classes**
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	**Technical Writing**	**Assignment**	**Writing Skills**	**12 Classes**
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively **Technical Report Writing** Types of technical reports (Lab reports, research reports, etc.) Components of technical reports Writing an abstract and executive summary Structure and content organization Transcoding: diagrams, charts and images				
List of Laboratory Tasks: 1. Module-1 Level 1: Worksheets Level 2: Worksheets 2. Module 2 Level 1: Preparing Presentation Level 2: Giving Presentation (Individual) 3. Module-3 Level 1: Product Description & User Manual Level 2: Process Description & Transcoding 4. Module 4 Level 1: Email Writing Level 2: Report Writing				
Targeted Applications & Tools that can be used: 1. Flipgrid				

2. Quizzes
3. Youtube Videos
4. Podcast

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

1. **Bring out the essence of technical communication with reference to the conventions of technical communication, with examples**
2. **Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.**

The following individual, as well as group Assignments, will be given to the students.

1. **Presentation**
2. **Describing a product/process**
3. **Individual Reports**

Text Books

1. Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers*. Oxford University Press. 2018.
2. Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf

Reference Book:

1. Chauhan, Gajendra Singh, and Kashmiramka, Smita, ***Technical Communication.*** Cengage Publication. 2018.
2. Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.
3. John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011

Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

4. Sharma, R.C. and K. Mohan. 2011. Business Correspondence and Report Writing, Fourth Edition. Tata McGraw Hill.

Web Resources:

1:https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.

2;https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdcb8f4a5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih

3: Last,Suzan, et. al. ***Technical Writing Essentials.*** University of Victoria, British Columbia, 2019 (E- Book)

4 Wambui, Tabita Wangare, et al. ***Communication Skills- Volume 1***, LAP LAMBRET, USA, 2012 (E Book)

Topics Relevant to the Development of Employability Skills:

Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.

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

	2. Communicate effectively, creatively, accurately and appropriately in their writing. 3. Deliver technical presentations 4. Design resume and create professional portfolio to find a suitable career

Course Content: Theory

Module 1	**Critical Reasoning and Writing**	**Writing Essays**	**Critical Reading**	**4 Classes**

Topics:

- A Catalog of Reading Strategies
- The Myth of Multitasking
- A Guide to Writing Essays Speculating about Causes or Effects
- Is Google Making Us Stupid (Self Study)

Module 2	**Technical Presentation**	**Presentation**	**Oral Skills**	**3 Classes**

Topics:

- Planning the presentation
- Creating the presentation
- Giving the presentation

Module 3	**Writing Reviews**	**Prezi**	**Review Writing**	**4 Classes**

Topics:

- Review Writing
- Short film reviews
- Advanced English Grammar (Self Study)

Module 4	**Starting your Career**	**Online Writing Lab**	**Writing Skills**	**4 Classes**

Topics**:**

- Preparing a Resume
- Writing Effective Application Letter
- Creating a Professional Portfolio

Course Content: Practical Sessions

Module 1	**Critical Reasoning and Writing**	**8 Classes**

1. Reading and Analyzing
   Level 1 – Annotation
   Level 2 - Assumptions
2. Writing Narrative Essays
   Level 1 – Draft 1
   Level 2 – Draft 2

Module 2	**Technical Presentation**	**10 Classes**

3. Fishbowl
   In Fishbowl, students form concentric circles with a small group inside and a larger group outside. Students in the inner circle engage in an in-depth discussion, while students in the outer circle listen and critique content, logic, and group interaction.
   Level 1 – within group
   Level 2 – Among 2 group
4. Technical Group Presentation

Module 3	**Writing Reviews**	4. **Classes**

5. Practice Worksheets
   Level 1 – Eliminating the Passive Voice

Level 2 – Simple, compound and complex sentences 6. Writing Short Film Reviews		
Module 4	**Starting your Career**	6. **Classes**
7. Collaborative Project Job search and writing report Writing Resume		
Module 1-4	**Academic Journal**	**2 Classes**
8. Academic Journal Writing Level 1- Mid Term Level 2 – End Term		
Targeted Application & Tools that can be used: Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com		
Project work/Assignment:		
Academic Journal – Assignment In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.		
References 1. Hering, Heik. *How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation*. Springer. 2. Johnson, Richard. (2010) *Technical Communication Today.* Pearson, 2015 3. Rice B. Adelrod, Charles R. Cooper and Ellen C. Carillo. (2020) *Reading Critically Writing Well: A Reader and Guide*. Beford/St. Martin's Macmillan Learning, New York. 4. The Princeton Review. (2010) *MCAT Verbal Reasoning & Writing.* The Princeton Review, Inc. 5. https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021 6. https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021		
Topics Relevant to "employability": Critical Reasoning, Presentation, Review Writing and Starting Career **Topics Relevant to "Human Values and Professional Ethics":** Critical reasoning		

PCC

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: **CSE3190**	**Course Title: Fundamentals of Data Analytics** **Type of Course: Theory-embedded Lab**	**L-T- P- C**	2	0	2	3
Version No.	3.0					
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 R Programming**			
Course Content:				
Module 1	Introduction to Data Analysis	Assignment	Data Collection, data analysis, Programming	**8 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. **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.				
Module 2	Data Analysis and Visualization	Case studies	Programming	**8 Sessions**
Topics: 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	Case studies	R programming	**7 Sessions**
Topics: Proportion tests-Chi squared test-Fisher exact test-Correlation-T test-Wilcoxon Rank sum tests-Wilcoxon signed rank test- one-way ANOVA test- Kruskal Wallis test				
Module 4	Predictive Analysis	Case studies	Programming	**8 Sessions**

Topics: Linear least-squares – implementation – the goodness of fit – testing a linear model – weighted resampling. Regression using Stats models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – accuracy. Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis

List of Laboratory Tasks:

Experiment No. 1: Introduction to R and RStudio

Level 1: Getting Started with R and RStudio

- Installing R and RStudio.
- Basic R syntax and commands.

Level 2: Working with RStudio

- Understanding the RStudio interface.
- Creating and managing R scripts.

Experiment No. 2: Basic Data Handling in R

Level 1: Data Types and Structures in R

- Vectors, matrices, and data frames.
- Lists and factors.

Level 2: Data Import and Export

- Reading data from CSV, Excel, and text files.
- Exporting data to different formats.

Level 3: Exploring Datasets

- Using functions like head(), summary(), and str().

Experiment No. 3: Basic Data structure in R

Level 1: a. Demonstrate a program to join columns and rows in a data frame using cbind() and rbind() in R.

b.Implement different data structures in R (Vectors, Lists, Data Frames)

Level 2: R AS CALCULATOR APPLICATION a. Using with and without R objects on console

a. Using mathematical functions on console
b. Write an R script, to create R objects for the calculator application

Experiment No. 4: Data Cleaning and Preprocessing

Level 1: Handling Missing Data in R

- Identifying missing values.
- Imputing missing values using mean, median, or other methods.

Level 2: Data Transformation in R

- Standardizing and normalizing data.
- Log-transformations and scaling.

Experiment No. 5: Exploratory Data Analysis (EDA) with R

Level 1: Descriptive Statistics

- Calculating mean, median, and standard deviation.
- Visualizing data using histograms, box plots, and scatter plots.

Experiment No. 6: Data Visualization with ggplot2

Level 1: Demonstrate various graphs that can be made and altered using the ggplot2 package.

Level 2: Create 500 random temperature readings for six cities over a season and then plot the generated data using ggplot2 packages in R

Experiment No. 7: Perform Tests of Hypotheses hypothesis test (parametric)

Level 1: How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region, the test statistic, and the p-value.

Level 2: A teacher claims that people who work for only five hours per week will score significantly lower than people who work for ten hours per week on a quantitative abilities test. He brings twenty people and randomly assigned them to one or two groups. In one group he has participants who work for ten hours and in another group, he has participants who work for five hours. He conducts the test for all participants. Scores on the test range from one to ten with higher scores representing better performance. Test if there is any significant difference between those who work for five hours per week versus those who work for ten hours per week based on the test performance.

Experiment No 8: Hypothesis – Non-Parametric Test

Level 1: A car manufacturing company like to find the sales of three types of cars produced by them in three regions and is given. Test if there is an association between the regions and types of cars purchased.

Experiment No 9: Correlation and Covariance

Level 1: Using the iris data set in R

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

Level 2 : Ramesh is doing a statistics paper in his post-graduation course. He met his friend Amal who is a textile engineer. Ramesh, who is doing his internship at ABC Researchers, is interested in a question. He poses this question to Amal and tries to find if he can answer. The question is as follows: The data regarding sales of soft- drinks and sales of cotton clothes in a place during the last 12 months are given. Find if there is any association between sales of soft drinks and sales of cotton clothes. Also explain the reason if there is any relationship.

Experiment No 11: Regression Model

Level 1: Import data from web storage (http://www.ats.ucla.edu/stat/data/binary.csv). Name the dataset and now do Logistic Regression to find out the relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained, and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS).

Level 2: Demonstrate multiple regressions, if data have a continuous Independent variable. Apply on the above dataset

Experiment No. 12: Time Series Analysis in R

Level 1: Demonstrate Timeseries analysis using Time Series Data Library at http://robjhyndman.com/TSDL/.

Targeted Application & Tools that can be used:

Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc.

Text Books

2. 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.
3. Introduction to statistics and Data analytics, Christian H, Michael S, Springer,2016
4. Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020 (E-resource)
5. Introduction to Time Series and Forecasting (Springer Texts in Statistics), Peter Brockwell, Richard A. Davis, Springer, 2016.

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.

Online resources:

http://www.modernstatisticswithr.com/solutions.html#solutionsch3

https://johnmuschelli.com/intro_to_r/

https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/

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: CSE2014	**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: 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: CSE2007	**Course Title: Design and Analysis of Algorithms** **Type of Course: Program Core & Theory only**	**L- T- P- C**	3	0	0	3

Version No.		2.1				
Course Pre-requisites		CSE2001, Data Structure and Algorithms				
Anti-requisites		**NIL**				
Course Description		This intermediate course enables students to design and analyze efficient algorithms to solve problems. This course covers typical design methods such as divide-and-conquer, dynamic programming and greedy method to solve problems. The students shall develop strong analytical 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] Identify the efficiency of a given algorithm. [Comprehension]** **2] Employ divide and conquer approach to solve a problem. [Application]** **3] Illustrate dynamic programming approach to solve a given problem. [Application]** **4] Solve a problem using the greedy method. [Application]** **5] Discuss the techniques to solve a real-world problem based on its complexity classes. [Comprehension]**				
Course Content:						
Module 1	Introduction to Algorithms	Assignment		Problem Solving	**06 Sessions**	
	Topics: Algorithm Design and efficiency, measuring of running time of algorithms. Insertion sort and merge sort, Asymptotic Growth and Notations. Recurrences--Masters method. **Assignment:** Comparatively evaluate bubble sort, insertion sort and mergesort.					
Module 2	Review of Searching and Sorting techniques	Assignment		Programming/ Problem Solving	**12 Sessions**	
	Topics: **Divide and Conquer:** Examples. Strassen's Matrix multiplication. **Sorting:** Quicksort, Heapsort, Lower bound of comparison-based sorting, non-comparison-based sorting: Radix sort. **Search:** Review of Linear Search and Binary Search, Hashing and hash tables.					

	Assignment: Design and develop an algorithm using Divide and Conquer technique for a given scenario.				
Module 3	Greedy Algorithms	Assignment		Programming/ Problem Solving	**09 Sessions**
	Topics: Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm. Huffman Codes. **Assignment:** Design and Develop a solution to a given scenario using greedy method.				
Module 4	Dynamic Programming	Assignment		Programming/ Problem Solving	**09 Sessions**
	Topics: Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Optimal Binary Search Trees, Chain Matrix Multiplication. **Assignment:** For a given scenario, attempt the three design paradigms learned so far and argue the best approach to solve the problem				
Module 5	Complexity Classes and Heuristics	Assignment		Programming/ Problem Solving	**09 Hours**
	Topics: plexity classes: P, NP, and NP-Complete Problems. Backtracking: n-Queens. Branch and bound: Travelling Salesman Problem. **Assignment:** Apply backtracking algorithmic designing technique for solving queen's problems for 4, 8 and 16 inputs.				
	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.	**2. Problem Solving: Design of Algorithms and implementation of programs.** **3. Programming: Implementation of given scenario using Java.**				
	Text Book: T1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *'Introduction to Algorithms'*, MIT Press, 2022. T2. J. Kleinberg and E. Tardos, *'Algorithm Design'*, Addison-Wesley, 2005.				
	References R1. Anany Levitin, *'Introduction to the Design and Analysis of Algorithms'*, Pearson Education, 2003. R2. Tim Roughgarden, *'Algorithms Illuminated'* (books 1 through 3), Soundlikeyourself Publishing, 2017,18,19 respectively.				

	R3. AV Aho, J Hopcroft, JD Ullman, *'The Design and Analysis of Algorithms'*, Addison-Wesley, 1974.

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

Catalogue prepared by	1. Dr. Madhura K 2. Dr. Nagaraja S R
Recommended by the Board of Studies on	BOS NO: SOCSE 2nd BOS held on 10/07/23
Date of Approval by the Academic Council	Academic Council Meeting No 21, Dated 06/09/2023

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: CSE3351	**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: IST2500	**Course Title:** Information Security and Management **Type of Course:** **Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1		
Course Pre-requisites	Data Communication and Computer Networks, Information Security, Database Management Systems and Concepts of cryptography.		
Anti-requisites			
Course Description	The course explores information security through some introductory material and helps gain an appreciation of the scope and context of information security. It includes a brief introduction to cryptography, security management, network and computer security. It allows a student to begin a fascinating journey into the study of information security and develop an appreciation of some key security concepts. The course concludes with a discussion of a simple model of the information security in industry and explores skills, knowledge and roles required for employability. A student will be able to determine and analyze potential career opportunities in this profession.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Information Security and Management and attain **Employability** through **Participative Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • 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: **CSE2019**	**Course Title: Foundations of Blockchain Technology** **Type of Course: Program Core**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	Networks		
Anti-requisites	NIL		
Course Description	The purpose of the course is to provide the fundamental knowledge on Blockchain technology and explore various aspects of Blockchain technology like types of Blockchain, Bitcoin and Ethereum Blockchain platform. With a good knowledge basic concepts of block chain, the student can gain the experience in implementing them, enabling the student to be an effective smart contracts creator.		
Course Objectives	This course is designed to improve the learners employability skills by using experiential learning techniques		
Course Out Comes	On successful completion of this course the students shall be able to: 1. **Understand** the concepts of an emerging blockchain technology (Knowledge). 2. **Infer** the knowledge about consensus protocols (comprehension). 3. **Construct** a Bitcoin payment (Application) 4. **Apply** smart contracts on Ethereum (Application).		
Course Content:			
Version No.	1.0		

Module 1	**Blockchain Basics**	**Quiz**	**Knowledge based quiz on distributed ledger**	**No. of Classes:09**
Topics: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design, Basic crypto primitives: Hash, Signature, Hashchain to Blockchain				
Module 2	**Distributed Consensus**	**Assignment**	**Comprehension, Assignment**	**No. of Classes:09**
Topics: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains.				
Module 3	**Bitcoin mechanics**	**case study**	**Application, Programing**	**No. of Classes:10**
Topics: Bitcoin definition, Digital keys and addresses, Transactions, mining, Bitcoin network wallets, Bitcoin payments.				
Module 4	**Smart contracts and Etherum**	**case study**	**Application, Programming**	**No. of Classes:8**
Topics: History, Purpose and types of smart contracts, Introduction to Ethereum, Bitcoin vs Ethereum stack. P2P network in Ethereum, consensus in Ethereum, scripts in Ethereum, Smart contracts (Ethereum Virtual Machine). Developing and executing smart contracts in Ethereum.				

List of Laboratory Tasks: NA

Targeted Application & Tools that can be used:

- **Ethereum Remix**
- **Meta Mask**
- **Truffle**
- **Ganache**

Case study/Assignment/Project:

- Do a survey on the various real-time applications in crypto-currencies (Bitcoin and Ethereum)
- Create simple smart contract for User identity management using Solidity language.
- Study of Blockchain development frame works (Truffle/ Ganache)
- Use the Meta Mask plugin to conduct transactions with Ether, a crypto-currency

Design Private Ethereum Network and Deploying Smart Contract & Security.

Textbook(s):

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
2. Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018

References

1. Andreas M. Antonopoulos , "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media Inc, 2015.
2. Blockchain by Melanie Swa, O'Reilly .
3. Udemy: Blockchain A-Z™: Learn How To Build Your First Blockchain | Udemy
4. https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency
5. https://www.coursera.org/specializations/introduction-to-blockchain

Course Code: CSE3035	**Course Title: R Programming for Data Science** **Type of Course: Program Core**	**L- T-P- C**	1-0-0-1
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				
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: **CSE3035** & CSE3035_P	**Course Title: R Programming for Data Science** **Type of Course: Program Core**	**L- T-P- C**	0-0-4-2	

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]**		

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 `subType`s. 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

2. 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: CSE2067	**Course Title: Web Technology** **Type of Course: Program core** **Theory Only**		**L-T- P-C**	3-0-0-3
Version No.	2.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This course highlights the basic web design using Hypertext Markup Language and Cascading Style Sheets. Students will be trained in planning and designing effective web pages by writing code using current leading trends in the web domain, enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia. The focus is on popular key technologies that will help students to build Internet- and web-based applications that interact with other applications and with databases.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Web Technology and attain Skill Development through Experiential Learning techniques.**			
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1:** Implement web-based application using client-side scripting languages. **(Application level)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Application level)** **CO3**: Illustrate java-script concepts to demonstration dynamic web site**(Application level)** **CO4:** Apply server-side scripting languages to develop a web page linked to a database. **(Application level)**			
Course Content:				
Module 1	**Introduction to XHTML**	Quizzes and Assignments	Quizzes on various features of XHTML, simple applications	**10 Sessions**
Topics: Basics: Web, WWW, Web browsers, Web servers, Internet. XHTML: Origins and Evolution of HTML and XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic Differences between HTML and XHTML.				
Module 2	**Advanced CSS**	Quizzes and assignments	Comprehension based Quizzes and assignments; Application of CSS in designing webpages	**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: **CSE2500**	**Course Title:** **Theory of Computation** **Type of Course:** **Theory Only**	**L- T-P- C**	3	0	0	3
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: CSE3075	Mobile Applications and Development	**L- T-P- C**	2	0	0	2
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	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. 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 multimedia and internet services for mobile applications. (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	**11 Sessions**
Activities, Services, Broadcast receivers, Content providers and Hosting the App in Playstore.				
Module 4	**Notifications and Data Persistence**	Term paper/Assignment	Simulation/Data Analysis	**9 Sessions**
Notification, Shared Preferences, SQLite database, Third party library integration (cloud).				
Module 5	**Advance App Development**	Term paper/Assignment	Simulation/Data Analysis	**9 Sessions**
Graphics and Animation, Multimedia, Telephony, email, Managing Network and Wi-Fi, Location Services and Android with IoT.				

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

NPTEL course – https://nptel.ac.in/courses/106106156

Course Code: CSE3075_P	Mobile Applications and Development Lab	**L- T-P- C**	0	0	4	2
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	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. 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 multimedia and internet services for mobile applications. (Application)

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.

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

NPTEL course – https://nptel.ac.in/courses/106106156

Topics relevant to the development of SKILLS: Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3080	**Course Title: Quantum Computing**	**L- T-P-C**	2-0-0-2
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.				

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: CSE3080_P	**Course Title: Quantum Computing**	**L- T-P-C**	0-0-2-1
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.		

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

2. Framework- Qiskit
3. Language- Python
4. 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

2. Nielsen, M., & Chuang, I. (2010). Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511976667
3. McMahon D. Quantum Computing Explained. Hoboken N.J: Wiley-Interscience : IEEE Computer Society; 2008.

References

2. 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)
3. 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: CSE3082	Course Title: Object Oriented Analysis and Design Type of Course: Program Core and Theory	L- T-P-C	3	0	0	3

Version No.	1.0
Course Pre-requisites	CSE 1001 Java Programming
Anti-requisites	**NIL**
Course Description	This course covers the analysis and design methodology in sufficient depth to convey a good understanding of object-oriented analysis and design using the unified process. Students will be able to design a use case model, identify the classes and their responsibilities, use interaction models to capture the interdependence among objects/classes and design an efficient solution. The application of the design axioms and the iterative nature of the process are emphasized. This course will enable students to apply object oriented concepts in all the stages of the software development life cycle.
Course objective	This course is designed to improve the learners " SKILL DEVELOPMENT "by using EXPERIENTIAL LEARNING techniques.
Course Outcomes	On successful completion of the course the students shall be able to: 1]Describe the basics of object oriented system development **[Knowledge]** 2]Identify the various techniques for object-oriented analysis techniques [**Comprehension]** 3] Apply the design axioms to create appropriate UML diagrams. [**Application]** 4]Apply the design process to develop implementation models. **[Application]**
Course Content:	

Module 1	Introduction to Object oriented system	Assignment	Identify problem domain objects for an application domain	**8 Classes**

Topics:

Object Basics-Object Oriented System Development Life Cycle- Use case driven approach-Rumbaugh Object Model- Booch Methodology-Jacobson Methodology-Unified Approach, Static and Dynamic Modeling-Unified Modeling Language

Module 2	Object oriented analysis	Assignment	Identification of candidate classes using various approaches	**10 Classes**

Topics:

Identifying use cases-Object Analysis-Classification: Theory-Approaches for Identifying Classes: Noun Phrase approach, Common Class pattern approach, Use case driven approach, Classes, Responsibilities and Collaborators- Identifying Object relationships: Associations, Super–sub class relationships, Aggregation. UML diagrams: Use case Diagram , Class diagram.

Module 3	Introduction to axiomatic design	Assignment	Apply axioms to create class diagram	**10 Classes**

Topics:

Object Oriented Design Axioms-Designing Classes -Class visibility -Redefining attributes -Designing methods and protocols -Packages and managing classes, UML Diagrams: Interaction diagram, Sequence diagram, Collaboration diagram, State-chart diagram, Activity diagram

Module 4	Object oriented Design process	Assignment	Apply the design process and develop a component and deployment diagram.	**10 Classes**

Topics:

Access Layer- Object Storage Persistence - Object oriented Database System-Designing view layer classes -Macro level process -Micro level process- Prototyping the user interface UML diagrams: component diagram, Deployment diagram, Quality Assurance Tests-Testing Strategies.

Tools that can be used:

Tools:
Microsoft visio, Rational software architect(RSA)
ArgoUML, Rational Rose, StarUML, Umbrello

Project work/Assignment:

Term Assignments:

identify Use Cases and develop the Use Case model

Identity the conceptual classes and develop a UML Class diagram

Using the identified scenarios find the interaction between objects and represent them using UML Interaction diagrams

Identify the business activities and develop an UML Activity diagram

Text Book

1. Ali Behrami, "Object Oriented Systems Development using Unified Modeling Language" McGraw Hill International Edition, July 2017.

References

1.Craig Larman, "Applying UML and Patterns", Pearson Education.

2.Grady Booch, "Object Oriented Analysis and Design with Applications", Addison-Wesly.

3.Simon Bennett, Steve McRobb, Ray Farmer, "Object Oriented Systems Analysis and Design using UML", McGrawHill Education

Topics related to development of "FOUNDATION": Object Basics-Object Oriented System Development Life Cycle- Use case driven approach-Rumbaugh Object Model- Booch Methodology-Jacobson Methodology-Unified Approach, Static and Dynamic Modeling-Unified Modeling Language

Topics related to development of " SKILL DEVELOPMENT": UML diagrams: Use case Diagram , Class diagram, Interaction diagram, Sequence diagram, Collaboration diagram, State-chart diagram, Activity diagram, component diagram, Deployment diagram using the tool StarUML software

Course Code: CSE3343	Course Title: Cloud Computing	**L- T-P- C**	2	0	0	2
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).

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: CSE3343_P	Course Title: Cloud Computing Lab	L- T-P-C	0	0	2	1
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: 2. Comprehend the significance of Cloud computing technologies 3. Describe appropriate Virtualization techniques to virtualize infrastructures 4. Apply Cloud mechanisms to optimize the QoS parameters 5. Interpret recent technologies on Cloud					

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)

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

References

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

Web Resources and Research Articles links:

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

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

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

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

Course Code: CSE4010	**Course Title: Soft Computing**	**L- T-P- C**	2-0-0-2
Version No.	2.0		
Course Pre-requisites	**Calculus, Probability, Linear Algebra and Basic Programming Skills**		
Anti-requisites	**NIL**		
Course Description	Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on biologically inspired methodologies such as genetics, evolution, ant behaviors, particle swarming, human nervous systems, etc. Soft computing is the only solution when we don't have any mathematical modeling of problem-solving (i.e., algorithm), needs a solution to		

	a complex problem in real-time, and easily adapts with changing scenarios and is implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Soft Computing** and attain **SKILL DEVELOPMENT** through **Problem Solving Methodologies**.			
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Define the concept and applications of Soft Computing. CO2: Discuss Fuzzy logic concepts and its applications. CO3: Demonstrate Artificial Neural Networks concepts and its applications. CO4: Apply Evolutionary algorithms and hybrid soft computing techniques.			
Course Content:				
Module 1	Introduction Soft Computing	Assignment	Analysis	**9 Sessions**
Topics: Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Applications of Soft computing techniques, Elements of soft Computing.				
Module 2	Fuzzy Logic	Assignment	Analysis, Data Collection	**12 Sessions**
Topics: Fuzzy Logic: Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design, Predicate logic, Fuzzy decision making.				
Module 3	Neural Networks	Case Study	Analysis, Data Collection	**10 Sessions**
Topics: Neural Network: Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning, Network rules and various learning activation functions, Introduction to Associative memory, Adaptive resonance theory and self-organizing map, Recent Applications. Neural Networks as Associative Memories: Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks: Competitive Learning, Kohonen Maps.				
Module 4	Evolutionary Computing	Assignment	Analysis, Data Collection	**10 Sessions**
Topics: Evolutionary Computing: "History of Genetic Algorithm and Optimization working principle, The Schema Theorem, GA operators: Encoding, Crossover, Selection, Mutation, bit wise operation in GA etc. Introduction to ant colony optimization and particle swarm optimization. Integration of genetic algorithm with neural network and fuzzy logic.				
Targeted Application & Tools that can be used:				

In recent times, engineers have very well accepted soft computing tools such as Fuzzy Computing, ANN, Neuro-Computing and Evolutionary Computing, etc., for carrying out various numerical simulation studies. In the last two decades, these tools independently and in hybrid forms have been successfully applied to varieties of problems. The main objective is to introduce students to the latest soft computing tools. The training of these tools will be helpful to develop rigorous applications in the engineering domain.

Tools:

- MATLAB
- PYTHON
- C

Project work/Assignment:

Mini Project:

- Training of known/classified datasets representing some objects/pattern using various ANN learning methods including Perceptron, BPN, Adaline, Associative memory networks, Hopfield, kohenen networks.
- Classification of new input feature set/pattern based on training & learning
- Applying GA search to optimize the solutions. Implementation of the GA procedure.

Text Book

T1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India, 3rd Edition 2019

T2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley.

References

R1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2nd Edition 2017.

R2. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2nd Edition, 2015.

R3. Fakhreddine O. Karray, and Clarence W. De Silva. Soft computing and intelligent systems design: theory, tools, and applications. Pearson Education, 2009.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home

W2.https://www.geeksforgeeks.org/fuzzy-logic-introduction/

Topics relevant to development of "SKILL DEVELOPMENT": Solving real world problems with uncertainty using Nature Inspired Algorithms for developing SKILL DEVELOPMENT through **Problem Solving Methodologies** . This is attained through assessment component mentioned in course handout

Course Code: IST2502	**Course Title:** **Fundamentals of Natural Language Processing**	**L-T-P-C**	3-0-0-3
Version No.	1.2		
Course Pre-requisites	**[1] Applied Statistics (MAT1003)**		
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.** **The course will cover fundamentals of NLP, such as word and text representations, part-of-speech tagging, and constituency parsing. In addition to this, students will also get an introduction to different NLP applications such as Sentiment Analysis, Lexical Resource Creation, and Machine Translation.**			
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. **Understand** the fundamental concepts of Natural Language Processing [Comprehension] 2. Create and **use** word embeddings [Application] 3. Read corpora to train models and **use** them for different NLP tasks. [Application] 4. **Understand** sequence to sequence modeling as used in machine translation. [Comprehension]			
Course Content:				
Module 1	**Introduction**	Quizzes		**6 Classes**
Topics: Introduction. History. Text Analytics. Various tasks in NLP. Sentence boundary Detection. Edit distance. Introduction to word embeddings, Part-of-Speech tagging, chunking, parsing, machine translation.				
Module 2	**Word and Text Representations**	Quizzes and Assignment	Learning Text Representations for Classification	**8 Classes**
Topics: Naïve Bayes classification. Vector semantics and embeddings. Neural Language Models. Text representations and classification using features, bag-of-words, and embeddings.				
Module 3	**PoS Tagging, NER Tagging, Constituency Parsing**	Quizzes and Assignment	Building a Part-of-Speech Tagger with the given data	**9 Classes**
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. Constituents and Constituency Parsing.				
Module 4	**NLP Applications**	Quizzes		**9 Classes**
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 and Software (Eg. NLTK, Spacy, Google Colab, etc.)** 2. **Java (Stanford CoreNLP)** 3. **NLP Resources (WordNet, VADER, Stanford NER Tagger, etc.)** 4. **ML Libraries (Weka, Scikit-Learn, Numpy, etc.)**				
Project work/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.				
Textbook(s): Daniel Jurafsky, and James Martin. "*Speech and Language Processing*", 3rd edition draft, 2021 **Link:** https://web.stanford.edu/~jurafsky/slp3/				
References: Chris Manning and Hinrich Schutze, "*Foundations of Statistical Natural Language Processing*", 1st Edition, MIT Press. 1999. **Link:** https://nlp.stanford.edu/fsnlp/				

Topics related to development of "EMPLOYABILITY": Assignment implementations in software, batch wise presentations.	
Catalogue prepared by	Dr. Sandeep Albert Mathias
Recommended by the Board of Studies on	BOS NO: 12th BOS, held on 04/08/2021
Date of Approval by the Academic Council	Academic Council Meeting No. 16, Dated 23/10/2021

Course Code: IST2000	**Course Title: Business Continuity and Risk Analysis** **Type of Course: Theory**	**L- T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	Through the study of incident response and contingency planning, including incident response plans, disaster recovery plans, and business continuity plans, this course aims to help students comprehend the principles of risk management.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Business Continuity and Risk Analysis** and attain **Employability** through **Participative Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Describe concepts of risk management [Knowledge] 2. Define and be able to discuss incident response options [Comprehension] 3. Design an incident response plan for sustained organizational operations [Comprehension] 4. Discuss and recommend contingency strategies, including data backup and recovery and alternate site selection for business resumption planning. [Knowledge]		
Course Content:			
Module 1 Sources of disaster and types of disasters			**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: CSE2018	**Course Title:** Theory of Computation **Type of Course:** Theory Only	**L- T-P- C**	3	0	0	3
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: 2. Describe various components of Automata. (Knowledge) 3. Illustrate Finite Automata for the given Language. (Application) 4. Distinguish between Regular grammar and Context free grammar. (Comprehension) 5. Construct Push down Automata. (Application) 6. 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: 2. Text Processing 3. Compilers 4. Text Editors 5. Robotics Applications 6. Artificial Intelligence Tools: 2. JFLAP (Java Formal Language and Automata Package) Software simulation tool. It's interactive educational software written in Java to experiment topics in automata theory. 3. Turing machine Online simulators.				
Text Book				

2. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6th Ed, 2018.

References

2. Aho, Ullman and Hopcroft, "Theory of Computation", Pearson India 3rd Edition 2008.
3. 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: CSN2508	**Course Title:CSE3016 Neural Networks and Fuzzy Logic** **Type of Course: Discipline Elective in AI & ML Basket** **Theory Course**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Neural Networks and Fuzzy Logic** and attain **Skill Development** through **Participative Learning** techniques.		
Course Outcomes	**On successful completion of this course the students shall be able to:** 1. Define the concept of Neural Networks. [Knowledge] 2. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge] 3. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 4. Demonstrate the Fuzzy logic concepts and its applications.[Application]		
Course Content:			

Module 1	**Introduction to Neural Network**	Quiz	Single Layer Perceptron	**9Classes**

Topics:
Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks.
Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models.
Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.

Module 2	**Multilayer Perceptron**	Quiz	Multilayer Perceptron	**10 Classes**

Topics:
Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples.
Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies.
Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.

Module 3	**Fuzzy Sets, Operations and Relations**	Quiz	Fuzzy Operations	**10Classes**

Topics:
Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets.
Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations.
Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.

Module 4	**Fuzzy Logic and Fuzzy Logic Controller**	Assignment	Developing Fuzzy Logic Controller	**10Classes**

Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions.
Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.

Targeted Application & Tools that can be used:

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: CSD1714 & CSD1715	**Course Title:** Predictive Analytics **Type of Course: Integrated**		**L- T-P-C**	2-0-0-2 0-0-2-1
Version No.	1			
Course Pre-requisites	Fundamentals of Data Analytics			
Anti-requisites	NIL			
Course Description	Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analysing and synthesizing data sets for decision making in the firms.			
Course Objective	The objective of the course is skill development of student by using Learning techniques			
Course Out Comes	**On successful completion of the course the students shall be able to:** • CO 1: Define the nature of analytics and its applications (Knowledge) • CO 2: Discuss the concepts of predictive analytics and data mining (Comprehension) CO 3: Compute the analytical tools in business scenarios to achieve competitive advantage (Application) • CO 4: Relate the real-world insights in decision trees and time series analysis methods in dynamic business environment (Application) • CO 5: Outline the importance of big data in predictive analytics (Comprehension)			
Course Content:				
Module 1	Introduction to Predictive Analytics	Self-Learning	Applications of analytics	**8 Sessions**
Topics: Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics; Popularity in Analytics; Predictive analytics in business Scenarios- case studies				
Module 2	Predictive Analytics & Data Mining	Case analysis	Predictive Analytics – Employee Attrition Case center.CO2. https://www.thecase centre.org/products/ view?id=143229	**8 Sessions**
Topics: Predictive Analytics- Definition, Importance and application; Predictive Analytics – Marketing, Health care & other industries; Skills and roles in Predictive Analytics; Tools & Software; Data Mining-Definition, applications, kinds of pattern data mining can discover, data mining tools & dark side of data mining				
Module 3	Data, Methods & Algorithms for Predictive Analytics	Participative Learning & Case Analysis	Predictive analytics in HR	**8 Sessions**
Topics: Nature; Pre-processing of data for analytics; Data Mining methods; Prediction; Classification- Decision tress; Algorithms - Naïve Bays, nearest neighbour; Cluster analysis, K means clustering, Association; Predictive analytics misconception; Regression - Simple linear regression (SLR) using OLS method, Multiple linear regression (MLR); applications of multiple regression for numeric prediction Violation of Ordinary least squares (OLS) method - Auto correlation, Heteroscedasticity , multicollinearity				
Module 4	Business Forecasting & Decisions Trees	Discussion & Presentation	Business Forecasting	10 Sessions
Topics Module 4: Business Forecasting; Time Series Data and Time Series Analysis- based Forecasting, Forecasting Accuracy, Auto-regressive and Moving average model-Unstructured data				

Module 5	Big Data in Predictive Analytics	Discussion & Presentation	Darkside of data mining, Challenges and problems in data analytics	06 Sessions

Fundamental concepts of Big data; Challenges and problems in data analytics; Big data technologies; Big data & stream analytics; Expert views on analytics;
Simulation – A/B Testing Data preparation, cleaning, and exploratory analysis using data visualization and descriptive statistics;

List of Laboratory Tasks:

1.Predicting buying behavior

- analytics to identify buying habits based on previous purchase history.
- predict customer purchase patterns.

2.Fraud detection

a. To identify anomalies in the system and detect unusual behavior to determine threats.
b. experts can feed historical data of cyberattacks and threats to the system. When the predictive analytics algorithm identifies something similar, it will send a notification to the respective personnel.

3.Healthcare diagnosis

- understanding the disease by providing an accurate diagnosis based on past data.
- predictive analytics help doctors reach the root cause of diseases.

4.Card abandonment

- predict how likely a customer is to abandon the cart.
- It will also provide companies with details about each customer about whether they will purchase or abandon the cart based on the previous visits to the store.

5.Content recommendation

- entertainment companies can predict what users want to watch based on their history.
- use analytics for predicting the user's behavior.

6. Equipment maintenance

the machinery would alert the personnel and the maintenance can be done to avoid unscheduled and accidental breakdowns.

Targeted Application & Tools that can be used

Statistical tools, documentary review, case analysis and Simulation help students to understand the data driven decisions for firms

Project work/Assignment:

Project:

By developing the questionnaire for specific objective of the brands, primary data collection and do the sales forecasting by using predictive analysis using SPSS software and develop report on data storytelling from the data analysis.

Assignment:

1. Review the article on Organisational capabilities in PA using PU link https://wwwemerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018-0324/full/html
2. Develop a podcast of 5 mins of each group discussions on Darkside of data mining. Each group consist of 5 members in the team

Text Book

T1 : Predictive Analytics Delen, D. (2020). Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners. Upper Saddle River, NJ, USA: FT Press. (Pearson Publication)

References

R1 Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.

R2 Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

E book link R1: Raman, R., Bhattacharya, S., & Pramod, D. (2018). Predict employee attrition by using predictive analytics. Benchmarking: An International Journal. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/BIJ-03-2018- 0083/full/html

E book link R2: Jing, Z., Luo, Y., Li, X., & Xu, X. (2022). A multi-dimensional city data embedding model for improving predictive analytics and urban operations. Industrial Management & Data Systems, (ahead-of-print). https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IMDS-01-2022-0020/full/html

E book link R3: Singh, R., Sharma, P., Foropon, C., & Belal, H. M. (2022). The role of big data and predictive analytics in the employee retention: a resource-based view. International Journal of Manpower. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IJM-03-2021-0197/full/html

E book link R4: Mishra, D., Luo, Z., Hazen, B., Hassini, E., & Foropon, C. (2018). Organizational capabilities that enable big data and predictive analytics diffusion and organizational performance: A resource-based perspective. Management Decision. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018- 0324/full/html

Web resources:

W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html

W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics

W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-intofuture-insights.html

W4. https://www.simplilearn.com/what-is-predictive-analytics-article

W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/

W6.https://www.marketingevolution.com/knowledge-center/the-role-of-predictive-analyticsin-data-driven-marketing

Swayam & NPTEL Video Lecture Sessions on Predictive Analytics

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc19_mg42/preview

Case References

1. Predictive Analytics Industry Use cases.
2. https://www.rapidinsight.com/blog/11-examples-ofpredictive-analytics/
3. Srinivasan Maheswaran (2017). Predictive Analytics – Employee Attrition Case center.

Topics relevant to development of "Skill Development": ": Application of Business Analytics to enhances customer satisfaction and firms' success

Topics relevant to development of "Environment and sustainability: Focus on Predictive analytics to minimize the errors in decision making

PEC

Course Code: **CSE3087**	**Course Title: Applied Machine Learning** **Type of Course: 1] Program Core** **2] Laboratory integrated**	**L-T- P-C**	2-0-2-3
Version No.	1.0		

Course Pre-requisites	**CSE3001 Artificial Intelligence and Machine Learning**
Anti-requisites	**NIL**
Course Description	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

<table>
<tr><td>Course Code:
CSE3009</td><td colspan="3">Course Title: Optimization Techniques for Machine Learning

Type of Course: Discipline Elective in Artificial Intelligence and Machine Learning Basket Theory</td><td>L-T- P-C</td><td>3-0-0-3</td></tr>
<tr><td>Version No.</td><td colspan="5">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">CSE3008 Machine Learning Techniques</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">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.</td></tr>
<tr><td>Course Objective</td><td colspan="5">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.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">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].</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1:</td><td>Fundamentals of Machine learning</td><td colspan="2">Quiz</td><td>Knowledge based Quiz</td><td>8 Sessions</td></tr>
<tr><td colspan="6">Topics: Machine learning paradigm, empirical risk minimization, structural risk minimization, learning guarantees, introduction of VC-dimension.</td></tr>
<tr><td>Module 2:</td><td>Machine learning models</td><td colspan="2">Quiz</td><td>Comprehension based Quiz</td><td>10 Sessions</td></tr>
<tr><td colspan="6">Topics: logistic regression, support vector machines, sparse regression, low dimensional embedding, low rank matrix factorization, sparse PCA, multiple kernel learning.</td></tr>
<tr><td>Module 3</td><td>Convex optimization models</td><td colspan="2">Assignment</td><td>Batch-wise Assignments</td><td>9 Sessions</td></tr>
<tr><td colspan="6">Topics: linear optimization, convex quadratic optimization, second order cone optimization, semidefinite optimization, convex composite optimization</td></tr>
<tr><td>Module 4:</td><td>Methods for convex optimization</td><td colspan="2">Assignment and Presentation</td><td>Batch-wise Assignment and Presentations</td><td>11 Sessions</td></tr>
<tr><td colspan="6">Topics: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting plances, stochastic gradient.</td></tr>
<tr><td colspan="6">Targeted Application & Tools that can be used: Use of Matlab tool</td></tr>
<tr><td colspan="6">Project work/Assignment:
Survey on Methods for convex optimization</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

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: **IST2504**	**Course Title: Reinforcement Learning** Techniques **Type of Course: 1] Program Core**	**L- T-P-C**	2-0-0-2
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)				
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: 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: CSE3088	**Course Title: Business Intelligence and Analytics** **Type of Course:1] Theory**	**L- T-P-C**	**3-0-0-3**
Version No.	1.0		
Course Pre-requisites	**CSE1002: Programming using Python** **CSE2012: Database Management Systems**		
Anti-requisites	**NIL**		
Course Description	The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective. Business Intelligence (BI) is a set of architectures, theories, methodologies and technologies that transform structured, semi-structured and unstructured data into meaningful and useful information. Students will analyze enterprise data requirements to develop queries, reports and build OLAP cubes that use business analytics to answer complex business questions.		
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		

<table>
<tr><td>Course Out Comes</td><td colspan="4">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]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>An Overview of Business Intelligence, Analytics (Comprehension)</td><td>Assignment</td><td></td><td>10 Hours</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Business Reporting, Visual Analytics and Business Performance (Knowledge)</td><td>Assignment</td><td></td><td>10 Hours</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Big Data and Analytics (Application)</td><td>Assignment</td><td></td><td>10 Hours</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 4</td><td>Emerging Trends and Future Impacts (Application)</td><td>Assignment</td><td></td><td>10 Hours</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio, Deep Note</td></tr>
<tr><td colspan="5">Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</td></tr>
<tr><td colspan="5">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)</td></tr>
</table>

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-T- P- C**	3-0-0-3
Version No.	1.1		
Course Pre-requisites	CSE3008: Machine Learning Techniques		
Anti-requisites	NIL		
Course Description	Overview of biological structure and artificial network, sensing algorithms, machine learning, localization. Hands-on implementation of cognitive recognition algorithms on both simulated and physical platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for cognitive analysis. It culminates in a critical review of recent advances in the field and a team project aimed at advancing the Reasoning.		
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Understand the different neural network models. **[Understand]** 2. Understand cognition systems and its requirements. **[Understand]** 3. Apply dynamic System concepts in Cognitive Science and Neuroeconomics. [**Application**] 4. Apply Cognitive Science in Learning and Reasoning. [**Application**]		

Course Content:	

Module 1	8 Sessions

Introduction to Biological Neuron: Structure of Neuron, Action Potential, Process of Action Potential, Process of Synaptic Transmission, Stimulate the synaptic vesicle, *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** **Course type : Theory Only**		**L- T-P-C**	**3-0-0-3**
Version No.	1.0			
Course Pre-requisites	**"CSE 3108 – Expert systems" course**			
Anti-requisites	**NIL**			
Course Description	The purpose of this course is to present the concepts of intelligent agents, searching, knowledge and reasoning, planning, learning and expert systems, to study the idea of intelligent agents and search methods, to study about representing knowledge, to study the reasoning and decision making in uncertain world, to construct plans and methods for generating knowledge, to study the concepts of expert systems.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Expert Systems and attain **Employability** through **Participative Learning** techniques .			
Course Out Comes	On successful completion of this course the students shall be able to: 1. CO1: Describe the modern view of AI as the study of agents that receive percepts from the Environment and perform actions. 2. CO2: Demonstrate awareness of informed search and exploration methods. 3. CO3: Explain about AI techniques for knowledge representation, planning and uncertainty Management. 4. CO4: Develop knowledge of decision making and learning methods.			
Course Content:				
Module 1	Introduction	Assignment	Theory	**9 Hours**
Topics: **Introduction to AI:** Intelligent agents – Perception – **Natural language processing** – Problem – Solving agents – Searching for solutions: Uniformed search strategies – Informed search strategies.				
Module 2	Knowledge and Reasoning	Assignment	Theory	**9 Hours**
Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – **Logical agents:** Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.				
Module 3	Uncertain knowledge and Reasoning	Assignment	Theory	**8 Hours**
Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – **Probabilistic reasoning** – Making simple decisions.				

Module 4	Planning and Learning	Assignment	Theory	**9 Hours**
Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – **Learning:** Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.				
Module 5 Expert Systems 10hrs		Assignment	Theory	
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: CSE3191	**Course Title: Generative AI** **Type of Course: Program Core – Lab Integrated**	**L- T-P-C**	2-0-2-3
Version No.	1		
Course Pre-requisites	Students are expected to be familiar with the basics of Machine Learning,Artificial Intelligence,Deep Learning,Natural Language Processing, Linear Algebra, Python.		
Anti-requisites	NILL		
Course Description	This course introduces students to the exciting world of generative AI, focusing on the algorithms, techniques and applications of creating novel data. Students will gain an understanding of generative models, explore various architectures and learning paradigms and delve into the ethical considerations and societal implications of this rapidly evolving field.		

Course Objective	objective of the course is to familiarize the learners with the concepts of **Generative AI** and attain **Skill Development** through **Experiential Learning** techniques.			
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand the fundamental concepts of generative modeling.(Understand) 2. Explore various generative model architectures.(Analyse) 3. Implement and train generative models.(Apply) 4. Apply generative models to real-world applications in various domains.(Apply) 5. Understand ethical implications of generative AI, including issues of bias, fairness and misuse.(Understand)			
Course Content:				
Module 1	**Introduction to Generative AI**	Assignment		07 Sessions
Overview of generative models: Historical perspective and evolution, Applications and use cases, **Generative Models Overview:** Types of generative models: RNN, Transformers, Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), and others, Strengths and weaknesses of each approach. Comparison of generative models.				
Module 2	**Transfer Learning & Fine Tuning**	Assignment		10 Sessions
Sequence Generation: Recurrent Neural Networks (RNNs) for sequence generation, Long Short-Term Memory (LSTM) networks, Transformer based generative model. **Transfer Learning & Fine tuning:** Using pre-trained models for generative tasks, Fine-tuning for specific applications, Case studies of transfer learning in generative AI.				
Module 3	**Prompt Engineering**	Assignment		10 Sessions
Prompt Engineering: Introduction, LLM for Text Generation-Text Generation Models, Transformer Architecture, OpenAI's pre-trained Transformers: ChatGpt, GPT 3.5, GPT 4. Standard Practices for Text Generation with ChatGPT.				
Module 4	**GANs and VAEs**	Assignment		10 Sessions
Generative Adversarial Networks (GANs): GAN architecture: Generator and Discriminator, Style transfer with GAN, Training GANs and common challenges, GAN applications in image and text generation.				
Variational Encoders(VAEs): Principles of VAEs, Encoder and decoder architecture, Training and optimization, Conditional VAEs and GANs, Controllable generation.				
Module 5	**Ethical Considerations in Generative AI**	Assignment		05 Sessions
Bias and fairness in generative models, Ethical implications of AI-generated content, Responsible AI development and deployment.				
List of Laboratory Tasks: Lab 1: Setting Up the Environment Objective: Install and set up the necessary tools and frameworks for generative AI development. Lab 2: Variational Autoencoders (VAEs) Objective: Implement a simple Variational Autoencoder for image generation using a dataset (e.g., MNIST). Tasks: Build and train a VAE model using TensorFlow or PyTorch. Visualize the latent space and generated images.				

Lab 3: Generative Adversarial Networks (GANs)
Objective: Implement a basic Generative Adversarial Network for image generation.
Tasks: Create a generator and discriminator using deep learning frameworks. Train the GAN on a dataset and visualize the generated images.

Lab 4: Conditional Generative Models
Objective: Extend the GAN or VAE to a conditional generative model.
Tasks: Introduce conditioning variables (e.g., class labels) to control generation. Train and evaluate the model on a conditional dataset.

Lab 5: Text Generation with Recurrent Neural Networks (RNNs)
Objective: Generate text sequences using Recurrent Neural Networks.
Tasks: Implement an RNN for text generation. Train the model on a text dataset and generate sample sequences.

Lab 6: Style Transfer with Generative Models
Objective: Apply generative models for artistic style transfer.
Tasks: Use a pre-trained model or implement a style transfer algorithm. Experiment with different styles and content images.

Lab 7: Transfer Learning for Generative Models
Objective: Explore transfer learning in the context of generative AI.
Tasks: Fine-tune a pre-trained generative model for a specific dataset or task. Evaluate the performance and compare it with training from scratch.

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

Project work/Assignment:
Assignment:
During the course, students would need to do coding assignments to learn to train and use different generative AI models.

Project Assignment:
Assignment 1: Module 1,
2
Assignment 2: Module 4,5

Textbooks:

T1: Generative Deep Learning, 2nd Edition by David Foster, O'Reilly Media, Inc. ISBN: 9781098134181.May 2023.

T2: Generative AI with Python and TensorFlow 2, By Joseph Babcock, Raghav Bali, ISBN:9781800200883.April 2021.

T3: Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, O'Reilly Media, Inc., ISBN: 9781098153373, July 2024.

References:

- Online tutorials and lectures by leading researchers in generative AI.
- Open-source libraries and frameworks for implementing generative models.
- Research papers and articles on recent advancements in generative AI

Web references: https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-courses/

https://cloudxlab.com/course/188/pg-certificate-program-in-data-science-ai-by-cec-iit-roorkee?utm_source=google&utm_campaign=20676271827&utm_medium=g&utm_content=learn%20artificial%20intelligence&utm_term=learn%20artificial%20intelligence&utm_creative=682957531590&gclid=EAIaIQobChMIgI-Bs8GBgwMVdh6DAx0W8gUOEAMYASAAEgKAV_D_BwE

Topics relevant to "Employability": Understand and implement generative models for various real-time applications.
Topics relevant to "Environment and Sustainability": Ethical Considerations and Societal Implications of Generative AI.

Course Code: CSE2023	**Course Title: Data Warehousing and its Applications** **Type of Course:** **Theory**		**L-T- P- C**	3-0-0-3
Version No.	1.0			
Course Pre-requisites	NIL			
Anti-requisites	Basics of data mining & Python			
Course Description	The Objective of this course is to create a trove of historical data that can be retrieved and analyzed to provide useful insight into the organization's operations. A data warehouse is a vital component of business intelligence. This course will introduce basic concepts of data warehousing, architecture, design principles, building data warehouse, data mining techniques and major application areas of data warehouse.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data Warehousing and its Applications** and attain **Employability** through **Participative Learning** techniques.			
Course Outcomes	On completion of this course, the students will be able to • 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: CSE3002	**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: CSE3030	**Course Title:** **Mining Massive Datasets** **Type of Course: Program Core** **Theory and Lab Integrated Course**	**L- T-P-C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	CSE2021- Data Mining		
Anti-requisites	**NIL**		
Course Description	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 Learning	Programming Assignment	Data Collection and Analysis	**11 Classes**
Mining Social-Network Graphs Clustering of Social-Network Graphs - Direct Discovery of Communities - Partitioning of Graphs Finding Overlapping Communities - Counting Triangles using MapReduce Neighbourhood Properties of Graphs **Semi-Supervised Learning** Introduction to Semi-Supervised Learning, Semi-Supervised Clustering, Transductive Support Vector Machines				
Targeted Application & Tools that can be used: • **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: CSE3032	**Course Title:** Streaming Data Analytics **Type of Course:** Program Core **Theory and Lab Integrated Course** **Big Data Basket**	**L- T-P-C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	CSE3002 - Big Data Technologies		
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 knowledge of the fundamentals of streaming analytics, the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volume of streaming data.		
Course Objective	The course provides the foundational concepts, methods, languages, and systems for ingesting, processing, and analyzing data that flows to enable real-time decisions. The course aims to the tame velocity dimensions of Big Data without forgetting the volume and variety dimensions.		
Course Outcomes	On successful completion of the course the students shall be able to: **(1)Recognize** the characteristics of data streams that make it useful to solve real-world problems**.** **(2)Identify** appropriate algorithms for analyzing the data streams for a variety of problems**.** **(3)Apply** different algorithms for analyzing the data streams**.**		
Course Content:			
Module 1	**Introduction to Data Streams**	Assignment/Quiz	Streaming methods	**08 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	**08 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

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 Clustering Algorithm.

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

5. **Level 1: Implementation of The ODAC Global Algorithm.**
   Level 2: Implementation of The ODAC: The Test Split 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 Itemsets mining of data streams using Lossy Counting algorithm**
   Level 2: Reservoir Sampling for Sequential Pattern Mining over Data 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, 2010.

References

David Luckham, “The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems”, Addison Wesley, 2002.

Charu C. Aggarwal, "Data Streams: Models And Algorithms", Kluwer Academic Publishers, 2007.
Topics related to development of "FOUNDATION": Basic Streaming Methods Topics related to development of "EMPLOYABILITY": Project on streaming analysis of real time data set

Course Code: CSE2029	**Course Title: Web Data Analytics** **Type of Course: Discipline Elective in data Science basket** **Theory & Integrated Laboratory**		**L-T-P- C**	2-0-2-3
Version No.	1.0			
Course Pre-requisites	Python programming			
Anti-requisites	**NIL**			
Course Description	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: CSE3136	**Course Title:** **E-Business and Marketing Analytics** **Type of Course:** **Theory Only Course**	**L-T-P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course describes the basic principles of e-business technologies. Upon the completion of this course, students should have a good working knowledge of e-business concepts, applications, technologies (e.g. e-business infrastructure, technology required for e-business, e-business marketplace, e-Commerce, B2B e-		

	business, E-business strategy, e-procurement, customer relationship management and service implementation and optimization) and ability to understand any kind of marketing analytics.
Course Objective	This course is designed to improve the learner's EMPLOYABILITY SKILLS by using real-world PROBLEM-SOLVING methodologies.
Course Out Comes	**On successful completion of the course, the students shall be able to:** 1. Demonstrate the strategy of E-Business and identify the component parts (Knowledge). 2. Identify records according to management policy by maintaining database and processing software (Knowledge). 3. Identify the ethical, social and security issues of information systems (Knowledge). 4. Apply the basic concepts and technologies used in the field of business management information systems (Application).

Course Content:

Module 1: E-BUSINESS – An Introduction	**10 Sessions**
Introduction, E-Commerce – definition, History of E-commerce, types of E-Commerce B to B etc. Comparison of traditional commerce and e-commerce. E-Commerce business models – major B to B, B to C model, Consumer-to-Consumer (C2C), Consumer-to-Business (C2B) model, Peer to-Peer (P2P) model – emerging trends. Advantages/ Disadvantages of e-commerce, web auctions, virtual communities, portals, e-business revenue models.	
Module 2: MARKETING ANALYTICS	**10 Sessions**
Introduction to Marketing Analytics-Marketing Budget and Marketing Performance Measure, Marketing Metrics and its application- Financial Implications of various Marketing Strategies-Geographical Mapping, Data Exploration, Market Basket Analysis, History and Evolution of social media-Understanding Science of social media, Web analytics, Search analytics. E-Commerce and marketing B to B and B to C marketing and branding strategies.	
Module 3: SECURITY THREATS OF E-BUSINESS	**09 Sessions**
Security threats – An area view – implementing E-commerce security – encryption – Decryption, Protecting client computers E-Commerce Communication channels and web servers Encryption, SSL protocol, Firewalls, Cryptography methods, VPNs, protecting, networks, policies and procedures, E-payment systems – An overview. B to C payments, B to B payments. Types of E- payment system, Secure Electronic Transaction (SET) protocol. RFID Concepts.	
Module 4: E-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: CSE2026	**Course Title: Data Handling and Visualization** **Type of Course:1] Program core** **2] Lab Integrated Course**	**L-T- P-C**	**2-0-2-3**
Version No.	1.0		
Course Pre-requisites	**Python Programming, Basic Mathematics**		
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 Out Comes	On successful completion of this course the students shall be able to: 1. Employ the complete Data Handling pipeline 2. Handle data occurring in large volumes 3. Apply the basic principles and elements of visualization 4. Implement the visualization concepts practically using Python		
Course Content:			

Module 1	Introduction to Data Handling (Comprehension)	Assignment	Programming activity	**10 Hours (8L,2P)**

Topics:
Data collection, Data Preparation Basic Models-Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases, Data Cleaning and Preparation, Handling Missing Data, Data Transformation, String Manipulation.

Python Libraries: NumPy, pandas, matplotlib, GGplot ,Introduction to pandas Data Structures

Module 2	Data Wrangling and Analysis (Application)	Assignment	Programming activity	**10 Hours (8L,2P)**
Topics: Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. Data Analysis: The problems you face when handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Case study 1: Predicting malicious URLs, Case study 2: Building a recommender system inside a database				
Module 3	**Data Visualization Techniques** (Application)	Assignment	Programming activity	**10 Hours (6L,4P)**
Topics: Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation Scalar and Point techniques – Color maps – Contouring – Height Plots - Vector visualization techniques – Vector properties – Vector Glyphs – Vector Color Coding – Matrix visualization techniques				
Module 4	**Diverse Types of Visual Analysis** (Application)	Assignment	Programming activity	**10 Hours (6L,4P)**
Topics: Time- Series data visualization – Text data visualization – Multivariate data visualization and Case studies				
List of Laboratory Tasks: **Labsheet -1 [3 Practical Sessions]** Working with Numpy Functions Working with Pandas functions Practicals based on Interacting with Web APIs **Labsheet -2 [2 Practical Sessions]** Practicals based on Data Cleaning and Preparation Practicals based on Data Wrangling **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				
Targeted Application & Tools that can be used: Anaconda/Google Colab, Google Data Studio				
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. Munzner, T., "Visualization Analysis and Design", CRC Press, (2015).
3. Dr. Ossama Embarak, "Data Analysis and Visualization Using Python", Apress,(2018)

References

R1. García Salvador, Luengo Julián, & Herrera, F. "Data preprocessing in Data Mining", Springer,(2015)

R2. Belorkar, A, "Interactive Data Visualization with Python" - [S.l.]: Packt Publishing, Second Edition. (2018)

R3. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/

Weblinks

Making data visual : a practical guide to using visualization for insight, Shroff Publishers and Distributors, 2018

http://puniversity.informaticsglobal.com:2232/cgi-bin/koha/opac-detail.pl?biblionumber=17611

Python for Data Science, IIT Madras
https://nptel.ac.in/courses/106106212

Course Code: CSE3022	**Course Title:** Cryptocurrency Technology **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1		
Course Pre-requisites	• 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: CSE3169	**Course Title: Modern Cryptography** **Type of Course: Theory**	**L- T-P-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The area of cryptography focuses on various problems pertaining to secure communication and computation. It entails the study of models that express security properties as well as the algorithms and protocols that are the implementation candidates for satisfying these properties. An important dimension of modern cryptography is the design of security proofs that establish security properties. Such proofs are conditional on assumptions that fall in two categories: "system assumptions" such as the faithful execution of code, or the availability of private randomness and "computational assumptions" that are related to the computational complexity of various problems (including factoring large numbers and others). Students will learn to model security problems, design protocols and prove them secure under precisely formulated system and computational assumptions.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe basic group theory, number theory, discrete probability. (Remember) 2. Explain the model security problems and to write security proofs. (Understand) 3. Examine fundamental cryptographic primitives including Key Exchange, Digital Signatures, Oblivious Transfer, Public-Key Encryption, Commitment. (Apply) 4. Demonstrate basic computational problems that are important for cryptography such as the factoring problem, the RSA problem, the discrete-logarithm problem. (Apply)					

Course Content:

Module 1	**Securing Our Data**	Assignment		**10 Classes**
Topics: Current Threat landscape, Understanding security services, Common cryptographic concepts, Substitution and transposition, The evolution of ciphers, Comparing passive and active attacks, Protecting sensitive data, Maintaining integrity				
Module 2	**Cryptographic Techniques**	Assignment		**10 Classes**
Topics:				

Evolution of Symmetric Encryption, Dissecting block and stream ciphers, Comparing symmetric encryption operation modes, Securing wireless communication, Comparing public key algorithms, Digital signatures, Describing a hash algorithm, Identifying optimal hash algorithms, Authenticating a message				
Module 3	**Applying Cryptography**	Assignment		**10 Classes**
Topics: Understanding FIPS and PCI DSS, Leveraging encrypted data, Describing a PKI framework, Managing public keys, Examining a certificate				
Module-4	**IPsec and TLS**	Assignment		**12 Classes**
Topics: Using a VPN, Outlining a IPSec VPN, TLS, Recognizing cryptographic attacks, Attacking the infrastructure, Influence of quantum computing				
Project work/Assignment:				
1. **Assignment 1 on (Module 1 and Module 2)** 2. **Assignment 2 on (Module 3 and Module 4)**				
REFERENCE MATERIALS: TEXTBOOKS 1. Lisa Bock, "Modern Cryptography for Cybersecurity Professionals", 1st Edition, Packt Publications, 2021. REFERENCES 1. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", 2nd Edition, Chapman and Hall/CRC, 2014. **JOURNALS/MAGAZINES** 1. International Journal of Applied Cryptography https://www.inderscience.com/jhome.php?jcode=ijact SWAYAM/NPTEL/MOOCs: 1. Coursera – Principles of Modern Cryptography 2. Futurelearn – Introduction to Cryptography				

Course Code: CSE2037	**Course Title: Cyber Forensics** **Type of Course: Program Core**	**L- T-P-C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**Cryptography and Network Security**		
Anti-requisites	NIL		
Course Description	The purpose of this course is to introduce to the students Cyber Forensic concepts. The course is both conceptual and analytical and is understood with various open-source software's. The course develops critical thinking like correctly collect and analyze computer forensic evidence, analyze and validate Forensics Data, study the tools and tactics associated with Cyber Forensics. The course involves quizzes, assignments with various open-source software.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **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 Evidence and Data Recovery**	Assignment	Writing task	**No. of 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: CSE3342	**Course Title:** Ethical Hacking **Type of Course:** Discipline Elective in Cyber Security Basket	**L- T-P-C**	**1-0-4-3**
Version No.	1.0		
Course Pre-requisites	Basic networking tools knowledge and Cryptography & Network Security		
Anti-requisites	NIL		
Course Description	This course introduces students to a wide range of topics related to ethical hacking. It also provides an in-depth understanding of how to effectively protect computer networks. These topics cover some of the tools and penetration testing methodologies used by ethical hackers and provide a thorough discussion of what and who an ethical hacker is and how important they are in protecting corporate and government data from cyber-attacks		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Ethical Hacking** and attain **Skill Development** through **experiential Learning** techniques.		
Course OutComes	On successful completion of this course the students shall be able to: 1. Illustrate the importance of ethical hacking 2. Categorize the various techniques for performing reconnaissance. 3. Demonstrate various types of system scanners and their functions 4. Demonstrate the function of sniffers on a network		
Course Content:			

Module 1	**Introduction to Hacking** (Knowledge, Application)	Assignment	Programming activity	**12 Hours**
Topics: Introduction to Hacking-Important Terminologies - Asset - Vulnerability - Penetration Test - Vulnerability Assessments versus Penetration Test - Penetration Testing Methodologies - Categories of Penetration Test. **Assignment:** Different phase methodologies on penetration testing				
Module 2	**Linux Basics**	Assignment	Programming activity	**10 Hours**
Topics: Major Linux Operating Systems - File Structure inside of Linux - BackTrack - Changing the Default Screen Resolution - Some Unforgettable Basics. **Assignment:** Penetration testing distribution				
Module 3	**Information Gathering Techniques**	Assignment	Programming activity	**11 Hours**
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 Code: CSE2040	**Course Title:** Cyber threats for IOT and Cloud **Type of Course:1] Program Core** **2] Theory Only**	**L-T- P- C**	3-0-0-3
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.

Module 3	**Cyber Threats in Internet of Things**	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:

IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats- Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats.

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

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** techniques. This is attained through the assessment component 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- T-P- C**	3-0-0-3
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: CSE3094	**Course Title:** Cyber Security **Type of Course:1] Discipline Elective 2] Theory Only**		**L- T-P- C**	3-0-0-3
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-UeDqJ ,https://presiuniv.knimbus.com/user#/home

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

Course Code: CSE3098	**Course Title: Vulnerability Assessment and Penetration Testing** **Type of Course: Theory Only Course**		**L-T- P-C**	3-0-0-3
Version No.	1.0			
Course Pre-requisites	CSE3078			
Anti-requisites	**NIL**			
Course Description	This course explores the tools that can be used to perform information gathering. This course also covers how vulnerability can be carried out by means of tools or manual investigation, and analysis of common attacks in data, mobile applications and wireless networks			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Vulnerability Assessment and Penetration Testing** and attain **Employability** through **Problem Solving** Methodologies.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • 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: **CSE397**	**Course Title:** **Digital and Mobile Forensics** **Type of Course:** **Theory**	**L-T- P-C**	3-0-0-3
Version No.	2.0		
Course Pre-requisites	Operating System, Computer Networks.		
Anti-requisites	Nil		
Course Description	This course demonstrates the use of Mobile phones and digital devices across the globe has increased dramatically. These devices are more susceptible to information security attacks and thus they also possess huge evidences which shall be used during crime scene investigation. This makes the Course on mobile and digital forensics an inevitable one for the security professionals. This Course on mobile and digital forensics will provide a better understanding on different forms of evidences in many digital devices, collection and interpretation of the same. Topics include: Wireless technologies and security-wireless protocols, wireless threats, cell phones and GPS, SMS and data interception in GSM. Mobile phone forensics - files present in SIM card, device data, external memory dump, Android forensics. Digital forensics: - evaluating digital evidence, Digital forensics examination principles		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain EMPLOYABILITY SKILLS through PARTICIPATIVE Learning techniques		

Course Outcomes	On successful completion of this course the students shall be able to: CO 1: Outline the basic concepts of Cybercrime and digital Forensics. (L1) CO 2: Employ various digital Forensic tools to perform Forensic investigation(L3) CO 3: Interpret security challenges and Forensic examination process of wireless devices. (L2) CO 4: Produce digital evidence through the usage of mobile device Forensic tools (L3)			
Course Content:				
Module 1	Cybercrime and Digital Forensic Principles	Assignment	Seminar	10 Sessions
Cybercrime: Definition, Nature and Scope of Cyber crime, Types of cyber crime, Categories of cyber crime, Investigating Cybercrime, Digital Evidence, Prevention of cyber crime, Overview of Digital Forensics, Phases of Digital Forensics, Digital devices in society, Evidential Potential of Digital Devices: closed and open systems, Digital investigation process models: Staircase Model, Evidence Flow Model, Increasing awareness of digital evidence, Case studies on Cyber Crimes.				
Module 2	Digital Forensics examination process	Case Studies	Case Study	11 Sessions
Language of Computer crime investigation, preparing a Digital Forensics Investigation, Chanllenging aspects of digital evidence, Presenting digital evidence, Device usage, Profiling and cyberprofiling, Contamination, Digital forensics examination principles: Previewing, Imaging, Continuity and hashing, Evidence locations, A seven-element security model, A developmental model of digital systems. .				
Module 3	Wireless technologies and Wireless threats	Quiz	GSM, Parben's Cell Seizure	12 Sessions
Overview of Modern Wireless Technology, Wireless Crime Prevention Techniques, War-Driving, War-Chalking, War Flying, Voice SMS, GSM and Identification Data Interception in GSM, Cell Phone Hacking and Phreaking, Who's Tracking You and Your Cell Phone? How Does Cellular Fraud Occur? Cell Phone Forensics, Forensic Rules for Cellular Phones, Cell Phone Flowchart Processes Using Paraben's Cell Seizure.				
Module 4	Mobile phone Forensics	Quiz	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:

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

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: CSE3102	**Course Title:** Malware Analysis **Type of Course:** Discipline Elective in Cyber Security Basket			**L- T-P-C**	3-0-0-3
Version No.	1.0				
Course Pre-requisites	Should Have the knowledge of Cryptography and Network Security				
Anti-requisites	**NIL**				
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Malware Analysis and attain **Employability** through **Participative Learning** techniques.				
Course OutComes	On successful completion of this course the students shall be able to: 1. Understanding the nature of malware, its capabilities, and how it is combated through detection and classification. 2. Apply the methodologies and tools to perform static and dynamic analysis on unknown executables. 3. Analyze scientific and logical limitations on society's ability to combat malware.. 4. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.				
Course Content:					
Module 1	**Introduction to MALWARE ANALYSIS**		Assignment	Programming activity	**12 Hours**

Topics:
Introduction to malware, OS security concepts, malware threats, evolution of malware, malware 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: CSE3043	**Course Title:** Automated Test Management **Type of Course: Integrated**	**L- T-P-C**	2-0-2-3
Version No.	1.0		
Course Pre-requisites	**Introductory course on Software Engineering.**		
Anti-requisites	NA		
Course Description	This course is intended for understanding the principles of automation and the application of tools for the analysis and testing of software. The automated analysis encompasses both approaches to automatically generate a very large number of tests to check whether programs meet requirements, and also means by which it is possible to prove that software meets requirements and that it is free from certain commonly-occurring defects, such as divide-by-zero, overflow/underflow, deadlock, race-condition freedom, buffer/array overflow, uncaught exceptions, and several other commonly-occurring bugs that can lead to program failures or security problems. The learner will become familiar with the fundamental theory and applications of such approaches, and apply a variety of automated analysis techniques on example programs.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Automated Test Management and attain **SKILL DEVELOPMENT** through **Experiential Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • 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: CSE3044	**Course Title:** BUILD AND RELEASE MANAGEMENT **Type of Course: Theory Only Course**	**L-T- P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	CSE 2014 – Software Engineering		
Anti-requisites	-		
Course Description	Build and Release management course guides the software development efforts from planning to deployment, resulting in better customer satisfaction with the end product. The benefits of Build and release is essential to high-performing software development and delivery. Build and release enhanced by safely testing features in production environments, gathering valuable feedback and releasing new and improved features continuously. In this course, Students will learn about the benefits of using a release management process to manage and improve the development of a software build. This course covers the key concepts and principles that apply to release management, as well as common considerations and potential challenges to be aware of.		
Course Objective	The objective of the course is to familiarize the learners with the concepts Of Build And Release Management and attain **Employability** through **Participative Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • 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: CSE3045	**Course Title: Development Automation** **Type of Course:** **Elective in Devops Basket** **Theory & Integrated Laboratory**	**L-T- P-C**	2-0-2-3
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.

Course Code:	**Course Title:**		
CSE3053	**Big Data Analytics for IoT**	**L-T- P-C**	1-0-4-3
	Type of Course: **Program Core**		

	Theory with embedded lab			
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: CSE3176	**Course Title: Edge Computing** **Type of Course: Theory**	**L- P- T-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Fundamentals of Cloud Computing					
Anti-requisites	NIL					
Course Description	This course we will cover fundamentals of Edge computing and its applications in low latency and critical real-time computing scenarios. The course brings in theory of Edge computing, focusing on it as a complementary approach that addresses some of the limitations of cloud computing. The course will cover applications where edge computing is a necessity, such as real-time applications that require low latency and high bandwidth. For example, autonomous vehicles require real-time processing of data from sensors, which cannot be done in a centralized data center due to latency issues. This course provides an in-depth understanding of edge computing principles with different use case of edge computing. Topics include Overview of Edge Computing, Fundamental concepts edge computing, Edge Computing Architecture and Technologies, Security and Privacy in Edge Computing, Applications and Case Studies in Edge Computing.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. List the Concepts and Principles of Edge Computing. (Remember). 2. Explain the key components and architecture of an edge computing system. (Understand). 3. Identify the need of Security and Privacy in Edge Computing. (Understand). 4. Discuss the edge computing concept for real-world case studies. (Understand)					

Course Content:

Module 1	**Fundamentals of Edge Computing**	Assignment		**08 Classes**
Topics: Overview of Edge Computing: Concepts and Definitions, Evolution of Edge Computing from Cloud Computing, Use Cases and Applications of Edge Computing, Challenges and Opportunities in Edge Computing				
Module 2	**Edge Computing Architecture and Technologies**	Assignment		**10 Classes**
Topics: Edge Computing Architecture: Components and Layers, Edge Devices and Sensors: IoT Integration, Edge Computing Frameworks and Platforms, Networking Technologies for Edge Computing: 5G, Wi-Fi 6, and LPWANs				
Module 3	**Security and Privacy in Edge Computing**	Assignment		**10 Classes**
Topics:				

Security Challenges in Edge Computing Environments, Threats and Vulnerabilities at the Edge, Edge Security Best Practices: Encryption, Authentication, and Access Control, Privacy Considerations in Edge Computing: Data Ownership and Compliance

Module-4	**Applications and Case Studies in Edge Computing**	Assignment		**12 Classes**

Topics:
Real-time Analytics at the Edge: Predictive Maintenance and Anomaly Detection, Edge AI and Machine Learning: Intelligent Edge Devices, Edge Computing in Smart Cities and Industrial IoT, Case Studies of Edge Computing Deployments in Various Industries

Project work/Assignment:

1. **Assignment 1 on (Module 1 and Module 2)**
2. **Assignment 2 on (Module 3 and Module 4)**

REFERENCE MATERIALS:

TEXTBOOKS

1. "Edge Computing: Concepts, Technologies, and Applications" by Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, published in 2017, is Wiley.
2. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya, Satish Narayana Srirama, Pradeep Kumar Singh, Rodrigo N. Calheiros
3. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya, Satish Narayana Srirama, Pradeep Kumar Singh, Rodrigo N. Calheiros was published by Wiley in 2019.
4. "Edge Security in the IoT Era: Trustworthiness and Resilience" by Raja Naeem Akram and Mubashir Husain Rehmani was published by Springer in 2020.
5. "Edge Intelligence: Pioneering the Future of AI" by Hsinchun Chen, Roger H.L. Chiang, Veda C. Storey, Wingyan Chung was published by Springer in 2019.

REFERENCES

1. Edge Computing Systems with Kubernetes: A use case guide for building edge systems using K3s, k3OS, and open source cloud native technologies, Sergio Mendez, Packt Publishing 2022, ISBN 1800568592, 9781800568594.

JOURNALS/MAGAZINES

1. **IEEE Transactions on Services Computing (TSE): (https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4629386).**
2. **Journal of Edge Computing (JEC): (https://acnsci.org/cms/)** .

SWAYAM/NPTEL/MOOCs:

1. NPTEL - **Edge Computing, IIT Kanpur https://nptel.ac.in/courses/106104449**
2. Coursera – https://www.coursera.org/learn/security-at-the-edge-first-course-1

Course Code: CSE3095	**Course Title: Cloud Security** **Type of Course: Discipline Elective in Cloud Computing Basket** **Theory**	**L-T- P-C**	3-0-0-3
Version No.	1.0		

Course Pre-requisites	**[1] Cloud Computing and Services (CSE322)**			
Anti-requisites	**NIL**			
Course Description	This course provides ground-up coverage on the high-level concepts of cloud landscape, architectural principles, and techniques. It describes the Cloud security architecture and explores the guiding security for Infrastructure and Softwares.			
Course Objective	**This course is designed to improve the learners' 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: CSE3186	**Course Title:** Cloud Infrastructure and Systems Software **Type of Course: Theory**	**L- P- T-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course presents a top-down view of cloud computing that provide students with a sound foundation of the cloud computing so that they are able to start using and adopting cloud computing services and tools in their real-life scenarios. Students will study state-of-the-art solutions for cloud computing. This course gives students an insight into the basics of cloud computing along with virtualization, cloud platforms, data storage, security, and advanced cloud enabling technologies. Cloud Computing and its infrastructure is one of the fastest growing domains from a while now.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand the main concepts, key technologies and fundamentals of cloud computing. 2. Understand cloud enabling technologies and virtualization. 3. Analyze various cloud programming models and apply them to solve problems on the cloud. 4. Explain data storage and major security issues in the cloud. 5. Understand application development for cloud. 6. Understand trends in cloud enabling technologies					
Course Content:						
Module 1	Introduction to Cloud Computing and analytics	Assignment				**08 Classes**
Topics: Originations and Influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges, Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Federated Cloud/Inter cloud, Types of Clouds. Cloud Analytics						
Module 2	Virtualization	Assignment				**10 Classes**
Topics: Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory and I/O Devices, Implementation level of virtualization, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation.						
Module 3	Cloud Plat forms and Standards	Assignment				**10 Classes**

Amazon web services: Compute services, Storage Services, Communication Services, Additional services, Google App Engine: Architecture and core concepts, Application lifecycle, Cost model Microsoft Azure: Azure core concepts, SQL Azure, Windows Azure platform appliance.
Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application.

Module-4	Cloud Systems Software	Technical Presentation		**12 Classes**

Topics:
Programming frameworks and their implementation issues in the Cloud, Scalable distributed data stores for organizing persistent data in Cloud applications, Resource Management, Virtualization technology.

Project work/Assignment:

1. **Assignment 1 on (Module 1 and Module 2)**
2. **Assignment 2 on (Module 3 and Module 4)**

REFERENCE MATERIALS:

TEXTBOOKS

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Pearson, ISBN:9789332535923, 9332535922, 1st Edition.
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: APracticalApproach",2010, The McGraw-Hill.

REFERENCES

3. Srinivasan, J. Suresh, Cloud Computing: A practical approach for learning and implementation, Pearson, ISBN: 9788131776513.
4. Kris Jamsa, Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, Jones and Bartlett, ISBN: 9789380853772

JOURNALS/MAGAZINES

- Cloud Computing: System Instances and Current Research: https://www.researchgate.net/publication/251043013_Cloud_Computing_System_Instances_and_Current_Research_Cloud_Computing_System_Instances_and_Current_Research
- Systematic analysis of software development in cloud computing perceptions https://onlinelibrary.wiley.com/doi/10.1002/smr.2485

SWAYAM/NPTEL/MOOCs:

1. Swayam Nptel – Cloud Computing and Distributed Systems – IIT Patna https://onlinecourses.nptel.ac.in/noc21_cs15/preview
2. Coursera – Cloud Systems Software https://www.coursera.org/learn/cloud-sys-software#testimonials

Course Code: CSE3187	**Course Title:** Virtualization and Containerization **Type of Course: Theory**	**L- P- T-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Cloud Computing concepts					
Anti-requisites	NIL					
Course Description	This course focus on cloud computing models for enabling ubiquitous, convenient, on-demand access to a shared computing resources. It also enables the students to understand the benefits, risk and recommendations for cloud security implications from technical perspective.					

	In addition to this, the course provides an understanding of pros and cons of different approaches to virtualization enabling students to gain research competence from industry.
Course Outcomes	On successful completion of this course the students shall be able to:

CO1	Organize the main concepts, key technologies, strengths and limitations of cloud computing and development.	Analyze
CO2	Use the key enabling technologies that help in the development of cloud.	Apply
CO3	Develop the ability to use the architecture of cloud, service and delivery models.	Apply
CO4	Examine the core issues of cloud computing such as resource management and security.	Analyze
CO5	Investigate current cloud technologies and resources to achieve significant economic resources.	Create
CO6	Select the appropriate technologies, algorithm, and approaches for the development of cloud related issues.	Evaluate

Course Content:

Module 1	Introduction	Assignment		**08 Classes**

Topics:
Introduction to Cloud Computing with simple web application programs – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

Module 2	Virtualization And Cloud Enabling Technologies	Assignment		**10 Classes**

Topics:
Service Oriented Architecture – REST and Systems of Systems – Web Services with sample experiments – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

Module 3	Cloud Architecture, Services and Storage	Assignment		**10 Classes**

Topics:
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service with programming – Advantages of Cloud Storage – Cloud Storage Providers – S3.

Module-4	Introduction to Containerization	Technical Presentation		**12 Classes**

Topics:
What is containerization, Benefits of containerization, use cases, Functionality of containerization, Container orchestration, types of container technology, Virtualization vs Containerization

Project work/Assignment:

1. **Assignment 1 on (Module 1 and Module 2)**
2. **Assignment 2 on (Module 3 and Module 4)**

REFERENCE MATERIALS:

TEXTBOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. https://dzone.com/articles/introduction-to-containerization.

REFERENCES

3. The Metaverse: Buying Virtual Land, NFTs, VR, Web3 & Preparing for the Next Big Thing! by Alan Turton published by Terry Winters, November 2021.
4. https://aws.amazon.com/what-is/containerization.

JOURNALS/MAGAZINES

- Containers for Virtualization: An Overview https://www.researchgate.net/publication/325534952_Containers_for_Virtualization_An_Overview
- Container Technology https://www.researchgate.net/publication/364181139_Container_Technology

SWAYAM/NPTEL/MOOCs:

1. Swayam Nptel – Edge Computing – IIT Patna by Prof. Rajiv Misra https://onlinecourses.nptel.ac.in/noc24_cs66/

2. Coursera – **Containerized Applications on AWS** https://www.coursera.org/learn/containerized-applications-on-aws?isNewUser=true

Course Code: CSE2058	**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: CSE3090	**Course Title:** 5G Networking **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1		
Course Pre-requisites	Digital communications, Mobile Communication Systems, Wireless Networks		
Anti-requisites	Nil		
Course Description	The aim of this course is to let the students understand that air Interface is one of the most important elements that differentiate between 2G, 3G, 4G and 5G. While 3G was CDMA based, 4G was OFDMA based; this course reveals the contents of air interface for 5G. While 4G brought in a deluge of infotainment services, 5G aims to provide extremely low delay services, great service in crowd, enhanced mobile broadband (virtual reality being made real), ultra-reliable and secure connectivity, ubiquitous QoS, and highly energy efficient networks.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of 5G Networking and attain **Employability** through **Participative Learning** techniques		
Course Out Comes	**On successful completion of the course the students shall be able to:** • 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: CSE3132	**Course Title: Network Management Systems** **Type of Course: Theory Only Course**	**L- T-P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	To understand the principles of network management, different standards and protocols used in managing complex networks and the Automation of network management operations and making use of readily available network management systems.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Network Management Systems** and attain **Skill Development** through **Participative Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** 1]Acquire the knowledge about network management standards (OSI and TCP/IP). 2]Acquire the knowledge about various network management tools and the skill to use them in monitoring a network. 3]Analyze the challenges faced by Network managers. 4]Evaluate various commercial network management systems and open network management systems. 5]Analyze and interpret the data provided by an NMS and take suitable actions.		

Course Content:				
Module 1	DATA COMMUNICATION AND NETWORK MANAGEMENT	Assignment	Data Collection/Interpretation	**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: ISE2502	**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: **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 and Deadlocks**	Coding Assignment/Case Study	Pseudocode/Programming	**9 Classes**

Topics:

The Critical-Section Problem - Peterson's Solution, Synchronization hardware, Mutex locks, Semaphores, Classic Problems of Synchronization, Monitors. Introduction to Deadlocks, Deadlock Characterization, Methods for handling deadlock: Deadlock Prevention- Deadlock Avoidance- Deadlock detection & Recovery from Deadlock

Linux Operating System: Pipe, semaphore and message queue

List of Laboratory Tasks:

Experiment No. 1: Basic UNIX Commands

Level 1: Linux commands- PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, file handling utilities, security by file permissions, process utilities

Level 2: Text Processing utilities and backup utilities , tail, head, sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Experiment No. 2: Programs using system calls of UNIX operating system

Level 1 Programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir

Level 2 Simulate UNIX commands like cp, ls, grep.

Experiment No. 3: Programs to demonstrate process creation and termination
Level 1: Program to demonstrate creating new processes and waiting for a process
Level 2: Program to demonstrate creation of zombie processes and orphan process

Experiment No. 4: Programs to demonstrate inter process communication using Pipe
Level 1: Programs to illustrate execution of two commands concurrently with a command pipe and communication between two unrelated processes
Level 2: Program to demonstrate inter process communication using mkfifo, open, read, write and close APIs

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: **CSE3123**	**Course Title: Search Engine Optimization**	**L-T- P- C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites	Basic knowledge of computer network		
Anti-requisites	**NIL**		
Course Description	This course covers the basics of how a website is structured, how search engines work, what to look for, choosing competitive keywords, writing content for a website, code optimization, link building, social media, and some advanced optimization techniques.		
Course Outcomes	Upon successful completion of the course the students shall be able to:		

	Explain the significance of search engine and its working Building an SEO-Friendly Site Optimize the SEO Foundations Differentiate On-page SEO vs Off-page SEO

Course Content:

Module 1	How Search Engines Work	Assignment	Theory	**No. of Classes:10**	

Topics: Putting Search Engines in Context, Meeting the Search Engines, Recognizing and Reading Search Results, Getting Your Site in the Right Results, Knowing What Drives Search Results, Spam Issues: When Search Engines Get Fooled.

Module 2	SEO Web Design	Assignment	Theory	**No. of Classes:10**

Topics: The Basics of SEO Web Design, Building an SEO-Friendly Site, Making Your Page Search Engine-Compatible, Perfecting Navigation and Linking Techniques

Module 3	Optimizing the Foundations and Analyzing Results	Assignment	Theory	**No. of Classes:10**

Topics: Server Issues: Why Your Server Matters, Using Redirects for SEO, implementing 301 Redirects, Watching Your Backend: Content Management System Troubles, Solving SEO Roadblocks, Employing Site Analytics, Tracking Behavior with Web Analytics

Module 4	On-page SEO vs Off-page SEO	Assignment	Case Study	**No. of Classes:10**	

Topics: On-page SEO: Website Content, URL Structure, Pictures, Title Tags, Meta Tags, Headline Tags, Internal Linking. Off-page SEO: Who‟s Linking to You? How are they Linking to You? Using Social Media to Spread Content, Using Email to Spread Content

Targeted Application & Tools that can be used:

Targeted Applications:

Developing applications focusing on search engine optimization

SEO Tools:

Analytics
Research
WordPress SEO

Project work/Assignment:

Students shall read a research article and develop a detailed SEO strategy for the article. The “strategy” consists of two parts: what keywords to target; where to place the keywords in the article.
Select a webpage to optimize, and a search phrase to optimize the webpage for.

Suggested List of Hands-on Activities:

Text Book

Bruce Clay, Susan Esparza, "Search Engine Optimization All-in-One For Dummies", John Wiley distributor, 2nd Edition, 2012

Introduction to Search Engine Optimization, Getting Started With SEO to Achieve Business Goals, Accessed e-Book from https://www.hubspot.com/hs-fs/hub/53/file-13221845-pdf/docs/ebooks/introduction-to-seo-ebook.pdf

References

Eric Enge, Stephan M. Spencer, Jessie Stricchiola, "The Art of SEO: Mastering Search Engine Optimization", O'Reilly Media [2015]

David Amerland, "Google Semantic Search: Search Engine Optimization Techniques That get Your Company More Traffic, Increase Brand Impact, and Amplify Your Online Presence", PEARSON Education, India [2014]

Web Resources and Research Articles links:

International Journal of Technology Marketing -
https://www.inderscience.com/info/inarticletoc.php?jcode=ijtmkt&year=2012&vol=7&issue=3
SEJ, Search Engine Journal- https://www.searchenginejournal.com/

Course Code: CSE2059	**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: **CSE218**	**Course Title: Human Computer Interaction** **Type of Course: Theory Only**	**L- T-P-C**	3	0	0	3
Version No.	1.0					

Course Pre-requisites	**Basic knowledge of HTML and web design**			
Anti-requisites	NA			
Course Description	The Course is intended 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 **SKILL DEVELOPMENT** of students by using **PROBLEM SOLVING METHODOLOGIES**			
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**	Assignment	Knowledge, Quizzes	**10 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**	Assignment	Application, Quizzes	**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**	Term paper/Assignment	Comprehension, Quizzes	**8 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, Quizzes	**8 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: **UI design in web applications**				
Assignment:				
Case study – "User Interface designing" is a lab based course in presidency university. In User interface designing lab students need to develop User Interfaces for web based project by following all the guidelines and principles of designing interfaces. The evaluation of the interfaces will be done based on interface satisfying all the rules, principles and guidelines of designing interfaces. If the project is unable to satisfy any one of the guidelines or principles it will be rejected.				

Assume that you are a student registered for User Interface designing lab course. Suggest the Guidelines which you will follow to make your project successful and mention why those Guidelines are to be followed.

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

NPTEL course –

Human Computer Interaction https://nptel.ac.in/courses/106103115

HCI Interactions https://onlinecourses.nptel.ac.in/noc19_cs86/preview

Topics relevant to the development of SKILLS: UI Design, HTML

Course Code: CSE3185	**Course Title:** UI/UX Design **Type of Course: Theory**	**L- P- T-C**	**3**	**0**	**0**	**3**
Version No.						
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces students to understand to inculcate the knowledge on user- centered design, graphic design on screens with various wire framing techniques and various design tools.					
Course Outcomes	On successful completion of this course the students shall be able to: Apply the concepts of UI and UX for graphical user interface design and development. Synthesize UI/UX design for applications Analyze the high-quality professional documents and artifacts related to the design process. Understand the basic Prototyping software in the various UI/UX Design tools designing with user centered design					

Course Content:

Module 1	**Introduction to The UI**	Assignment		**08 Classes**

Topics:

What is User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief Historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design.

Module 2	**Introduction to The UX**	Assignment		**10 Classes**

Topics:

UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design.

Module 3	UI/ UX Design Tools	Assignment		**10 Classes**

Topics:

User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wireframing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design.

Module-4	**Visual Design and UI Prototyping**	Assignment		**12 Classes**

Topics:

Fundamentals of Visual Design, Color theory, typography, and layout, Creating visually appealing interfaces, UI Prototyping Tools, Rapid prototyping techniques. Mobile-First Design :Design considerations for mobile devices, Responsive web design principles Adaptive and Responsive Prototyping, Building prototypes for various screen sizes, Testing on multiple devices

Project work/Assignment:

Assignment 1 on (Module 1 and Module 2)
Assignment 2 on (Module 3 and Module 4)

REFERENCE MATERIALS:

TEXTBOOKS

A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012.

The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.

REFERENCES

The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007.

The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012

JOURNALS/MAGAZINES

1. IEEE Transactions on UI-UX design using user centred design (UCD) method.
https://ieeexplore.ieee.org/abstract/document/9740997

IEEE Transactions on the Effect of UI/UX Design on User Satisfaction in online Art Gallery
https://ieeexplore.ieee.org/document/9609764

ARRUS Journal of of Engineering Ui/UX design web-based learning application using design thinking method
https://sainsmat.org/index.php/jetech/article/view/532

SWAYAM/NPTEL/MOOCs:

Swayam Nptel – User Interface Design – IIT Roorkee https://onlinecourses.nptel.ac.in/noc21_ar05/preview

Coursera - Introduction to User Experience Principles and Processes
https://www.coursera.org/learn/introtoux-principles-and-processes?specialization=michiganux&utm_medium=institutions&utm_source=umich&utm_content=sem&utm_campaign=adwords-ux-introtoux-principles-and-processes&utm_term=user%20experience%20design%20course&gad_source=1&gclid=

Course Code: **CSE3216**	**Course Title:** Mastering Object- Oriented Concepts in Python **Type of Course:** Lab		**L- T-P-C**	0-0-2-1
Version No.	1			
Course Pre-requisites	CSE1005 – Programming in Python			
Anti-requisites	NIL			
Course Description	This course covers mastering object-oriented concepts in Python, including classes, inheritance, polymorphism, and encapsulation. Students will learn to design and implement robust, reusable code using real-world examples. Ideal for those with basic Python knowledge, it enhances problem-solving skills and software development proficiency.			
Course Objective	**The objective of the course is to familiarize the learners with the concepts of Mastering Object Oriented Concepts in Python and attain Skill Development through Experiential Learning.**			
Course Out Comes	**CO1:** Explain features of Oops along with creation of Python classes and objects to represent real world Objects. **[Understand]** **CO2:** Demonstrate inheritance, polymorphism, and abstraction in Python to build maintainable and extendable software systems.**[Apply]** **CO3:** Demonstrate exception handling in Python to build robust error-handling mechanisms and debugging tool and Assess various file handling techniques in Python. **[Apply]**			
Course Content:				
Module 1	**Introduction to OOPS, Classes and Objects**	MCQ	Assignment	**10 Sessions**
Topics:				

Introduction to OOPs: Problems in Procedure Oriented Approach, Specialty of Python Language, Features of OOPS - Classes and Objects, Encapsulation, Abstraction, Inheritance and Polymorphism.

Classes and Objects: Creating a Class, The Self Variable, Constructor, Destructors, Types of Variables, Namespaces, Types of Methods - Instance Methods, Class Methods, Static Methods, Passing Members of One Class to Another Class, Inner Classes.

Module 2	**Inheritance and Polymorphism**	MCQ	Assignment	**10 Sessions**

Constructors in Inheritance, Overriding Super Class Constructors and Methods, The Super() Method, Types of Inheritance – Single Inheritance, Multiple Inheritance, Method Resolution Order(MRO), Polymorphism, Duck Typing Philosophy of Python, Operator Overloading, Method Overloading, Method Overriding.

Abstract Classes and Interfaces: Abstract Method and Abstract Class, Interfaces in Python, Abstract Classes vs. Interfaces.

Module 3	**Exceptions and Files in Python**	MCQ	Assignment	**10 Sessions**

Exceptions: Errors in a Python Program – Compile-Time Errors, Runtime Errors, Logical Errors. Exceptions, Exception Handling, Types of Exceptions, The Except Block, The assert Statement, User-Defined Exceptions, Logging the Exceptions.

Files in Python: Files, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods.

Targeted Application & Tools that can be used:

Python, PyCharm

Project work/Assignment:

Assignment:

Module 1 Assignment: Design and implement a Python application that simulates a banking system using classes and methods for customers and accounts.

Module 2 Assignment: Develop a Python application that simulates Library management system that demonstrates inheritance, polymorphism and abstraction concepts.

Module 3 Assignment: Develop a Python program that handles different types of exceptions while processing user input for a movie ticket booking system showcasing exception handling and File handling concepts.

Text Book

Dr. R Nageshwara Rao, “Core Python Programming”, Dreamtech Press, 3rd Edition, 2021.

References

Alex Martelli, Anna Ravenscroft & Steve Holden, “Python in a Nutshell The Definitive Reference”, O'Reilly Media, 3rd edition, 2017.

Luciano Ramalho, “Fluent Python Clear, Concise, and Effective Programming”, O'Reilly Media, 2nd edition, 2022.

Mark Lutz, “Learning Python: Powerful Object-Oriented Programming”, O'Reilly Media, 5th edition, 2013.

David Beazley, Brian K. Jones, “Python Cookbook: Recipes for Mastering Python 3”, O'Reilly Media, 3rd edition, 2013.

Weblinks:

www.learnpython.org

https://realpython.com/python3-object-oriented

https://www.tutorialspoint.com/python/python_oops_concepts.htm

Topics relevant to “SKILL DEVELOPMENT”:

Building Real-World Applications Using OOPS Concepts, Error Handling and Debugging Techniques, Concurrency in Python, Advanced File Handling Techniques, Creating and Managing Python Packages and Modules, Designing and Implementing Python Interfaces

This is attained through assessment component mentioned in course handout.

Course Code: IST2503	**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: MAT1001	**Course Title: Calculus and Linear Algebra** **Type of Course:1] School Core** **Lab Integrated**	**L-T- P- C**	**3**	**1**	**0**	**4**
Version No.	2.0					
Course Pre-requisites	Basic Concepts of Limits, Differentiation, Integration					
Anti-requisites	**NIL**					
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature.					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "**CALCULUS AND LINEAR ALGEBRA" **and attain Skill Development through problem solving techniques**.					
Course Out Comes	On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations.					
Course Content:						
Module 1	**Linear Algebra**					**16 Classes**
	Review: Types of matrices, elementary transformations, **Linear Algebra:** Echelon form, rank of a matrix, consistency and solution of system of linear equations - Gauss elimination method, Gauss-Jordan method. Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.					
Module 2	**Partial Derivatives**					**14 CLASSES**
	Review: Differential calculus with single variable. **Differential Calculus:**					

	Partial differentiation, Homogeneous functions and Euler's theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor's series for functions of two variables, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers. Engineering Applications of partial derivatives.				
Module 3	**Integral calculus**				**12 Classes**
	Review: Integral calculus for single integrals. **Integral calculus:** Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates. Beta and Gamma functions–inter-relation-evaluation of integrals using gamma and beta functions. Evaluate double & triple integrals.				
Module 4	**Differential Equations**	**Assignment**		**Programming**	**16 Classes**
	Definition, types of differential equations, order and degree, Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non - Exact Differential Equations. Higher order Differential Equation with constant coefficients and with right hand side of the form eax, sinax, cosax, eaxf(x), xnf(x) etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, Method of Variation of Parameters. Engineering applications of differential equations.				
	Targeted Application & Tools that can be used: The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design. Tools Used: Python.				
	Assignment:				
	1. List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using C Programming/Python. 2. Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.				
	Text Book 1. Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011 2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.				
	References: 1. Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013. 2. Walter Ledermann, Multiple integrals, Springer, 1st edition 3. Lay, Linear Algebra ansd its applications, 3rd Ed., 2002, Pearson Education India. 4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 5. MatLab usage manual **E-resources/ Web links:** 1. https://nptel.ac.in/courses/109104124 2. https://nptel.ac.in/courses/111106051				

	3. https://nptel.ac.in/courses/111102137 4. https://www.cuemath.com/learn/mathematics/algebra-vs-calculus/ 5. https://stanford.edu/~shervine/teaching/cs-229/refresher-algebra-calculus 6. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/linear-algebra/ 7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
	Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software. for **Skill Development through** Experiential Learning **methodologies.** This is attained through assessment component mentioned in course handout.

Course Code: **ECE1001**	**Course Title: Elements of Electronics Engineering** **Type of Course: School Core Theory & Integrated Laboratory**	**L-T-P-C**	3	0	2	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	Nil					
Course Description	The purpose of this course is to enable the students to learn the fundamental concepts of electronic devices and circuits. The course aims at nurturing the students with the fundamental principles of electronics engineering, prevailing in various engineering applications. The nature of the course is conceptual and analytical which imparts knowledge of electronic components and their behavior under various operating conditions. The course develops thinking skills of the students, encouraging their quest for knowledge about electronic devices and their usage in higher semester courses. The associated laboratory provides an opportunity to validate the concepts taught in theory classes and enable the students to work with basic electronic circuits using electronics components.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Elements of Electronics Engineering and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING .					
Course Outcomes	On successful completion of this course the students shall be able to: Identify various electrical and electronic components and basic electrical laws. Explainapplications of Diodes and BJTs. Summarize the concepts of Digital Electronics and Communication Systems. Discuss the basic concepts of microprocessorand computer organization. Perform experiments to familiarizevarious Electrical & Electronic components and equipment. Verify Basic Electrical Circuit configurations and Laws.					
Course Content:						
Module 1	Basic Electrical and Electronic Components	Assignment / Quiz	Identification of Practical electronic and electrical components / Memory Recall based Quizzes	10 Sessions		
Topics:						

ELECTRICAL CIRCUITS AND LAWS:DC Circuits: Classification of Electrical Elements, Ohm's law, Series and Parallel Circuits, Kirchhoff's Voltage and Current laws, Power and Energy, Transformers and their types.

ELECTRONIC MATERIALS AND COMPONENTS: Conductors, Insulators, Semi-Conductor Material, P-N Junction diode, Characteristics and Parameters, Ideal Diode approximations, DC load line.

Module 2	Applications of Diodes and Introduction to BJT	Assignment / Quiz		Simulation Task/ Memory Recall based Quizzes	12 Sessions

Topics:

RECTIFIERS: Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit (only qualitative approach).

ZENER DIODE: Zener diode, Zener Characteristics, Zener diode as a voltage regulator.

BIPOLAR JUNCTION TRANSISTORS: BJT Construction and Operation, BJT Voltages and Currents, Common Base, Common Emitter Configuration and Characteristics, Current amplification Factor alpha and beta, DC Load line w.r.t. fixed bias circuit (Q-Point), AC Analysis.

Module 3	Digital Electronics and Communication System	Assignment / Quiz		Simulation Task / Memory Recall based Quizzes	13 Sessions

Topics:

NUMBER SYSTEMS: Decimal Number System, Binary Number System, Hexadecimal Number System, Conversions: Binary to and from Hexadecimal; Hexadecimal to and from Decimal;1's and 2's Complement of Binary Numbers, Binary Addition.

BOOLEAN ALGEBRA: Boolean Laws and Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, X-NOR Gate, NAND Gate, NOR Gate.

COMMUNICATION SYSTEM: Block diagram of communication system, Modulation: Definition of Modulation, Need of Modulation, Types of Modulation: Amplitude Modulation and Frequency Modulation (Waveforms only).

Module 4	Microprocessors and Computer Organization	Assignment / Quiz	Memory recall based Quizzes	10 Sessions

Topics:

INTEL 8085 MICROPROCESSOR: Basic Architecture and features of 8085 Microprocessor.

COMPUTER ORGANISATION:Basic structure of Computer Organisation describing the various Computer types, Functional Units, Basic Operational concepts, Bus Structures, Memory System: RAM and ROM.

List of Laboratory Tasks:

Experiment No. 1:Study of Resistors, Measuring instruments and DC Power Supply.

Level 1:Identification of resistor values from color bands and verification with Multimeter.

Level 2:Connecting a resistive circuit to a DC Power Supply and observing the input and output values using Voltmeters, Ammeters and hence calculate resistance values.

Experiment No. 2:Study of Reactive components, Multimeter, CRO and Function Generator.

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

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

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

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

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

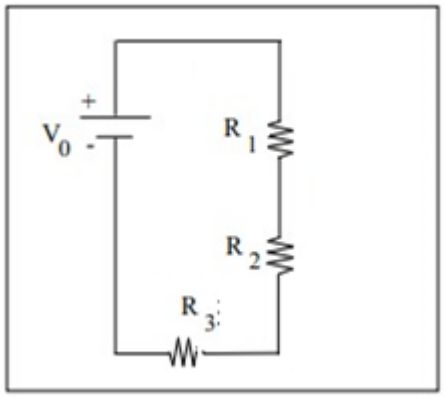
Experiment No. 4:Study of Series and Parallel Resistor Connections.

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

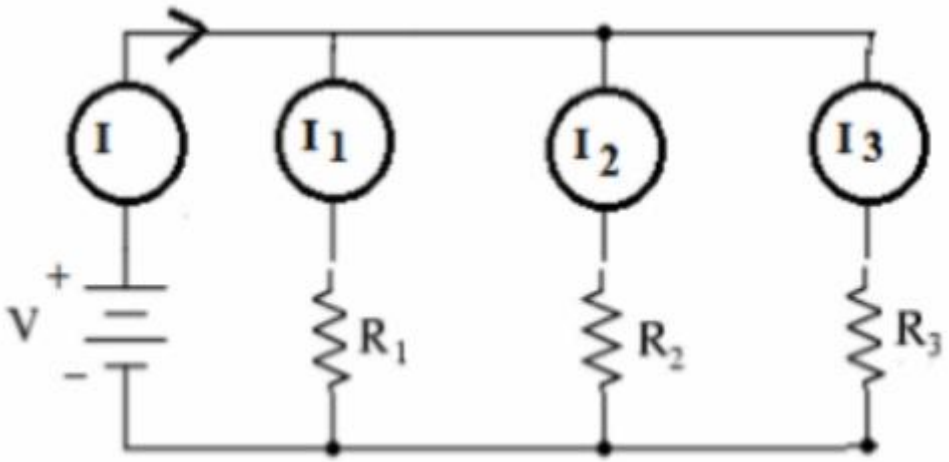
Level 2:Rig up a Current Divider Circuit and a Voltage Divider Circuit and verify the results.

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

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

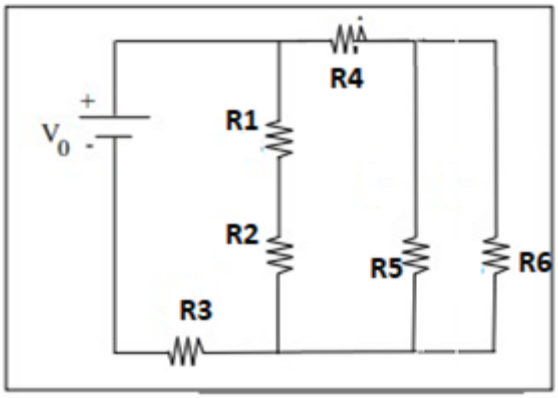


(a)



(b)

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



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

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

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

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

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

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

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

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

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

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

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

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

Targeted Application & Tools that can be used:

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

Professionally Used Software: MultiSim/ PSpice

Besides these software tools hardware equipment such as Multimeters, Function Generators, Power Supplies, Oscilloscopes etc., can be used to perform component/circuit testing and analysis.

Textbook(s):

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

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

Reference(s):

Reference Book(s):

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

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

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

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

Video lectures on "BASIC ELECTRONICS" by Prof. Dr. Chitralekha Mahanta, Department of Electronics and communication Engineering, IIT Guwahati": https://nptel.ac.in/courses/117/103/117103063/

Lecture Series on " Useful Laws in Basic Electronics" by Prof. T.S.Natarajan, Department of physics, IIT Madras: https://www.youtube.com/watch?v=vfVVF58FtCc

Lecture Series on "Introduction to Bipolar Junction Transistors BJT " by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=-VwPSDQmdjM&list=PLwjK_iyK4LLDoFG8FeiKAr3IStRkPSxqq

Lecture Series on " PN Junction Diode " by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=USrY0JspDEg

Lecture Series on "Introduction to Digital Electronics" by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=DBTna2ydmC0&list=PLwjK_iyK4LLBC_so3odA64E2MLgIRKafl

Lecture Series on "Introduction to Microprocessors" by Bharat Acharya Education :https://www.youtube.com/watch?v=0M74z5jEAyA

Lecture Notes on : "Electronic Devices", Bipolar Junction Transistors, 2nd Chapter, by Shree Krishna Khadka (PDF) Bipolar Junction Transistor (researchgate.net)https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor

E-content:

V. Milovanovic, R. van der Toorn, P. Humphries, D. P. Vidal and A. Vafanejad, "Compact model of Zener tunneling current in bipolar transistors featuring a smooth transition to zero forward bias current," *2009 IEEE Bipolar/BiCMOS Circuits and Technology Meeting*, 2009, pp. 99-102, doi: 10.1109/BIPOL.2009.5314134. https://ieeexplore.ieee.org/document/5314134

M. Oueslati, H. Garrab, A. Jedidi and K. Besbes, "The advantage of silicon carbide material in designing of power bipolar junction transistors," 2015 IEEE 12th International Multi-Conference on Systems, Signals & Devices (SSD15), 2015, pp. 1-6. https://ieeexplore.ieee.org/document/7348149

H. Luo, F. Iannuzzo, F. Blaabjerg, X. Wang, W. Li and X. He, "Elimination of bus voltage impact on temperature sensitive electrical parameter during turn-on transition for junction temperature estimation of high-power IGBT modules," *2017 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2017, pp. 5892-5898 https://ieeexplore.ieee.org/document/8096974

F. Bauer, I. Nistor, A. Mihaila, M. Antoniou and F. Udrea, "Super junction IGBT Filling the Gap Between SJ MOSFET and Ultrafast IGBT," in *IEEE Electron Device Letters*, vol. 33, no. 9, pp. 1288-1290, Sept. 2012 https://ieeexplore.ieee.org/document/6246672

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

Course Code: MAT1002	**Course Title: Transform Techniques, Partial Differential Equations and Their Applications** **Type of Course: School Core**	**L-T- P-C**	**3**	**0**	**0**	**3**
Version No.	2.0					
Course Pre-requisites	**MAT1001 - Linear Algebra and Calculus**					
Anti-requisites	**NIL**					
Course Description	This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solution of difference equations using z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					
Course Outcomes	On successful completion of this course the students shall be able to: CO-1: Express functions in terms of uniformly convergent Fourier series. CO-2: Apply Laplace transform technique to solve differential equations. CO-3: Employ z-transform technique to solve difference equations. CO-4: Solve a variety of partial differential equations analytically.					
Course Content:						
Module 1	**Fourier Series**					**10 CLASSES**
Fourier series: Fourier series - Euler's formulae - Dirichlet's conditions - Change of Interval - half range series – RMS value – Parseval's identity – Computation of harmonics. Engineering Applications of Fourier series.						
Module 2	**Integral Transforms**					**15 Classes**
Laplace Transform: Definition and Laplace transforms of elementary functions. Properties of Laplace transform. Laplace transform of periodic function, unit-step function and impulse function and the related problems. Inverse Laplace transform of standard functions and problems, initial and final value theorems. Convolution theorem, solution of linear ordinary differential equations, LCR circuit problems. **Fourier Transform:** Integral transforms, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms. Engineering Applications of Fourier transform.						
Module 3	**Z Transform and Difference Equations**					**8 Classes**

Definition of Z-transform, Z transforms of standard functions and the related problems, standard inverse Z transforms and problems, computation of inverse Z-transform by partial fraction and convolution methods, solution of difference equations using Z-transforms.
Business and Engineering Applications of Z transform.

Module 4	**Partial Differential Equations**			**12 Classes**

Partial Differential Equations: Formation of PDEs, solution of non-homogeneous PDEs by direct integration, solution of homogeneous PDEs involving derivatives with respect to only one independent variable, method of separation of variables, solution of the Lagrange's PDE of the type Pp + Qq = R.
Applications of PDEs: Various possible solutions of the one dimensional wave and heat equations by the method of separation of variables, D'Alembert's solution of the wave equation, solution of related boundary value problems.

Targeted Applications & Tools that can be used:
Applications to electrical engineering, vibrational analysis, acoustics, optics, signal processing, image processing, quantum mechanics, econometrics and shell theory by means of Fourier Series and integral transforms.
Opens up new approaches in terms of Z-transform to solving one of the central problems of modern science involving difference equations.
Finding the solutions of boundary value problems involving PDEs with reference to wave, heat, and Laplace equations.

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

Two Assignments based on the applications of the concepts leading to a minimum of 5 engineering problems from a common pool of problems.

Text Book
Erwin Kreyszig, 2017: " Advanced Engineering Mathematics", 10th Edition, John Wiley.

References:

1. B. S. Grewal, 2017: "Higher Engineering Mathematics" 45th Edition, Khanna Publishers.
2. Peter V O'Neil, 2015: "Advanced Engineering Mathematics", 7th Edition, Cengage Learning.
3. Glyn James, 2016: "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education.
4. Michael D. Greenberg, 2018: "Advanced Engineering Mathematics", 2nd Edition, Pearson Education.

Topics relevant to the development of Foundation Skills: All the solution methods.
Topics relevant to development of Employability skills: Use of relevant scientific application packages.

Course Code: MAT2004	**Course Title: Discrete Mathematical Structures** **Type of Course: Program Core**	**L-T- P- C**	3	0	0	3

Version No.	1.0					
Course Pre-requisites	**Nil**					
Anti-requisites	**Nil**					
Course Description	The course provides insights into the fundamental aspects of mathematical logic and predicate calculus. The course delves deeply into the concepts of algebraic structures, lattices and Boolean algebras which are widely used in computer science and engineering. It also highlights the principles of counting techniques and their applications.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain logical sentences through predicates, quantifiers and logical connectives. CO2: Comprehend the basic principles of set theory and different types of relations. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Deploy the counting techniques to tackle combinatorial problems.					
Course Content:						
Module 1	**Mathematical Logic and Predicate Calculus**			**12 classes**		
Propositional Logic, Propositional Logic Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus.						
Module 2	**Algebraic Structures**			**10 classes**		
Sets and set-operations, functions, relations and their properties & representations of relation by matrix, closure of different type of relations, equivalence relations, primitive recursive function.						
Module 3	**Lattices and Boolean Algebra**			**11 classes**		
Partial ordering, Posset, Lattices & Algebraic structures, Sub lattice, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra, cancellation laws and unique complement theorem.						
Module 4	**Principles of Counting Techniques**			**12 classes**		

Chinese Remainder Theorem, pigeonhole principle, generalized pigeonhole principle, Generalized Permutations and Combinations, Recurrence Relations.

Targeted Application & Tools that can be used:

Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.

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

Assignment 1: Logic Equivalences and Predicate calculus.
Assignment 2: Equivalence Relations and Lattices
Assignment 3: Recurrence Relations

Text Books

Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill's 7th Edition, 2011.
Kolman, Bernard; Busby, Robert C; Ross, Sharon Cutler," Discrete mathematical structures", Pearson India, 6th Edition, 2015.
Liu, C L Mohapatra, D P.," Elements of Discrete Mathematics a Computer oriented approach", New Delhi McGraw Hill Education, 4th Edition, 2015.
Mott, Joe L; Kandel, Abraham; Baker, Theodore P, "Discrete Mathematics for Computer Scientists and Mathematicians", Pearson India, 2nd Edition, 2015.
Epp, Susanna S, "Discrete Mathematics with applications", New Delhi Cengage Learing, 4th Edition, 2016.

References:

Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.

Course Code: ECE2011	**Course Title: Innovative Projects using Raspberry Pi**	**L- T-P-C**	-	-	-	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide an in-depth understanding of Raspberry-pi Single Board Computers and their application in various real time projects involving sensors. Throughout the course, students					

	will learn Raspberry-pi programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Raspberry-pi, read sensor data, and use it to control various output devices This course is suitable for advance learners who are interested in exploring the world of electronics and developing practical applications using Raspberry-pi and sensors.			
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies by using sensors and their interfacing to solve real-time problems **.**			
Course Outcomes	**On successful completion of the course the students shall be able to** 1) Understand the concept of micro python 2) Explain the main features of the Raspberry-pi prototype board 3) Analyse the hardware interfacing of the peripherals to a Single board computer system. 4) Demonstrate the functioning of live projects carried out using Raspberry-pi system			
Course Content:				
Module 1	**Introduction to Micro python**	Hands-on	Interfacing Task and Analysis	**4 Sessions**
Topics: Introduction to MicroPython, Comparison with other programming languages, Setting up the MicroPython development environment, Basics of MicroPython syntax and structure.				
Module 2	**Working with Raspberry-pi**	Hands-on	Interfacing Task and Analysis	**4 Sessions**
Introduction to raspberry pi boards, pin-diagram, different types of raspberry pi boards and its application, LED and switch control. Mastering Modules, Setup Raspberry - PuTTY SSH,VNC Viewer to interface with more complicated sensors and actuators. Various Libraries and its functions.				
Topics: Micro Python, types of Raspberry-pi boards, sensors, 3D Printer				
Targeted Application & Tools that can be used: **Application Area:** Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino and sensors can be applied. The flexibility and affordability of Arduino,				

combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

Professionally Used Software: students can use open SOURCE Softwares Thonny Python, Python IDLE etc.

Project work/Assignment:

Projects: At the end of the course students will be completing the project work on solving many real time problems.

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 presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same

Textbook(s):

Monk Simon "Raspberry Pi Cookbook: Software and Hardware Problems and Solutions", Publisher(s): O'Reilly Media, Inc. ISBN: 9781098130923 fourth Edition.

References
Reference Book(s)

1. Charles Bell Micro Python for the Internet of Things: A Beginner's Guide to Programming with Python on Microcontrollers" by" Edition 1, 2017, ISBN 978-1-4842-3123-4

2. Stewart Watkiss "Learn Electronics with Raspberry Pi " Apress Berkeley, CA . second edition,2020. ISBN978-1-4842-6348-8

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

1. Raspberry-pi Projects < https://magpi.raspberrypi.com/articles/category/tutorials/>
2. Introduction to internet of things< https://nptel.ac.in/courses/106105166>
3. Case studies on Wearable technology< https://www.hticiitm.org/wearables>

E-content:

1. Basil, Eliza Sawant, S.D. "IoT based traffic light control system using Raspberry Pi " DOI 10.1109/ICECDS.2017.8389604

2. Supriya S, 2Dr. Aravinda " Green leaf disease detection and identification using Raspberry Pi https://www.irjet.net/archives/V9/i8/IRJET-V9I847.
3. Dr. E.N. Ganesh., "Health Monitoring System using Raspberry Pi and IOT" DOI : http://dx.doi.org/10.13005/ojcst12.01.03

Topics relevant to development of "SKILL": System design for achieving Sustainable Development Goals.

Course Code: PPS4002	**Course Title: Introduction to Aptitude Type of Course: Practical Only Course**	**L- T-P- C**	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English		
Anti-requisites	Nil		
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: CO1] **Recall** all the basic mathematical concepts they learnt in high school. CO2] **Identify** the principle concept needed in a question. CO3] **Solve** the quantitative and logical ability questions with the appropriate concept. CO4] **Analyze** the data given in complex problems. CO5] **Rearrange** the information to simplify the question		
Course Content:			

Module 1	Quantitative Ability	Assignment	Bloom's Level : Application	**02 Hours**

Topics: Introduction to Aptitude, working of Tables, Squares, Cubes				
Module 2	Logical Reasoning	Assignment	Bloom's Level : Application	**18 Hours**
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning				
Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS				
Text Book Quantitative Aptitude by R S Aggarwal Verbal & Non-Verbal Reasoning by R S Aggarwal				
References www.indiabix.com www.youtube.com/c/TheAptitudeGuy/videos				
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.				

Course Code: PPS4004	**Course Title: Aptitude Training- Intermediate** **Type of Course: Practical Only Course**	**L-T P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Students should have the basic concepts of Quantitative aptitude along with its applications in real life problems.					
Anti-requisites	Nil					
Course Description	This is a skill-based training program for the students (Undergraduate). This course is designed to enable the students to enhance their skills in Quantitative Aptitude.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1] **Understand** all the concepts. CO2] **Apply** the concepts in problem solving (Bloom's taxonomy Level 3)					
Course Content:						
Module 1	Quantitative Ability	Assignment				**24 Hours**
Topics:						

Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Boats and Streams, Simple Interest and Compound Interest, Probability, Permutation and Combination.

Targeted Areas Application area: Placement activities and Competitive examinations. Tools: LMS
Text Book Fast Track Objective by Rajesh Verma R S Aggarwal Rakesh Yadav
References www.indiabix.com www.testbook.com www.youtube.com/c/TheAptitudeGuy/videos
Topics relevant to Skill development: Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.
Evaluation – Continuous Evaluation (Topic wise evaluation Mid-Term & End term)

Course Code: **CHE1018**	**Course Title:** **Environmental Science** **Type of Course:** **School Core- Theory and Lab**	**L- T- P- C**	**1**	**0**	**2**	**0**
		Contact hours	**1**	**0**	**2**	**3**
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education. **This course is designed to cater to Environment and Sustainability**					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.**					

Course Outcomes	On successful completion of this course the students shall be able to: 1) Appreciate the historical context of human interactions with the environment and the need for eco-balance. 2) Describe basic knowledge about global climate change with particular reference to the Indian context. 3) Understand biodiversity and its conservation 4) Develop an understanding on types of pollution and ways to protect the environment 5) Learn about various strategies on Global environmental management systems			
Course Content:				
Module 1	**Humans and the Environment**	Assignment	Data Collection	**01 class**
Topics: The man-environment interaction: Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment. ***Self-learning topics:*** Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Environmental Ethics and emergence of environmentalism.				
Module 2	**Natural Resources and Sustainable Development**	Assignment		**03 Classes**
Topics: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Water resources**: Types of water resources- fresh water and marine resources; **Soil and mineral resources**: Important minerals; Mineral exploitation Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages. ***Self- learning topics:*** Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)-targets, indicators, and challenges for SDGs.				
Module 3	**Environmental Issues: Local, Regional and Global**	Case study		**02 Classes**
Topics: **Environmental Pollution**: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans-boundary air pollution; Acid rain; Smog. **Land use and Land cover change**: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change ***Self -learning topics:*** Environmental issues and scales				
Module 4	**Conservation of Biodiversity and Ecosystems**	Assignment		**02 Classes**
Topics: **Biodiversity-**Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities. **Self-learning topics:** Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.				
Module 5	**Environmental Pollution and Health**	Case study		**03 Classes**
Topics: Pollution, Definition, point and nonpoint sources of pollution, **Air pollution**- sources, major air pollutants, health impacts of air pollution. **Water pollution**– Pollution sources, adverse health impacts on human and aquatic life and mitigation, Water quality parameters and standards.				

Soil pollution and solid waste- Soil pollutants and their sources, solid and hazardous waste, Impact on human health.

Self-learning topics: Noise pollution, Thermal and radioactive pollution.

	Module 6	**Climate Change: Impacts, Adaptation and Mitigation**	Assignment/case		**02 Classes**

Topics:

Understanding climate change: Natural variations in climate; Projections of global climate change with special reference to temperature, rainfall and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Impacts

Vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Indigenous knowledge for adaptation to climate change.

Self-learning topics: Mitigation of climate change: Synergies between adaptation and mitigation measures; National and international policy instruments for mitigation.

	Module 7	**Environmental Management**	Case study	Data analysis	**02 Classes**

Topics:

Environmental management system: ISO 14001; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability.

Self-learning topics: Environmental audit and impact assessment; Eco labeling /Eco mark scheme

	Module 8	**Environmental Treaties and Legislation**	Case study	Data analysis	**01 Classes**

Topics:

Major International Environmental Agreements: Convention on Biological Diversity (CBD), Major Indian Environmental Legislations: Environmental Protection Act, Forest Conservation Act, Public awareness.

Self-learning topics: Paris Agreement, Conference of the Parties (COP), India's status as a party to major conventions: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act.

List of laboratory tasks : Any eight experiments will be conducted

1. Determination of total alkalinity of a water sample (knowledge)
2. Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
3. Estimation of copper from industrial effluents by colorimetric method (Comprehensive)
4. Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)
5. Estimation of nickel from industrial effluents by titrimetric method (Comprehensive)
6. Estimation of chloride in drinking water by titrimetric method (Comprehensive)
7. Estimation of fluoride in ground water by colorimetric method (Comprehensive)
8. Determination of calcium in aqueous solution (Comprehensive)
9. Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
10. Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
11. Biological oxygen demand of waste water sample (Comprehensive)
12. Determination of dissolved oxygen of an industrial effluent (Comprehensive)
13. Quality monitoring analysis of a soil sample (knowledge)
14. Flame photometric estimation of Sodium and potassium (Application)
15. Gas Chromatographic analysis of volatile organic compounds (Application)

Targeted Application & Tools that can be used:

Application areas are Energy, Environment and sustainability

Tools: Statistical analysis of environmental pollutants using excel, origin etc.

Project work/Assignment:

Assessment Type

- **Midterm exam**
- **Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.)**
- **Lab evaluation/Assignment**
- **End Term Exam**
- **Self-learning**

Assignment 1: Write a Statement of Environment report of your town/city/state/country

Assignment 2: Individual students will carry out the analyses of polluted solid, liquid, and gaseous samples and propose suitable mitigation measures. A detailed and in-depth report needs to be submitted for each case. This may include preparation of reagents, sample preparation (extraction), chemical analysis carried out, instruments and tools used, data collected and processed, inferences made and conclusions arrived at. Necessary support is given in the form of lab manual and reference links to e-books.

Text Book

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

Reference Books

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

E-resources:

1. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_18126**
2. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_8761**
3. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_3333**
4. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3063**
5. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_20719**
6. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_16824**
7. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3954**
8. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_491**
9. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488**
10. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583**
11. **https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER_INDEST_1_171**
12. **https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129**

13. https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979
14. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_395&xIndex=4
15. https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf

Topics relevant to Skill Development:

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

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

Course Code: **CSE2009**	**Course Title: Computer Organization and Architecture**		**L-T- P- C**	3-0-0-3
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

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

References

William Stallings, "Computer Organization & Architecture – Designing for Performance", 11th Edition, Pearson Education Inc., 2019

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:

NPTEL Course on "Computer architecture and organization" IIT Kharagpur By Prof. Indranil Sengupta, Prof. Kamalika Datta. https://nptel.ac.in/courses/106105163

NPTEL Course on "Computer Organization", IIT Madras By Prof. S. Raman. https://nptel.ac.in/courses/106106092

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: PPS1001	**Course Title: Introduction to Soft Skills** **Type of Course: Practical Only Course**	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity		

Course Content:				
Module 1	INTRODUCTION TO SOFT SKILLS		**Classroom activity**	**04 Hours**
Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality				
Module 2	EFFECTIVE COMMUNICATION		**Individual Assessment**	**10 Hours**
Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email-writing, Resume Building- Digital, Video, Traditional.				
Module 3	HABIT FORMATION		**Worksheets & Assignment**	**4 Hours**
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right				
Module 4	Goal setting & Time Management		**Goal sheet**	**8 Hours**
A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity				
Targeted Application & Tools that can be used: LMS				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
1) Individual Assessment 2) LMS MCQ				
The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: **PPS1011**	**Course Title: Introduction to Verbal Ability** **Type of Course: Theory Only Course**	L- T- P- C	0	1	0	0
Version No.	1.0					
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					

Course Description	This course is designed to enable students understand the importance of Verbal Ability and improve confidence, communication and professional skills to give them a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various worksheets and learning methodologies.		
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Verbal Ability" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of verbal ability CO2: **Utilize** the rules of communication CO3: **Apply** techniques of vocabulary building to showcase effective communication		
Course Content:			
Module 1	INTRODUCTION TO VERBAL ABILITY	**Individual Assessment**	**01 Hour**
Topics: Setting Expectations, Ice Breaker, Significance of verbal ability, pre-assessment			
Module 2	EFFECTIVE VERBAL COMMUNICATION	**Practice Worksheets**	**06 Hours**
Topics: Different rules of grammar and application, Subject-Verb Agreement, Tenses			
Module 3	VOCABULARY BUILDING	**Practice Worksheets**	**04 Hours**
Topics: Root words, Synonyms and antonyms, analogies, para-jumbles			
Module 4	READING COMPREHENSION	**Individual Assessment**	**02 Hours**
A session where students will be introduced to speed reading and comprehension, **post-assessment**			
Targeted Application & Tools that can be used: LMS			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
Individual Assessment LMS MCQ			

The topics related to Skill Development: Communication, grammar rules, vocabulary building, effective presentation for skill development through participative learning techniques. This is attained through **learning and practicing the rules of effective communication through worksheets** as mentioned in the assessment component.

Course Code: MAT2004	**Course Title: Discrete Mathematical Structures** **Type of Course: Program Core**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**Nil**					
Anti-requisites	**Nil**					
Course Description	The course provides insights into the fundamental aspects of mathematical logic and predicate calculus. The course delves deeply into the concepts of algebraic structures, lattices and Boolean algebras which are widely used in computer science and engineering. It also highlights the principles of counting techniques and their applications.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain logical sentences through predicates, quantifiers and logical connectives. CO2: Comprehend the basic principles of set theory and different types of relations. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Deploy the counting techniques to tackle combinatorial problems.					
Course Content:						
Module 1	**Mathematical Logic and Predicate Calculus**			**12 classes**		
Propositional Logic, Propositional Logic Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus.						
Module 2	**Algebraic Structures**			**10 classes**		
Sets and set-operations, functions, relations and their properties & representations of relation by matrix, closure of different type of relations, equivalence relations, primitive recursive function.						
Module 3	**Lattices and Boolean Algebra**			**11 classes**		
Partial ordering, Posset, Lattices & Algebraic structures, Sub lattice, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra, cancellation laws and unique complement theorem.						

Module 4	Principles of Counting Techniques			12 classes

Chinese Remainder Theorem, pigeonhole principle, generalized pigeonhole principle, Generalized Permutations and Combinations, Recurrence Relations.

Targeted Application & Tools that can be used:

Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.

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

Assignment 1: Logic Equivalences and Predicate calculus.
Assignment 2: Equivalence Relations and Lattices
Assignment 3: Recurrence Relations

Text Books

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill's 7th Edition, 2011.
2. Kolman, Bernard; Busby, Robert C; Ross, Sharon Cutler," Discrete mathematical structures", Pearson India, 6th Edition, 2015.
3. Liu, C L Mohapatra, D P.," Elements of Discrete Mathematics a Computer oriented approach", New Delhi McGraw Hill Education, 4th Edition, 2015.
4. Mott, Joe L; Kandel, Abraham; Baker, Theodore P, "Discrete Mathematics for Computer Scientists and Mathematicians", Pearson India, 2nd Edition, 2015.
5. Epp, Susanna S, "Discrete Mathematics with applications", New Delhi Cengage Learing, 4th Edition, 2016.

References:

1. Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
2. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.

Course Code: CSE1700	**Course Title:** Essentials of AI **Type of Course:** Theory	**L- T-P- C**	3	**0**	0	**3**
Version No.	2.0					
Course Pre-requisi Data **tes**	Basic knowledge of programming, mathematics, understanding of data handling					
Anti-requisites	**NIL**					
Course Description	This course is a comprehensive introductory course designed to equip learners with the fundamental Python programming skills necessary to work with artificial intelligence (AI) technologies. This course is aimed at individuals who are new to AI but have a basic understanding of programming concepts. It combines Python programming fundamentals with hands-on experience in implementing AI techniques such as machine learning, neural networks, and natural language processing.					
Course Objective	The objective of the course is to Understand Python Programming Fundamentals, Manipulate and Process Data with Python, Implement Machine Learning Algorithms and Build and Train Neural Networks for AI Applications.					

Course Outcomes	On successful completion of the course the students shall be able to: CO 1: Apply Python Programming to AI Projects CO 2: Build and Train Machine Learning Models CO 3: Develop Deep Learning Models with Neural Networks CO 4: Deploy AI Solutions and Understand Ethical Implications			
Course Content:				
Module 1	Introduction to Python Programming for AI	Assignment	Implementation	**10 Sessions**
Topics: Python Basics: Variables, Data Types, Operators, and Control Flow Functions, Loops, and Conditionals statements, Data Structures: Lists, Tuples, Dictionaries, Sets ,Introduction to Libraries: NumPy and Pandas for data manipulation, Basic Input/Output and File Handling Introduction to Python for AI: Libraries and Frameworks Overview				
Module 2	Data Processing, Visualization	Assignment	Implementation	10 Sessions
Topics: cleaning and preprocessing with Pandas,Handling missing data, outliers, and duplicates, Data transformation (Normalization, Encoding), Introduction to Matplotlib and Seaborn for Data Visualization, Exploratory Data Analysis (EDA), Visualizing datasets to understand patterns and relationships.				
Module 3	Introduction to Machine Learning	Mini - Project	Implementation	10 Sessions
Topics: What is Machine Learning? Types of ML algorithms Supervised Learning: Regression, Classification, Unsupervised Learning: Clustering, Key ML Algorithms: Linear Regression, Decision Trees, K-Means ,Introduction to Scikit-learn library Model evaluation (Accuracy, Precision, Recall, Confusion Matrix)				
Module 4	Neural Networks and Deep Learning	Quiz	Implementation	10 Sessions
Topics: Introduction to Neural Networks and Deep Learning, Perceptron Model and Backpropagation Deep Neural Networks and Activation Functions, Introduction to TensorFlow and Keras, Building and Training Neural Networks for Image and Text Classification, Overview of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)				

Targeted Application & Tools that can be used:

Applications:

1. **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.
2. **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
3. **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
4. **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
5. **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

Tools:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine learning tasks.

- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.
- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.
  NLTK: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.
  spaCy: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.
  Transformers (by Hugging Face): A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

Text Book(s):

T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi

Reference(s):

- "Artificial Intelligence with Python" – Prateek Joshi
- "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili
- "Hands-On Artificial Intelligence with Python" – Teet Straus
- "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

Course Code: CSE1701	**Course Title:** Essentials of AI LAB **Type of Course:** Lab	**L- T-P- C**	0	0	4	2
Version No.	2.0					
Course Prerequisites	Basic Java Programming Knowledge, Mathematics: Linear Algebra and Probability, Basic Data Structures and Algorithms, Familiarity with Libraries and Tools, Understanding of Basic Machine Learning Concepts.					
Anti-requisites	**NIL**					
Course Description	This course introduces students to the essential concepts and techniques of Artificial Intelligence (AI) with a focus on practical implementation using Python. Students will explore core AI topics such as search algorithms, knowledge representation, machine learning, and neural networks, while gaining proficiency in using popular Python libraries like NumPy, pandas, scikit-learn, and TensorFlow. Through a series of lab exercises and projects, students will apply AI principles to solve real-world problems, develop intelligent applications, and understand how AI systems function at a foundational level.					
Course Objective	The primary objectives of the course are to Gain Proficiency in AI Concepts and Python Implementation, Develop and Implement Machine Learning Models, Understand and Build Neural Networks, Apply AI to Real-World Problems					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Proficiency in Implementing AI Algorithms Using Python 2. Ability to Build and Evaluate Machine Learning Models 3. Hands-on Experience with Neural Networks and Deep Learning 4. Practical Application of AI to Solve Real-World Problems					
Course Content:						
Module 1	Introduction to AI and Python for AI	ssignment	mplementation		**8 Sessions**	

Lab Assignment 1: Setting Up the Python Environment

- **Objective:** Get familiar with setting up a Python environment for AI projects.
- **Tasks:**
  1. Install Python, Anaconda, and Jupyter Notebook.
  2. Set up a virtual environment for AI development.
  3. Install essential Python libraries: numpy, pandas, matplotlib, and scikit-learn.

4. Write and execute simple Python code to verify installation (e.g., print a “Hello AI” message).

Lab Assignment 2: Basic Python Programming for AI

- **Objective:** Understand and practice the basic Python syntax and data structures used in AI.
- **Tasks:**
    1. Write Python code to work with basic data types (integer, float, string, boolean).
    2. Implement and manipulate Python lists, tuples, sets, and dictionaries.
    3. Create basic control flow structures: if-else, for loops, while loops.
    4. Use functions and lambda functions to solve small AI-related problems, such as calculating factorial or Fibonacci numbers.

Lab Assignment 3: Data Exploration and Preprocessing

- **Objective:** Learn how to work with data for AI models.
- **Tasks:**
    1. Load a dataset (e.g., Titanic or Iris dataset) using pandas.
    2. Clean the dataset by handling missing values, removing duplicates, and converting data types if needed.
    3. Explore the dataset by visualizing it using matplotlib and seaborn.
    4. Perform basic data preprocessing tasks such as feature scaling, encoding categorical variables, and splitting data into training and testing sets.

Module 2	Data Processing, Visualization	Assignment	Implementation	8 Sessions

Lab Assignment 1: Data Preprocessing with Pandas

Objective:
Learn the fundamentals of data preprocessing, including cleaning, handling missing values, and performing basic transformations using **Pandas**.

Tasks:

1. **Load and Inspect the Dataset:**
    - Load a dataset (e.g., **Iris**, **Titanic**, **Wine Quality** dataset) using pandas.read_csv() or pandas.read_excel().
    - Inspect the first few rows of the dataset using .head() and check basic information using .info().
2. **Handle Missing Values:**
    - Identify missing values in the dataset using .isnull() or .isna().
    - Handle missing data by imputing with mean, median, or mode using SimpleImputer from sklearn, or remove rows with missing data using .dropna().
3. **Data Transformation:**
    - Convert categorical variables to numerical values using one-hot encoding or label encoding.
    - Normalize/standardize numerical columns using StandardScaler or MinMaxScaler from sklearn.
4. **Subset and Filter Data:**
    - Create subsets based on certain conditions (e.g., select rows where a specific feature value is greater than a threshold).
    - Filter outliers from numerical data using interquartile range (IQR).

Lab Assignment 2: Data Aggregation and Grouping with Pandas

Objective:
Master aggregation and grouping techniques using **Pandas** for summarizing data.

Tasks:

1. **Group Data by Category:**
    - Group data by one or more categorical features (e.g., "class" in the Iris dataset or "embarked" in Titanic dataset).
    - Use .groupby() to calculate aggregate statistics such as mean, median, sum, and count.
2. **Pivot Tables:**
    - Create a pivot table to summarize data (e.g., aggregate the average age of passengers in the Titanic dataset by class and gender).

- Use .pivot_table() to perform multi-dimensional aggregation.

3. **Data Aggregation and Custom Functions:**
   - Apply custom aggregation functions to the grouped data (e.g., calculate custom metrics or perform complex transformations within each group).
4. **Sorting and Ranking Data:**
   - Sort the dataset by multiple columns (e.g., sorting by "age" or "fare").
   - Rank data based on specific metrics (e.g., assign ranks to passengers by fare in the Titanic dataset).

Lab Assignment 3: Data Visualization with Matplotlib and Seaborn

Objective:
Learn to visualize datasets using **Matplotlib** and **Seaborn** for better understanding and insights.
Tasks:

1. **Basic Plotting with Matplotlib:**
   - Create simple plots like line plots, bar plots, and histograms using **Matplotlib**.
   - Customize the plots by setting titles, labels, and legends.
   - Create scatter plots to visualize relationships between two variables.
2. **Advanced Plotting with Seaborn:**
   - Use **Seaborn** to create advanced visualizations like pair plots, heatmaps, box plots, and violin plots.
   - Customize visualizations with color palettes, styling, and themes.
   - Create a correlation heatmap to visualize correlations between features in the dataset.
3. **Distribution Visualizations:**
   - Plot distributions of continuous variables using **Seaborn's** distplot() or kdeplot().
   - Create bar plots for categorical variables to understand their frequency distribution.
4. **Multi-Plot Grid Layouts:**
   - Use **Matplotlib's** subplots() function to create multiple plots in a grid layout for comparison (e.g., scatter plot and histogram in the same figure).

Lab Assignment 4: Visualizing Relationships and Feature Importance

Objective:
Understand how to visualize relationships between features and evaluate feature importance for predictive models.
Tasks:

1. **Scatter Plot Matrix:**
   - Use **Seaborn's** pairplot() to create a scatter plot matrix to visualize the relationships between multiple features.
   - Analyze the pairwise relationships between features and identify any patterns or correlations.
2. **Heatmap of Correlation Matrix:**
   - Use **Pandas** to calculate the correlation matrix of numeric features.
   - Visualize the correlation matrix using **Seaborn's** heatmap() to understand feature correlations and multicollinearity.
3. **Feature Importance from Models:**
   - Train a decision tree or random forest model using **scikit-learn** on a dataset (e.g., **Iris** or **Titanic**).
   - Visualize feature importance using a bar chart to understand which features have the most impact on the model.
4. **Visualizing Predictions vs. Actual Values:**
   - For regression tasks, visualize the predicted values against the actual values using a scatter plot.
   - For classification tasks, visualize the classification results with a confusion matrix.

Lab Assignment 5: Time Series Data Visualization and Processing

Objective:
Learn how to process and visualize time series data, which is common in AI applications like forecasting and trend analysis.
Tasks:

1. **Load and Preprocess Time Series Data:**
    - Load a time series dataset (e.g., stock market data, weather data).
    - Parse dates properly and set the date column as the index using pd.to_datetime() and .set_index().
2. **Plot Time Series Data:**
    - Plot a time series line chart using **Matplotlib** to visualize trends over time.
    - Create rolling averages (e.g., 7-day, 30-day) to smooth out short-term fluctuations in the time series data.
3. **Seasonal Decomposition of Time Series:**
    - Use **statsmodels** to decompose a time series into seasonal, trend, and residual components.
    - Visualize the decomposed components to understand seasonal variations.
4. **Forecasting with Simple Models:**
    - Use simple forecasting models (e.g., moving average, ARIMA) to predict future values.
    - Visualize the forecasted data along with actual historical data.

Module 3	Introduction to Machine Learning	Assignments	Implementation	8 Sessions

Lab Assignment 3: Implementing Linear Regression

- **Tasks:**
    1. Load a real-world dataset (e.g., **Boston Housing Price** dataset).
    2. Train a **Linear Regression** model using LinearRegression() from scikit-learn.
    3. Evaluate the model using **Mean Squared Error (MSE)** and **R-squared Score**.
    4. Visualize the regression line using Matplotlib.

Lab Assignment 4: Logistic Regression for Classification

- **Tasks:**
    1. Load the **Iris** or **Breast Cancer** dataset.
    2. Preprocess the dataset (handle missing values, encode categorical variables, scale data).
    3. Train a **Logistic Regression** model using LogisticRegression().
    4. Evaluate performance using **Accuracy, Precision, Recall, F1-score**.
    5. Plot the **Confusion Matrix** and **ROC Curve**.

Lab Assignment 5: Implementing K-Nearest Neighbors (KNN)

- **Tasks:**
    1. Load the **Iris dataset** and split it into training and testing sets.
    2. Train a **KNN classifier** using KNeighborsClassifier().
    3. Experiment with different values of **K** and evaluate performance.
    4. Visualize decision boundaries using a **scatter plot**.

Lab Assignment 6: Decision Trees and Random Forests

- **Tasks:**
    1. Train a **Decision Tree classifier** on the Titanic dataset.
    2. Visualize the tree structure using plot_tree().
    3. Train a **Random Forest classifier** and compare performance with the decision tree.
    4. Determine the **feature importance** using feature_importances_.

Module 4	Neural Networks and Deep Learning	Quiz	Implementation	6 Sessions

Lab Assignment 7: Introduction to Perceptron and Activation Functions

Tasks:

1. Implement a **single-layer perceptron** using NumPy.
2. Train the perceptron to classify **AND, OR, XOR** gates.
3. Experiment with different **activation functions** (Sigmoid, ReLU, Tanh).

4. Visualize decision boundaries.

Lab Assignment 8: Building a Simple Neural Network with Keras

Tasks:

1. Load the **MNIST dataset** from keras.datasets.
2. Preprocess the data (normalize pixel values, reshape input).
3. Create a **fully connected neural network** using Sequential API.
4. Train and evaluate the model using **categorical cross-entropy loss** and **accuracy**.

Lab Assignment 9: Implementing CNN from Scratch

Tasks:

1. Load the **CIFAR-10 dataset**.
2. Build a CNN with **Conv2D, MaxPooling2D, Flatten, Dense, Dropout** layers.
3. Use **Adam optimizer** and **categorical cross-entropy loss**.
4. Train and visualize loss/accuracy curves.

Lab Assignment 10: Image Augmentation & Regularization

Tasks:

1. Apply **data augmentation** (rotation, zoom, flipping) using ImageDataGenerator.
2. Add **dropout and batch normalization** to prevent overfitting.
3. Compare model performance with and without augmentation.

Lab Assignment 11: Transfer Learning with Pre-trained Models

Tasks:

1. Use **VGG16 or ResNet50** pre-trained on ImageNet.
2. Replace the output layer to classify **new images**.
3. Freeze earlier layers and fine-tune deeper layers.
4. Evaluate the model on a custom **dataset (e.g., Cats vs. Dogs)**.

Lab Assignment 12: Implementing RNN for Text Classification

Tasks:

1. Load **IMDB movie reviews dataset** from keras.datasets.
2. Preprocess text (tokenization, padding sequences).
3. Build an **RNN** with **Embedding, SimpleRNN, Dense** layers.
4. Train and evaluate the model.

Lab Assignment 13: Building an LSTM for Time Series Prediction

Tasks:

1. Load a **time series dataset** (e.g., stock prices, temperature data).
2. Preprocess the data (normalize, reshape).
3. Build an **LSTM-based model**.
4. Predict future values and visualize trends.

Targeted Application & Tools that can be used:

Applications:

1. **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.

- **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
- **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
- **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).

- **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

Tools:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine learning tasks.
- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.
- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.

NLTK: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.
spaCy: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.
Transformers (by Hugging Face): A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

Text Book(s):
*T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi*

Reference(s):

1. "Artificial Intelligence with Python" – Prateek Joshi
2. "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili
3. "Hands-On Artificial Intelligence with Python" – Teet Straus
4. "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

Course Code: CSE1504	**Course Title: Web Technology** **Type of Course: Program core** **Theory Only**	**L- T-P- C**	2-0-0-2
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	**8 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	**7 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	**7 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": 2. Web, WWW, Web browsers, Web servers, Internet. 3. CSS, PHP. 4. 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: CSE1505	**Course Title: Web Technologies Lab** **Type of Course: Program core lab course**	**L-T- P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Database Management Systems-CSE3156					
Anti-requisites	**NIL**					
Course Description	This course highlights the 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 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. **(Apply)** **CO2**: Apply various constructs to enhance the appearance of a website. **(Apply)** **CO3:** Apply server-side scripting languages to develop a web page linked to a database. **(Apply)**					
Course Content:						

List of Laboratory Tasks:

Experiment No. 1: Demonstration of XHTML features

Level 1: Demonstration of various XHTML Tags (Level 1)
Level 2: Design and develop static web pages for an online Book store (Level 2).

Experiment No. 2: Application of CSS in web designing

Level 1: Design a document using XHTML and CSS to create a catalog of items for online electronic shopping.
Level 2: Create and save XML document for students' information and display the same using cascaded style sheet.

Experiment No. 3: Application of PHP in web designing.

Level 1: Write a PHP program to read the personal information of a person such as first name, last name, age, permanent address, and pin code entered by the user into a table created in MySQL. Read the same information from the database and display it on the front end.
Level 2: Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition, and publisher and store information submitted through the web page in MySQL database.

Experiment No. 4: Building a website.

Build a website for organizing an International Conference. The conference website must be able to collect the author's details and upload a file.

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, 9th Edition, 2016.
2]Paul Deitel, Harvey Deitel, Abbey Deital,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.
3]CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
4]Deitel, Deitel, Goldberg,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.

Reference Book(s):

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.

Additional web-based resources

W1. W3schools.com
W2. Developer.mozilla.org/en-US/docs/Learn
W3. docs.microsoft.com
W4. informit.com/articles/ The Relationship Between Web 2.0 and Social Networking
https://presiuniv.knimbus.com/user#/home

Topics related to development of "FOUNDATION":

1. Web, WWW, Web browsers, Web servers, Internet.
2. CSS, PHP.
3. Designing the website for healthcare.

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 Code: CSE2508	**Course Title:** Mobile Applications and Development **Type of Course:** Theory	**L- T-P- C**	2	**0**	0	**2**
Version No.	2.0					
Course Pre-requisites	CSE3514 Object Oriented Programming Using Java					
Anti-requisites	**NIL**					
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 Outcomes	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	5 Sessions
Topics: Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.				
Module 2	User Interfaces, Intent and Fragments	Term paper/Assignment	Simulation/Data Analysis	6 Sessions
Topics: Views, Layout, Menu, Intent and Fragments.				
Module 3	Components of Android	Term paper/Assignment	Simulation/Data Analysis	6 Sessions
Topics: Activities, Services, Broadcast receivers, Content providers, User Navigation				
Module 4	Notifications and Data Persistence	Term paper/Assignment	Simulation/Data Analysis	6 Sessions
Topics: Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase.				
Module 5	Advance App Development	Term paper/Assignment	Simulation/Data Analysis	7 Sessions
Topics: Graphics and Animation, App Widgets, Sensors, Performance, Location, Places, Mapping, Custom Views, Canvas.				
Targeted Application & Tools that can be used: Applications: Native Android Applications Native iOS Applications Cross Platform mobile Apps Mobile web Applications				
Text Book(s): 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				
Reference(s): 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/

Course Code: CSE2509	**Course Title:** Mobile Applications and Development Lab **Type of Course:** Lab	**L- T-P- C**	0	**0**	4	**2**
Version No.	2.0					
Course Pre-requisites	CSE1514 Object Oriented Programming using Java					
Anti-requisites	**NIL**					
Course Description	The course provides hands-on experience in designing, developing, and deploying mobile applications for Android and iOS platforms. Students will work with native development frameworks such as Android Studio (Java/Kotlin) and Xcode (Swift), as well as explore cross-platform tools like Flutter or React Native.					
Course Objective	The objective of the course is to develop Native and Cross-Platform Mobile Applications, design Interactive and Responsive User Interfaces, integrate Backend Services and APIs, implement State Management and Performance Optimization, ensure Mobile App Security and Data Protection					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Develop Functional Mobile Applications 2. Design and Implement Interactive UIs 3. Integrate Cloud Services and APIs 4. Integrate Backend Systems and Data Management 5. Deploy, Publish, and Maintain advanced Mobile Application					
Course Content:						
Module 1	Introduction and Architecture of Android	Assignment	Simulation/Data Analysis	8 Sessions		
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. Design an app to input your personal information. Use an autocomplete text view to select your place of birth.						
Module 2	User Interfaces, Intent and Fragments	Term paper/Assignment	Simulation/Data Analysis	13 Sessions		
3. a. 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. b. Design a restaurant menu app to print the total amount of orders.						
Module 3	Components of Android	Term paper/Assignment	Simulation/Data Analysis	13 Sessions		
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.

Module 4	Notifications and Data Persistence	Term paper/Assignment	Simulation/Data Analysis	13 Sessions

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.

Module 5	Advance App Development	Term paper/Assignment	Simulation/Data Analysis	13 Sessions

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:

Applications:

1. Native Android Applications (Java/Kotlin)
    - Android Mobile Apps built for Android smartphones and tablets using Java or Kotlin programming languages.
    - Target audience: Android users.
2. Native iOS Applications (Swift)
    - iOS Mobile Apps designed for iPhone and iPad using Swift.
    - Target audience: iOS users (Apple ecosystem).
3. Cross-Platform Mobile Apps (Flutter, React Native)
    - Cross-platform apps designed to run on both Android and iOS from a single codebase using frameworks like Flutter or React Native.
    - Target audience: Users on both Android and iOS platforms.
4. Mobile Web Applications (Progressive Web Apps - PWA)

- Mobile-optimized web applications using HTML5, CSS3, and JavaScript that run in a browser with native-like functionality (offline support, push notifications).
- Target audience: Users accessing apps via mobile browsers.

Development Tools and Frameworks

1. Integrated Development Environments (IDEs)
   - Android Studio (for Android): The official IDE for Android development, supporting Java, Kotlin, and Android SDK.
   - Xcode (for iOS): The official IDE for iOS development with Swift and Objective-C, providing a comprehensive suite of development tools for iPhone/iPad applications.
   - Visual Studio Code (VS Code): Lightweight IDE for working with Flutter, React Native, and web development projects.
2. Cross-Platform Development Frameworks
   - Flutter: Open-source UI framework by Google for building natively compiled applications for mobile, web, and desktop from a single codebase.
   - React Native: Open-source framework developed by Facebook for building cross-platform apps with JavaScript and React.
3. Backend & Cloud Tools
   - Firebase: Google's backend-as-a-service (BaaS) platform offering authentication, real-time databases, cloud storage, and push notifications for mobile apps.
   - AWS Amplify: Cloud platform for backend services (API, storage, authentication) and mobile deployment.
   - SQLite / Realm: Local storage solutions for mobile apps to manage data storage and retrieval on-device.
4. Mobile App Testing and Debugging Tools
   - Android Emulator (for Android): A virtual device to run and test Android apps without needing physical devices.
   - Xcode Simulator (for iOS): A tool to simulate different iOS devices and test apps during development.
   - Appium: Open-source tool for automated testing across native, hybrid, and mobile web applications.
5. Version Control and Collaboration
   - Git: Version control system for managing code changes and collaborating with teams.
   - GitHub / GitLab / Bitbucket: Online platforms for hosting Git repositories, collaboration, and version control management.
6. Mobile App Deployment Tools
   - Google Play Console: For managing Android app publishing, distribution, and monitoring.
   - Apple App Store Connect: For managing iOS app submissions, reviews, and releases on the Apple App Store.
7. UI/UX Design Tools
   - Figma / Adobe XD: Tools for UI/UX design and wireframing to create the visual elements of mobile applications before development.
   - Sketch: Vector-based design tool for iOS UI design and prototyping

Text Book(s):

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

Reference(s):

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/

Course Code: **CSI2505**	**Course Title: Soft Computing** **Type of Course:1] Program Core** **2] Laboratory integrated**	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	Artificial Intelligence and Machine Learning					
Anti-requisites	**NIL**					
Course Description	Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in environments of uncertainty and imprecision. It is based on biologically inspired methodologies such as genetics, evolution, ant behavior, particle swarming, and the human nervous system. Soft computing provides **a** solution when **there is no** mathematical modeling of problem-solving (i.e., no clear algorithm), when **a** real-time solution to a complex problem is needed, or when **adaptability to** changing scenarios **is required**. It **can also be** implemented with parallel computing. Soft computing has **wide-ranging** applications in areas such as medical diagnosis, computer vision, handwritten character **recognition**, pattern recognition, machine intelligence, weather forecasting, network optimization, and VLSI design. With **a strong foundation in** soft computing, students can develop efficient solutions for complex, highly stochastic real-world problems."					
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: **CO 1:** Define the concept and applications of Soft Computing. **CO 2:** Discuss Fuzzy logic concepts and its applications. **CO 3:** Demonstrate Artificial Neural Networks concepts and its applications. **CO 4:** Apply Evolutionary algorithms and hybrid soft computing techniques.			
Course Content:				
Module 1	**Introduction to Soft Computing**	Assignment	Programming	**L – 7 Sessions**
Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques. Brief descriptions of different components of soft computing including Artificial intelligence systems, Neural networks, fuzzy logic, genetic algorithms.				
Module 2	**Fuzzy Logic**	Assignment	Programming	**L-7-Sessions**
Fuzzy Logic: Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Some applications of Fuzzy logic.				
Module 3	**Neural Network**	Assignment/Quiz	Programming	**L-8 Sessions**
Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning. Neural Networks as Associative Memories: Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks: Competitive Learning, Kohonen Maps.				
Module 4	**Evolutionary Computing**	Assignment	Programming	**L-8 Sessions**
Evolutionary Computing: Concept of "Genetics" and "Evolution". Genetic Algorithm and Optimization, The Schema Theorem, GA operators: Encoding, Crossover, Selection, Mutation, etc. Introduction to ant colony optimization and particle swarm optimization. Integration of genetic algorithm with neural network and fuzzy logic.				
Targeted Application & Tools that can be used : 1. Execution of the Soft computing algorithms will be done using “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 and implement the Soft Computing algorithms				

Text Book

1. Shivanandam, Deepa S, "Principles of Soft computing", N Wiley India, 3rd Edition, 2018.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley, 2011.

References

1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2nd Edition 2017.
2. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2nd Edition, 2015.
3. Fakhreddine O. Karray, and Clarence W. De Silva. "Soft computing and intelligent systems design: theory, tools, and applications". Pearson Education, 2009.

Course Code: **CSI2506**	**Course Title: Soft Computing lab** **Type of Course:1] Program Core 2] Laboratory integrated**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Artificial Intelligence and Machine Learning					
Anti-requisites	**NIL**					
Course Description	Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in environments of uncertainty and imprecision. It is based on biologically inspired methodologies such as genetics, evolution, ant behavior, particle swarming, and the human nervous system. Soft computing provides **a** solution when **there is no** mathematical modeling of problem-solving (i.e., no clear algorithm), when **a** real-time solution to a complex problem is needed, or when **adaptability to** changing scenarios **is required**. It **can also be** implemented with parallel computing. Soft computing has **wide-ranging** applications in areas such as medical diagnosis, computer vision, handwritten character **recognition**, pattern recognition, machine intelligence, weather forecasting, network optimization, and VLSI design. With **a strong foundation in** soft computing, students can develop efficient solutions for complex, highly stochastic real-world problems.					
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: **CO1.** Develop programs for Fuzzy set operations and to create Fuzzy Inference System. **CO2.** Design neural network models including McCulloch - Pitts net, Hebb net ,Perceptron net, Hetero-associative net and Back Propagation net. **CO3**. Demonstrate an ability to listen and answer the viva questions related to programming skills needed for solving real-world problems in Computer Science and Engineering					
List of Laboratory Tasks:						**P– 13 Sessions**

1. Performing Union, Intersection and Complement operations.

2. Implementation of De-Morgan's Law.

3. Plotting various membership functions.

4. Fuzzy toolbox to model tip value.

5. Implementation of FIS Editor.

6. Simple addition and subtraction of fuzzy sets.

7. To find the weight matrix.

8. Generation of ANDNOT function using McCulloch-Pitts neural net.

9. Classification of two dimensional input patterns in bipolar in Hebb Net.

10. Perceptron net for an AND function with bipolar inputs and targets.

11. Calculate the weights using hetero-associative neural net for mapping of vectors.

12. XOR function (binary input and output) using back propagation algorithm.

Targeted Application & Tools that can be used :

3. Execution of the Soft computing algorithms will be done using "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
4. 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 and implement the Soft Computing algorithms

Text Book

3. Shivanandam, Deepa S, "Principles of Soft computing", N Wiley India, 3rd Edition, 2018.
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley, 2011.
5. J.S.R.Jang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson education 2004.
6. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

Course Code: CSI2507	Course Title: High Performance Computing Type of Course: Theory Course	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSI2507-High Performance Computing					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to Understand High-Performance Computing (HPC) system architectures and various computational models, Learn the basics of CUDA programming. Students may also apply parallel execution models and methodologies for parallel programming and application development. Design and implement compute-intensive applications on the HPC platform. The course develops critical thinking and analytical skills. The course also enhances programming abilities through assignments.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of **High Performance Computing** and attain **Employability skills** through **Participative Learning** Methodologies.			
Course Outcomes	**On successful completion of this course, the students shall be able to:** (1) Infer High Performance Computing (HPC) system architectures and various computational models. (Understand) (2) Illustrate Parallel Computing Architecture (Understand) (3) Explain the basics of CUDA programming. (Understand) (4) Apply parallel execution models and methodologies for parallel programming and parallel applications development. (Apply) (5) Implement compute intensive applications on HPC platform. (Apply)			
Course Content				
Module 1	**Parallel Programming & Computing - Introduction**	Quiz	Comprehension based Quizzes and assignments	**8 Sessions**
Topics: Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling				
Module 2	**Introduction to High Performance Computing**	Quizzes and assignments	Comprehension based Quizzes and assignments	**7 Sessions**
Topics: Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments				
Module 3	**Cluster Computing**	Assignment	Comprehension based Quizzes and assignments	**10 Sessions**
Topics: Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts				
Module 4	**High Speed Networks & Message Passing**	Assignment	Comprehension based Quizzes and assignments	**10 Sessions**
Topics: Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster **Open CL Programming** Introduction to OpenCL, OpenCL Setup, Basic OpenCL, Advanced OpenCL **Shared-memory programming** OpenMP: Introduction to OpenMP, Parallel Programming using OpenMP				

Module 5	CUDA Programming	Assignment	Comprehension based Quizzes and assignments	10 Sessions

Topics:

Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory

Targeted Applications & Tools that can be used:

OPENMP and MPI tools

Project work/Assignment:

Mooc Courses:

Course Name: High Performance Computing

Link: https://nptel.ac.in/courses/106/108/106108055/

Course Name: High Performance Computing Architecture

Link: https://nptel.ac.in/courses/106/105/106105033/

Textbook(s):

T1. Rajkumar, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education,2007

T2. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press, 2011

T3. **Thomas Sterling**, High Performance Computing: Modern Systems and Practices,2017

References

R1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Edition, 2003

Course Code: CSN2502	**Course Title: Adhoc networks** **Type of Course: Level 2 Theory**	**L- T-P- C**	2	0	0	2
Version No.	1.0					

Course Pre-requisites		CSE 2011-Data Communications and Computer Networks
Anti-requisites		NIL
Course Description		The course begins with an introduction to ad hoc networking, including perspectives from the Department of Defense (DOD) and commercial applications. Students will examine the fundamental characteristics and issues of ad hoc networks, along with proactive and reactive routing protocols. Subsequent units delve into specific routing protocols, starting with table-driven protocols such as the Destination-Sequenced Distance-Vector (DSDV) protocol. Students will explore the properties and features of DSDV, including clustering, transmission management, and routing efficiency.Students will also explore research issues in ad hoc networking, fostering critical thinking and

		innovation in this rapidly evolving field.
Course Objective		The objective of the course is to familiarize the learners with the concepts Of Wireless Adhoc Networks and attain **Employability** through E**xperiential Learning** techniques.
Course Out Comes		**On successful completion of the course the students shall be able to** CO1: Explain the fundamental concepts and principles of wireless ad hoc networks. [Understand] CO2: Discuss the design principles and architectural frameworks of ad hoc networks.[Understand] CO3: Identify a routing protocol for a given Ad hoc networks [Apply] CO4: Utilize simulation tools to model and analyze the performance of wireless ad hoc networks under various conditions.[Apply]

Course Content:

Module 1	**ADHOC NETWORKING**	Quiz	Data Collection/Interpretation	**10 Sessions**
Topics: Introduction – DOD perspective – Commercial applications – Characteristics and issues of adhoc networks – proactive and reactive routing protocols.				
Module 2	**TABLE DRIVEN PROTOCOLS**	Assignment	Network Exploration	**6 Sessions**
Topics: Preview of routing protocols – DSDV Protocol – Properties and features of DSDV – Clustering – Transmission management – Backbone formation –routing efficiency				
Module 3	**ON-DEMAND PROTOCOLS**	Assignment	Advanced Network Architectures	**6 Sessions**
Topics: AODV protocols – Unicast and Multicast – Optimizations and enhancements – DSR protocol – Overview – Properties – Additional features – support for heterogeneous networks				
Module 4		Assignment	**Routing Protocols**	**8 Sessions**
Reconfigurable Wireless networks – ZPR – Intra and Interzone routing – General approach of Link reversal routing – GB algorithm – LMR – TORA – Protocol description – Properties – Recent extensions				

Assignment: Module 1 & 2: Proactive and reactive routing protocols
Module 3: AODV Protocols
Module 4: Reconfigurable Wireless Networks
Module 5:Research Issues in Adhoc Networking

Assignment: CASE STUDY

Text Book

T1 A. Kumar and B. Singh, *Ad Hoc Networks: Principles and Applications*, 1st ed. New York, NY, USA: Springer, 2023.
T2 M. Patel and R. Gupta, *Advances in Ad Hoc Networking: Challenges and Solutions*, 1st ed. London, UK: Elsevier, 2023.

References

R1.A. Boukerche, Mobile Ad Hoc Networking: Protocols and Techniques. Boca Raton, FL, USA: CRC Press, 2008.

R2.A. Nasipuri and S. R. Das, Ad Hoc Networks: Technologies and Protocols. New York, NY, USA: Springer, 2009.

R3.A. K. Gupta and S. K. Gupta, Wireless Ad Hoc and Sensor Networks: Theory and Applications. New York, NY, USA: Springer, 2010.

R4. C. E. Perkins, E. M. Royer, and S. R. Das, Ad Hoc Networking. Boston, MA, USA: Addison-Wesley, 2001.

R5. S. K. Das, P. M. K. Reddy, and A. K. Gupta, Ad Hoc Networks: A Communication Perspective. New York, NY, USA: Wiley, 2011.

Web resources:

https://www.coursera.org/learn/packt-network-configuration-network-services-and-system-management-t69jg

https://presiuniv.knimbus.com

Topics relevant to development of "EMPLOYABILITY SKILLS": Routing protocols, AODV Protocols for development of Employability Skills through Experiential Learning techniques. This is attained through assessment component as mentioned in course handout.

Course Code: **CSN2509**	**Course Title: Network Security and Auditing** **Type of Course: Program Core**	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This course provides a comprehensive understanding of information security auditing, governance, and compliance within organizational frameworks. Students will explore the fundamental principles of auditing, including legal and regulatory requirements, security governance models, and industry standards such as ISO 27001, NIST, and COBIT. The course covers essential auditing tools and techniques, with a focus on evaluating and securing network infrastructure, including Cisco security solutions. Key topics include policy development, compliance management, risk assessment, and best practices for maintaining robust security controls. Additionally, the course examines critical aspects of infrastructure security, including perimeter intrusion prevention, access control mechanisms, secure remote access solutions, endpoint protection strategies, and unified communications security. By the end of the course, students will be equipped with the knowledge and skills necessary to assess, implement, and manage effective information security auditing processes in enterprise environments.						
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: **CO1: Recall** fundamental principles of auditing, key information security laws, and governance frameworks (e.g., ISO 27001, NIST, COBIT). **Identify** common auditing tools, techniques, and security controls used in network infrastructure.					

	CO2: Explain the role of compliance, risk management, and security policies in organizational governance. **Describe** the functions of perimeter security, access control mechanisms, and secure remote access solutions. **CO3: Utilize** auditing tools and techniques to assess security configurations in Cisco and other network environments. **Implement** security best practices for endpoint protection, intrusion prevention, and unified communications. **CO4: Evaluate** an organization's security posture by auditing policies, infrastructure controls, and regulatory compliance. **Compare** different security frameworks and standards to determine their applicability in real-world scenarios.

Course Content:				
Module 1	**Introduction**	Assignment	Quiz	**L – 7-Sessions**
The Principle of Auditing; Information Security and the law; Information Security Governance, Frameworks, and Standards.				
Module 2	**Tools and Techniques**	Assignment	Project	**L-8-Sessions**
Auditing Tools and Techniques; Auditing Cisco Security Solutions; Policy, Compliance and Management.				
Module 3	**Security**	Assignment	Project	**L-7-Sessions**
Infrastructure Security; Perimeter Intrusion Prevention; Access Control.				
Module 4	**Remote Access**	Assignment	Project	**L-8-Sessions**
Secure Remote Access; Endpoint Protection; Unified Communications.				

Targeted Application & Tools that can be used :

5. Execution of Network Security and Auditing will be done using "CISCO tool" or "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
6. 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 and implement network security and auditing solutions."

Text Book

1. Network Security Auditing (CISCO Press Networking Technology Series), Chris Jackson, 2010.

References:

1. Nmap Network Exploartion ans Security Auditing Cookbook, Paulino Calderon, Packt Publisher, Third Edition, 2021.

Course Code:	**Course Title: Software Defined Networks** **Type of Course: Level 2 Theory**	**L- T-P- C**	3	0	0	3
CSN2510						

Version No.	1.0	
Course Pre-requisites		CSE 2011-Data Communications and Computer Networks
Anti-requisites		NIL
Course Description		Software defined networking (SDN) is a rapidly emerging networking paradigm that facilitates the separation of control and data plane. The purpose of this course is to provide students the knowledge and skills necessary to use develop, manage, and secure software defined networks (SDN). The course will have the following elements, including software defined network (SDN) architectures/protocols, network functions virtualization (NFV), network virtualization technologies, and an introduction to programmable data planes. SDN enables innovation, openness and helps reduce CAPEX and OPEX. The course covers the SDN foundations and building blocks; control plane abstractions; SDN controller design and data consistency guarantees; SDN scalability, security, and reliability. The course will also introduce new SDN-enabled networking capabilities, including traffic engineering, automation/orchestration, network virtualization, and verification/troubleshooting for both cloud-native and carrier networks.
Course Objective		The objective of the course is to familiarize the learners with the concepts Of Software Defined Networks and attain **Employability** through E**xperiential Learning** techniques.
Course Out Comes		**On successful completion of the course the students shall be able to** CO1: Discuss the functions and components of the SDN architecture. [Understand] CO2: Discuss the major requirements of the design of an SDN protocol. [Understand] CO3: Design and create an SDN network consisting of SDN switches and a centralized controller. [Apply] CO4: Analyze the performance of the SDN network by using verification and troubleshooting techniques. [Apply]

Course Content:

Module 1	**INTRODUCTION TO SDN**	Quiz	Data Collection/Interpretation	**11 Sessions**

Topics:
Overview; History and evolution of SDN; Architecture of SDN; SDN Flavours; Scalability (Data Centres, Service provider networks, ISP Automation); Reliability (QoS, and Service Availability); Consistency (Configuration management, and Access Control Violations); Opportunities and Challenges

Module 2	**Architecture**	Assignment	Various SDN Architecture	**10Sessions**

Topics:
Network Operating System (NOS). SDN Architecture. Planes - data, management and control. Interfaces - northbound and southbound.

Module 3	**Protocols**	Assignment	Software Controllers	**12 Sessions**

Topics:
Languages and functions available for programming SDNs, northbound API. Mininet. Software vs. Hardware SDN switch implementations - Open vSwitch, WhiteBox, ONL. Controller implementations - POX, NOX, Beacon, Floodlight. Special Purpose controllers - Flowvisor, RouteFlow.

Module 4	**Design and Development**	Assignment	**SDN Application Programming**	**12 Sessions**

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing, SDX; Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs.

Assignment: Module 1 & 2: SDN Architectures
Module 3: RouteFlow
Module 4: Network Slicing

Assignment: CASE STUDY
Text Book **T1 J. Smith and A. Johnson, *Software Defined Networking: Principles and Practice*, 2nd ed. New York, NY, USA: Wiley, 2023.**

References R1. Stallings, William. Foundations of modern networking: SDN, NFV, QoE, IoT, and Cloud, 1st edition, Addison-Wesley Professional, 2015. R2. Oswald Coker, Siamak Azodolmolky. Software-Defined Networking with OpenFlow - Second Edition, Packt Publishing, 2017. **Web resources:** https://www.coursera.org/learn/SDN https://presiuniv.knimbus.com
Topics relevant to development of "EMPLOYABILITY SKILLS": SDN Architectures,RouteFlow for development of Employability Skills through Experiential Learning techniques. This is attained through assessment component as mentioned in course handout.

Course Code: **IST3407**	**Course Title: Infrastructure Management** **Type of Course: Program Core**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	This comprehensive course provides an in-depth exploration of modern **Information Technology (IT) systems**, covering essential concepts in **IT infrastructure, service management, security, and ethical practices**. Students will gain both theoretical knowledge and practical insights into managing IT resources effectively while addressing real-world challenges in technology deployment and maintenance.					
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: **CO 1: Recall** fundamental concepts of IT infrastructure, including hardware, software, networks, and computing resources. **List** key components of IT service management processes such as incident management, problem management, and change management. **CO 2: Explain** the role of IT infrastructure in business operations, including design issues and system management. **Describe** security management principles, including access control, identity management, and intrusion detection. **CO 3: Implement** basic IT service support processes such as configuration management and incident resolution in a simulated environment. **Use** disaster recovery and backup strategies to ensure data retention and system availability.					

	CO 4: Compare different IT service delivery models, including service level management and financial management. **Evaluate** ethical and legal issues in IT, such as cybercrimes, intellectual property rights, and privacy laws.			
Course Content:				
Module 1	**Introduction**	Assignment	Quiz	**L – 15-Sessions**
INTRODUCTION–Information Technology, Computer Hardware, Computer Software, Network and Internet, Computing Resources, IT INFRASTRUCTURE–Design Issues, Requirements, IT System Management Process, Service Management Process, Information System Design, IT Infrastructure Library. **SERVICE DELIVERY PROCESS**–Service Delivery Process, Service Level Management, Financial Management, Service Management, Capacity Management, Availability Management.				
Module 2	**Service Support Process**	Assignment	Project	**L-12-Sessions**
SERVICE SUPPORT PROCESS–Service Support Process, Configuration Management, Incident Management, Problem Management, Change Management, Release Management STORAGE MANAGEMENT–Backup & Storage, Archive & Retrieve, Disaster Recovery, Space Management, Database & Application Protection, Bare Machine Recovery, Data Retention.				
Module 3	**Security Management**	Assignment	Project	**L-9-Sessions**
SECURITY MANAGEMENT–Security, Computer and Internet Security, Physical Security, Identity Management, Access Management. Intrusion Detection, Security Information Management.				
Module 4	**IT Ethics**	Assignment	Project	**L-9-Sessions**
IT ETHICS–Introduction to Cyber Ethics, Intellectual Property, Privacy and Law, Computer Forensics, Ethics and Internet, Cyber Crimes EMERGING TRENDS in IT–Electronics Commerce, Electronic Data Interchange, Mobile Communication Development, Smart Card, Expert Systems.				
Targeted Application & Tools that can be used : 7. Execution of an IT Infrastructure Management will be done using "Colab", available at https://colab.research.google.com/ or Jupyter Notebook. 8. 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 and implement an IT Infrastructure Management				
Text Book 7. IT Infrastructure & Management, Authors: Surendra Keshari, Narendra Kumar, DreamTech Press, Distributed by WILEY, 2020 Edition.				
References 4. Zero To Mastery In IT Infrastructure And It's Management- No.1 Book To Become Zero To Hero In Infrastructure Management, This Amazing Book Covers A-Z IT Infrastructure t Concepts, 2024 Latest Edition (Paperback, Dr. R.K. Jain)				

Course Code: PPS1002	**Course Title: Soft Skills for Engineers** **Type of Course: Practical Only Course**	L- T-P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity		
Course Content:			

Module 1	INTRODUCTION TO SOFT SKILLS		**Classroom activity**	**04 Hours**
Topics: Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality				
Module 2	EFFECTIVE COMMUNICATION		**Individual Assessment**	**10 Hours**
Topics: Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email-writing, Resume Building- Digital, Video, Traditional.				
Module 3	HABIT FORMATION		**Worksheets & Assignment**	**4 Hours**
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right				
Module 4	Goal setting & Time Management		**Goal sheet**	**8 Hours**
A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity				

Targeted Application & Tools that can be used: LMS
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
1) Individual Assessment 2) LMS MCQ
The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE2506	Course Title: Cloud Computing	**L- T-P- C**	2	0	0	2
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: 3. Comprehend the significance of Cloud computing technologies 4. Describe appropriate Virtualization techniques to virtualize infrastructures 5. Apply Cloud mechanisms to optimize the QoS parameters 6. 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:

2. Automation of performance analysis of students through the Cloud
3. Chatbots development using Cloud resources
4. 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).

Text Book(s)

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

References

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

Web Resources and Research Articles links:

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

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

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

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

Course Code: CSE2507	Course Title: Cloud Computing Lab	L- T-P- C	0	0	2	1
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: 4. Comprehend the significance of Cloud computing technologies 5. Describe appropriate Virtualization techniques to virtualize infrastructures 6. Apply Cloud mechanisms to optimize the QoS parameters 7. Interpret recent technologies on Cloud					

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)

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

References

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

Web Resources and Research Articles links:

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

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

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

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

Course Code: CSE7000	**Course Title: Internship** **Type of Course:**	**L- T-P- C**	-	-	-	2
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.					
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. (Understand) 2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply) 3. Design the experiments as per the standards and specifications. (Analyze) 4. Interpret the events and results for meaningful conclusions. (Evaluate)

Course Code: **CSE7100**	**Course Title:** **Mini Project** **Type of Course:**	**L- T-P- C**	0	0	0	4
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. (Understand) 2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply) 3. Design the experiments as per the standards and specifications. (Analyze) 4. Interpret the events and results for meaningful conclusions. (Evaluate) 5. Appraise project findings and communicate effectively through scholarly publications. (Create)					

Course Code: **CSE7300**	**Course Title:** **Capstone Project** **Type of Course:**	**L- T-P- C**	0	0	0	10
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 problems based on societal /research needs. (Understand) 2. Apply Knowledge and skill to solve societal problems in a group. (Apply) 3. Develop interpersonal skills to work as member of a group or leader. (Apply) 4. Analyze the inferences from available results through theoretical / Experimental / Simulations. (Analyze) 5. Analyze the impact of solutions in societal and environmental context for sustainable development. (Analyze) 6. Improve in written and oral communication. (Create) 7. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. (Understand)

Course Code: **CSE2510**	**Course Title:** Competitive Programming and Problem Solving **Type of Course: Program Core**	L-T-P-C	0	0	4	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	The **Competitive Programming and Problem Solving** course equips students with efficient problem-solving skills for coding competitions and real-world challenges. Starting with brute-force solutions, students learn to optimize time and space complexity using advanced techniques like dynamic programming, greedy algorithms, and backtracking. Hands-on practice on platforms like CodeChef and Codeforces helps tackle problems involving number theory, data structures, and algorithmic paradigms. By understanding CP constraints and fostering a strategic mindset, students gain the confidence to excel in competitions, technical interviews, and practical applications.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 : Understanding the issues of online platforms and Competitive Programming (CP) and developing brute force coding for commonly asked CP problems. CO2 : Analyzing the space and time complexity of brute force solutions and designing efficient solutions. CO3 : Evaluating the applicability of suitable algorithmic approaches to solve relevant CP problems. CO4: Creating efficient solutions of CP problems using the learnt algorithmic approaches.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of **Competitive Programming and Problem Solving** and attain **Skill Development** through **Experiential Learning** techniques.

Module 1: Introduction to Competitive Programming

Overview of Efficient Coding for Problem Solving and CP: Introduction to competitive programming (CP); revisit of complexity analysis; introduction to online platforms such as codechef, codeforces etc and online submission; constraints during CP, online testing process and common errors such as TLE; use of STL

Module 2: Number Theory for Problem-Solving

Use of Number Theory for problem-solving: reducing time/space complexity of brute force[Text Wrapping Break]coding solution of Sieve Method, Inverse Module, Euclidian Method of factorization; efficient coding[Text Wrapping Break]for Permutation Combination; XORing based and pattern-based solutions.

Module 3: Optimizing Time & Space Using Sequential Storage

Coding for Optimizing time and Space using Sequential Storage: two pointer approach;[Text Wrapping Break]problem-solving using arrays and strings such as rotation on sorted arrays, duplicate removal, string[Text Wrapping Break]matching algorithms; Kadane's algo, stacks, priority-queues and hashing based efficient coding;[Text Wrapping Break]median based problems and alternate solutions.

Module 4: Non-Linear Data Structures

Applying Non-Linear Data Structures for real-life problems: design of efficient solutions for[Text Wrapping Break]problems such as finding loops in a linked list, memory efficient DLL, block reversal in LL; problem[Text Wrapping Break]solving using trees and binary trees, Catalan numbers, applications of graphs, spanning tree and path[Text Wrapping Break]algos for CP problems with reduced time/space complexity.

Module 5: Problem Solving using Advanced Topics

CP Problem Solving using Advanced Topics: concept of disjoint sets and their efficient[Text Wrapping Break]representation, algorithmic approaches such as Greedy, Backtracking, Dynamic Programming and[Text Wrapping Break]applying them for CP problems using bottom-up dynamic programming.

List of Laboratory Tasks:

1. You are given the finishing times of 'N' runners in a marathon. Write a program to find the runner who finished in the third position. **Focus:** Basic data structures (arrays), sorting algorithms (e.g., insertion sort, selection sort), and basic input/output.
2. In the same marathon, you are given the finishing times of 'N' runners and their bib numbers. Write a program to efficiently find the top 10 runners and their corresponding bib numbers. **Focus:** Efficient sorting algorithms (e.g., merge sort, quick sort), data structures like priority queues, and optimizing for large datasets.
3. A library maintains a list of books with their unique IDs. Write a program to check if a given book ID is present in the library. Focus: Searching algorithms (linear search), basic data structures (arrays or lists).
4. The library wants to implement a system to quickly find books by their titles. Suggest an efficient data structure (e.g., a hash table or a trie) and explain how to implement it to achieve fast book lookups. Focus: Understanding the trade-offs between different data structures, choosing the most appropriate data structure for a specific problem, and implementing efficient search operations.
5. An online store sells products with different prices. Write a program to calculate the total cost of a given list of products. **Focus:** Basic arithmetic operations, working with arrays or lists to store product prices.
6. The online store offers discounts based on the total purchase amount. Design an algorithm to efficiently calculate the final cost of an order, considering different discount rules (e.g., percentage discounts, fixed amount discounts, tiered discounts). Focus: Algorithmic design, conditional statements, handling complex scenarios with multiple rules, and potentially using dynamic programming techniques for optimization.
7. You are given two integers, 'a' and 'm'. Calculate 'a' raised to the power 'm' modulo a large prime number 'p'. **Focus:** Basic modular arithmetic operations (modular exponentiation), understanding the modulo operator.
8. In a secure communication system, you need to efficiently compute the modular exponentiation for very large values of 'm'. Implement and analyze the efficiency of the binary exponentiation algorithm for this task. **Focus:** Efficient algorithms for modular exponentiation (binary exponentiation), time complexity analysis, and understanding the importance of efficient algorithms in cryptography.
9. You have a deck of 'N' cards. Calculate the total number of possible hands of size 'K' that can be drawn from the deck. **Focus:** Basic combinatorics (combinations), factorial calculations.
10. In a card game, you need to calculate the probability of drawing certain combinations of cards (e.g., a pair, a three-of-a-kind) from a shuffled deck. Design an efficient algorithm to calculate these probabilities. **Focus:**

Advanced combinatorics (permutations and combinations with repetitions), probability calculations, and optimizing calculations to avoid overflows.

11. You are given a network of devices represented as a graph. Determine if there is a path between two given devices in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search).
12. In a secure network, you need to detect and isolate compromised devices. Design an algorithm that efficiently identifies devices that exhibit anomalous behavior (e.g., unusual traffic patterns) using XOR-based techniques for data comparison and pattern matching. **Focus:** Applying XOR operations for data comparison and pattern recognition, understanding the properties of XOR (e.g., commutative, associative), and designing algorithms for network anomaly detection.
13. You are given an array representing the speeds of cars on a highway. Find the minimum time required for all cars to pass a certain point. **Focus:** Basic array traversal, finding the minimum element in an array.
14. In a more realistic scenario, cars have different lengths. Implement a two-pointer approach to simulate the movement of cars and determine the minimum time for all cars to pass a given point. **Focus:** Two-pointer technique, simulating real-world scenarios with arrays, optimizing time complexity.
15. Given a string, find the number of occurrences of a specific substring within the string. **Focus:** Basic string manipulation, string matching (brute-force approach).
16. Implement the KMP (Knuth-Morris-Pratt) string matching algorithm to efficiently find all occurrences of a given pattern within a large text document. **Focus:** Advanced string matching algorithms, understanding the concept of the "next" array in KMP, optimizing for large input sizes.
17. An online auction platform receives bids for different items. Implement a data structure (e.g., a priority queue) to efficiently track the highest bid for each item. **Focus:** Priority queues, insertion and extraction operations on priority queues, basic implementation of a priority queue using an array or a suitable library.
18. The auction platform needs to handle a large number of bids concurrently. Design and implement a system that efficiently processes bids, updates the highest bid for each item, and handles potential race conditions. **Focus:** Concurrent data structures and algorithms, thread safety, handling race conditions, optimizing for high-throughput scenarios.
19. A social network can be represented as a graph where users are nodes, and connections between users are edges. Write an algorithm to find if two given users are connected in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search), basic graph representation (adjacency list or adjacency matrix).
20. In a large social network, efficiently finding the shortest path between two users is crucial. Implement Dijkstra's algorithm to find the shortest paths between users in the network, considering edge weights (e.g., representing the strength of connections). **Focus:** Shortest path algorithms (Dijkstra's algorithm), graph algorithms with weighted edges, optimizing for large graphs.
21. A file system can be modeled as a tree structure. Implement a function to traverse the file system and print the names of all files and directories. **Focus:** Tree traversal algorithms (depth-first search or breadth-first search), basic tree representation (using nodes and pointers).
22. Design and implement a file system that supports efficient operations like creating directories, deleting files, and finding files based on their names or paths. Consider using a combination of tree structures and hash tables for efficient indexing and searching. **Focus:** Designing and implementing file system structures, using multiple data structures together, optimizing for common file system operations.
23. An online shopping cart can be represented as a tree, where each node represents an item or a category of items. Write an algorithm to calculate the total price of all items in the shopping cart. **Focus:** Tree traversal, calculating sums within a tree structure.
24. Implement a system that allows customers to apply discounts and coupons to their shopping carts. Consider using a combination of trees and other data structures (e.g., hash tables) to efficiently apply discounts and calculate the final price. **Focus:** Applying discounts and promotions to tree-like structures, efficient implementation of discount rules, optimizing for complex pricing scenarios.
25. In a social network, users can form groups. Given a list of friendships, determine if all users in a specific group are connected (directly or indirectly) through friendships. **Focus:** Disjoint set union (DSU) data structure, basic connectivity checks.
26. Design an efficient algorithm to find the minimum number of new friendships needed to connect all users in the social network into a single, connected component. **Focus:** Applying DSU for finding connected components, greedy algorithms, optimization for minimizing connections.

27. A treasure hunt involves a series of clues leading to the final treasure. Given a list of possible paths and their associated costs, find the cheapest path to reach the treasure. **Focus:** Greedy algorithms (e.g., Dijkstra's algorithm for shortest paths), basic graph representation.
28. In a more complex treasure hunt, there are time constraints associated with each path. Design an algorithm to find the fastest path to the treasure while considering both path costs and time constraints.
    Focus: Combining greedy approaches with other techniques (e.g., priority queues), handling multiple constraints, optimizing for time-critical scenarios.
29. In a simplified chess game with only rooks, determine the minimum number of moves required for a rook to reach a specific target square on an empty board. **Focus:** Breadth-first search (BFS) on a graph (the chessboard), basic graph traversal.
30. In a more realistic chess game with multiple pieces and obstacles, implement a minimax algorithm with alpha-beta pruning to determine the best move for a player. **Focus:** Game tree search, minimax algorithm, optimization techniques like alpha-beta pruning, handling complex game states.

Targeted Application & Tools that can be used:

1. C or C++ Compiler (g++): The standard compiler for CP. Familiarize students with compilation flags (e.g., -O2 for optimization).
2. IDE (Integrated Development Environment): Code:: Blocks, Visual Studio, CLion, or similar IDEs. These provide debugging capabilities, code completion, and other helpful features.
3. Online Judges (CodeChef, Codeforces, LeetCode, HackerRank): Essential for practicing and submitting solutions.
4. Debugger (gdb): Crucial for understanding code execution and finding bugs. Origin, excel and Mat lab soft wares for programming and data analysis.
5. Number Theory Libraries: Some libraries provide pre-built functions for number theory operations (though often it's better to implement them yourself for learning).
6. Wolfram Alpha: A useful tool for verifying number theory calculations and exploring concepts.
7. **String Libraries:** Familiarize students with the string manipulation functions available in C++.
8. **Graph Visualization Tools:** Tools like Graphviz can be helpful for visualizing graphs and understanding graph algorithms.
9. **DP Debugging Techniques:** Practice debugging DP solutions, as they can be complex. Visualizing the DP table can be helpful.

Text Books:

1. **Guide to Competitive Programming: Learning and Improving Algorithms Through Contests" (3rd Edition), *Antti Laaksonen, springer, 2024***
2. **"Data Structures and Algorithms in Java: A Project-Based Approach" – *Dan S. Myers, Cambridge University Press***

Reference Books:

1. **Data Structures and Algorithmic Thinking with Python/C++/Java", *Narasimha Karumanchi, 5th Edition, Career Monk, 2017.***
2. **Introduction to Algorithms, Thomas H. Cormen (Author), Charles E. Leiserson (Author), Ronald L. Rivest , fourth edition April 2022**

Web Resources

1. https://nptel.ac.in/courses/106106231
2.

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

Assessment Type

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)
- Quiz
- End Term Exam
- Self-Learning

Ittagalpura, Rajanukunte, Yelahanka, Bengaluru 560 119