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

2024-2028

BACHELOR OF TECHNOLOGY (B.Tech.) in

COMPUTER ENGINEERING

B.Tech. [COM]

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

Regulations No: PU/AC-24.05/SOCSE04/COM/2024-2028

Resolution No. 05 of the 24th Meeting of the Academic Council held on 3rd August 2024,- and ratified by the Board of Management in its 24th Meeting held on 5th August 2024.

(As amended up to the 26th Meeting of the Academic Council held on 25th July 2025, and ratified by the Board of Management in its 27th Meeting held on 28th July 2025)

AUGUST 2024

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PART A – PROGRAM REGULATIONS

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

1.1 Vision of the University

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

1.2 Mission of the University

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

1.3 Vision of Presidency School of Computer Science and Engineering

- To be a value based, practice-driven School of Computer Science and Engineering, committed to developing globally-competent Engineers, dedicated to developing cutting-edge technology, towards enhancing Quality of Life.

1.4 Mission of Presidency School of Computer Science and Engineering

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

2. Preamble to the Program Regulations and Curriculum

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

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

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations, 2024 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 2024-2028.
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 2024-2028 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2024-2025.

4. Definitions

In these Regulations, unless the context otherwise requires:

a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;
b. "Academic Council" means the Academic Council of the University;
c. "Academic Regulations" means the Academic Regulations, of the University;
d. "Academic Term" means a Semester or Summer Term;
e. "Act" means the Presidency University Act, 2013;
f. "AICTE" means All India Council for Technical Education;
g. "Basket" means a group of courses bundled together based on the nature/type of the course;
h. "BOE" means the Board of Examinations of the University;
i. "BOG" means the Board of Governors of the University;
j. "BOM" means the Board of Management of the University;
k. "BOS" means the Board of Studies of a particular Department/Program of Study of the University;
l. "CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;
m. "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;
n. "COE" means the Controller of Examinations of the University;
o. "Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;
p. "Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;
q. "Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;
r. "Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.
s. "DAC" means the Departmental Academic Committee of a concerned Department/Program of Study of the University;

t. *"Dean" means the Dean / Director of the concerned School;*

u. *"Degree Program" includes all Degree Programs;*

v. *"Department" means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;*

w. *"Discipline" means specialization or branch of B.Tech. Degree Program;*

x. *"HOD" means the Head of the concerned Department;*

y. *"L-T-P-C" means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;*

z. *"MOOC" means Massive Open Online Courses;*

aa. *"MOU" means the Memorandum of Understanding;*

bb. *"NPTEL" means National Program on Technology Enhanced Learning;*

cc. *"Parent Department" means the department that offers the Degree Program that a student undergoes;*

dd. *"Program Head" means the administrative head of a particular Degree Program/s;*

ee. *"Program Regulations" means the Bachelor of Technology Degree Program Regulations and Curriculum, 2024-2028;*

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

gg. *"PSCS" means the Presidency School of Computer Science 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, 2022;*

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 2024-2028 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 2024-2028 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as CSE
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as CBD

3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as CBC
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as CDV
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as CCS
6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as CIT
7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as CSD
8. Bachelor of Technology in Computer Science and Technology, abbreviated as CSG
9. Bachelor of Technology in Information Science and Technology, abbreviated as IST
10. Bachelor of Technology in Computer Science and Information Technology, abbreviated as CSI
11. Bachelor of Technology in Computer Science and Engineering (Networks), abbreviated as CSN
12. Bachelor of Technology in Computer Engineering, abbreviated as COM
13. Bachelor of Technology in Information Science and Engineering, abbreviated as ISE and
14. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as CAI

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

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

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

6. Minimum and Maximum Duration

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

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

completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause 16.1 of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.

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

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.0 of Academic Regulations) in the prescribed maximum duration (Sub-Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

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

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

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

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

PEO4. Transform as an entrepreneur in the Computer Engineering and other related areas of Specialization.

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

8.1 Programme Outcomes (PO)

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

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

8.2 Program Specific Outcomes (PSOs):

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

PSO1	Demonstrate a strong understanding of computing fundamentals to explain key concepts, analyze computational problems using the theoretical knowledge gained to model and develop reliable and efficient computing systems that include both hardware and software.
PSO2	Utilize programming skills, software development tools, and domain knowledge to build practical, real-world applications, that help them prepare for a myriad of career opportunities in software development, pursue advanced studies, research or embark on entrepreneurial ventures.
PSO3	Design and implement embedded computing solutions by integrating sensors, actuators, and microcontrollers with software components for real-time and control applications.

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, 2024-2028, minus the number of Credits prescribed / accepted by the Equivalence Committee for the 1st Year (1st and 2nd Semesters) of the B.Tech. Program.

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

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

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

A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the B.Tech. / 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 8.8 of Academic Regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

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

12.4 Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach

to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:

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

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

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

12.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage for different category of Courses

Nature of Course and Structure	Evaluation Component	Weightage
Lecture-based Course L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	Continuous Assessments	50%
	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	75%
	End Term Examination	25%
Skill based Courses like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure	Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable.	

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

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

and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

12.6 **Minimum Performance Criteria:**

12.6.1 **Theory only Course and Lab/Practice Embedded Theory Course**

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

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

12.6.2 **Lab/Practice only Course and Project Based Courses**

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

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

13 Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc.

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

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer ANNEXURE B of Academic Regulations) and approved by the Dean - Academics.

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

13.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from

time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

13.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 13.3 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 shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

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

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

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

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

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

13.3.8 The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic Regulations.

Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses

Sl.	Course Duration	Credit Equivalence

No.		
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

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

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

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

13.5 Mandatory Non-Credit Course Completion Requirements: All mandatory non-credit courses shall be satisfactorily completed by the student as part of the degree requirements. These courses will be evaluated and awarded letter grades based on the following criteria:

- S (Satisfactorily Completed): Awarded when the student successfully completes all prescribed course requirements.
- NC (Not Completed): Awarded when the student fails to meet the prescribed course requirements.

A student receiving an NC grade must reappear for and complete the course in accordance with the guidelines prescribed by the University.

In the case of non-taught and non-credited mandatory courses—where students are advised to undertake learning through MOOC platforms—there shall be a clearly defined Course Catalogue and a corresponding Course Plan. The Course Plan shall outline the assessment components, which will form the basis for evaluation.

PART B: PROGRAM STRUCTURE

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

The B.Tech. (Computer Engineering) Program Structure (2024-2028) totalling 160 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. (Computer Engineering) 2024-2028: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	Humanities and Social Sciences including Management Courses (HSMC)	10
2	Basic Science Courses (BSC)	17
3	Engineering Science Courses (ESC)	23
4	Professional Core Courses (PCC)	70
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	06
7	Project Work (PRW)	16
8	Mandatory Courses (MAC)	0
	Total Credits	160

In the entire Program, the practical and skill based course component contribute to an extent of approximately 60% out of the total credits of 160 for B.Tech. (Computer Engineering) program of four years' duration.

15. Minimum Total Credit Requirements of Award of Degree

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

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

16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University**.**

16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:

a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause 19.2.1 of Academic Regulations**;**

c. No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and

d. No disciplinary action is pending against her/him.

PART C CURRICULUM STRUCTURE

17. Curriculum Structure – Basket Wise Course List (not Semester Wise)
List of Courses Tabled – aligned to the Program Structure
(Course Code, Course Name, Credit Structure (LTPC), Contact Hours, Course Basket, Type of Skills etc., as applicable).

Type of Skill
F - Foundation
S - Skill Development
EM – Employability
EN – Entrepreneurship

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability
HP - Human values and Professional Ethics

Baskets
HSMC - Humanities and Social Sciences (including Management courses)
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Program Core Course
PEC - Professional Elective Courses
OEC - Open Elective Courses
EEC - Employment Enhancement Courses
MAC - Mandatory Course

	Table 3.1: List of Humanities and Social Sciences including Management Courses (HSMC)								
S.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	ENG1002	Technical English	1	0	2	2	3	S	Secure above cutoff score in EPT/ ENG1001
2	PPS1001	Introduction to	0	0	2	1	2	S	--

		soft skills							
3	DES1146	Introduction to Design Thinking	1	0	0	1	1	S	--
4	ENG2001/ FRL1002	Advanced English	1	0	2	2	3	S	--
5	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	S	--
6	FIN1002	Managerial Economics and Financial Accounting & Analysis	3	0	0	3	3	S	--
7	PPS3026	Industry Readiness Program	2	0	0	0	2	S	--
		Total No. of Credits				**10**			

Table 3.2 : List of Basic Science Courses (BSC)

Sl. No.	Course Code	Course Name	L	T	P	Credits	Contact Hours	Type of Skill	Pre-requisite
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	F	Nil
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	F	Nil
3	MAT1003	Applied Statistics	2	0	0	2	2	EM	Nil
4	MAT2501	Integral Transforms and Partial Differential Equations	3	1	0	4	4	F	MAT1001
5	MAT2503	Discrete Mathematics	3	1	0	4	4	F	Nil
		Total No. of Credits				**17**			

Table 3.3: List of Engineering Science Courses (ESC)

S.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Prerequisites
1	MEC1006	Engineering Graphics	2	0	0	2	2	S	--
2	CSE1004	Problem Solving Using C	1	0	4	3	5	S	--

3	ECE2007	Digital Design	2	0	2	3	4	S	--
4	CIV1008	Basic Engineering Sciences	2	0	0	2	2	S	--
5	CSE1006	Problem Solving using JAVA	1	0	4	3	5	S	--
6	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	5	S	--
7	ECE2010	Innovative Projects Using Arduino	-	-	-	1	-	S	--
8	CSE1500	Computational Thinking using Python	**2**	**0**	2	3	4	S	--
9	CSE2274	Competitive Programming and Problem Solving	**0**	**0**	**4**	**2**	**4**	**S/EM**	**--**
		Total No. of Credits				23			

Table 3.4 : List of Professional Core Courses (PCC)

S. No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Prerequisites
1	CSE2251	Data Communication and Computer Networks	**3**	**0**	**0**	3	3	S	--
2	CSE2257	Computer Organization and Architecture	3	0	0	3	3	S	ECE2007
3	CSE2258	Web Technologies	3	**0**	**0**	3	3	S/EM	--
4	CSE2252	Data Communication and Computer Networks Lab	**0**	**0**	**2**	1	2	S/EM	--
5	CSE2259	Web Technologies Lab	**0**	**0**	**2**	1	2	S/EM	--
6	CSE2262	Analysis of Algorithms	3	1	0	4	4	S	CSE1508
7	CSE2260	Database Management Systems	**3**	**0**	**0**	3	3	S	CSE1508

8	CSE2269	Operating Systems	3	0	0	3	3	S	CSE2501
9	CSE2270	Operating Systems Lab	0	0	2	1	2	S/EM	CSE2501
10	CAI2500	Machine Learning	3	**0**	**0**	3	3	S	MAT1003
11	CAI2501	Machine Learning Lab	**0**	**0**	4	2	4	S/EM	CSE1500
12	CSE2261	Database Management Systems Lab	**0**	**0**	**2**	1	2	S/EM	CSE1509
13	CSE2263	Analysis of Algorithms Lab	**0**	**0**	**2**	1	2	S/EM	CSE1509
14	CSE2266	Theory of Computation	3	0	0	3	3	S	CSE1508
15	CSE2271	Software Design and Development	3	0	0	3	3	S/ EM/ EN	--
16	CSE2272	Cloud Computing	**2**	**0**	**0**	2	2	S	CSE2022
17	CAI2504	Natural Language Processing	3	0	0	3	3	S	CAI2500
18	CSE2503	Scalable Application Development using Java	3	0	0	3	3	S	CSE1006
19	CSE2504	Scalable Application Development using Java Lab	0	0	2	1	2	S/EM	CSE1006
20	CSE2273	Cloud Computing Lab	0	0	2	1	2	S/EM	CSE2023
21	CSE2502	Cryptography and Network Security	3	0	0	3	3	**S**	CSE2002
22	CSE2276	Introduction to IoT	3	0	0	3	3	S	CSE1506
23	COM2500	Computer Vision and LLMs	2	0	0	2	2	S	**CAI3400**
	CSE2277	Introduction to IoT Lab	0	0	2	1	2	--	**--**
24	COM2502	Applied Machine Learning	2	0	0	2	2	**S**	**CAI2500**
25	COM2503	Applied Machine Learning Lab	0	0	2	1	2	S/EM	CAI2501
26	COM2501	Computer Vision and	0	0	2	1	2	S/EM	CAI2501

		LLMs Lab							
27	CAI2505	Natural Language Processing Lab	0	0	2	1	2	S/EM	CAI2501
28	CSE2264	Essentials of AI	3	0	0	3	3	S	MAT2605
29	CSE2265	Essentials of AI Lab	0	0	2	1	2	S/EM	CSE1500
30	CSE2253	Data Structures	3	0	0	3	3	S	CSE1004
31	CSE2254	Data Structures Lab	0	0	2	1	2	S	CSE1004
32	ECE3111	Microprocessor and Microcontroller	3	0	0	3	3	S	ECE2007
		Total No. of Credits				**70**			**--**

Table 3.5 : List of course in Project Work basket (PRW)

S.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	CSE7300	Capstone Project	0	0	0	10	-	EM/EN	--
2	CSE7100	Mini Project	0	0	0	4	-	EM/EN	--
3	CSE7000	Internship	0	0	0	2	-	EM/EN	--
		Total No. of Credits				**16**			

Table 3.6 : List of Mandatory Courses (MAC)

S.No	Course Code	Course Name	L	T	P	C
1	CHE1018	Environmental Studies	1	0	2	0
2	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0
3	CIV7601	Universal Human Values and Ethics	-	-	-	0
4	APT4002	Introduction to Aptitude	0	0	2	0
5	APT4004	Aptitude Training – Intermediate	0	0	2	0
6	APT4006	Logical and Critical Thinking	0	0	2	0
7	APT4026	Aptitude for Employability	0	0	2	0
8	PPS4027	Preparedness for Interview	0	0	2	0
		Total No. of Credits				**0**

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

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

18.1 Internship / In-plant Training / Skill-based Program / International Immersion (IM) / Recognition of Prior Learning (RPL)

A student may undergo an Internship / In-plant Training / Skill-based Program / IM / RPL for a period minimum 04 weeks in an industry / company, government bodies, academic / research institution or recognized online platforms offering certified skill-based programs during the semester break between 4th and 5th semesters, subject to the following conditions:

18.1.1 The Internship / In-plant Training / Skill-based Program / IM / RPL shall be conducted in accordance with the Internship Policy prescribed by the University from time to time.

18.1.2 Internship: student shall undergo internship, either in industry / company, academic / research organizations, government bodies, or international institutions. The objective is to provide practical exposure, industry insights, and real-world experience relevant to the student’s field of study.

18.1.3 In-plant Training: student shall undergo training / industrial exposure program aimed at providing with practical insights into real-world working environments. The training may be conducted by industries / companies on-campus or through student visits to industries / companies, government bodies / institutions, or technical organizations.

18.1.4 Skill-based Program: student shall undergo a certified skill-based program of 30 hours / 04 weeks. Skill-based program should cater to Skill-Enhancement, Practical Focus, and Career orientation, Complementary to Curriculum or Industry relevant.

18.1.5 International Immersion (IM): student shall undergo IM aimed at providing global exposure through collaborations with foreign universities, industries, or research institutions. The International Immersion may include industry visits, expert interactions, and cultural exchange activities, enhancing students' international outlook, communication skills, and professional readiness.

18.1.6 Recognition of Prior Learning (RPL): student who shall undergo any formally recognize relevant prior work experience, internships, or project-based learning that meet the internship learning outcomes, thereby allowing students to earn internship credit without

repeating equivalent practical training.

18.1.7 The number of Internships available for the concerned Academic Term. Further, the available number of Internships / In-plant training / Skill-based Program / IM / RPL shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student and as per the selection criteria. Provided further, the student fulfils the criteria, as applicable, specified by the industry / company, government bodies, academic / research or through certified courses.

18.1.8 A student may opt for Internship / In-plant Training / IM / RPL in an industry / company, government bodies / academic / research institution, international bodies of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship / In-plant Training / IM / RPL on her / his own. Provided further, that the industry / company, government bodies, academic / research institution national or international offering such Internship / Training confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University / Rubrics.

18.1.9 A student undergoing RPL must submit an application with supporting documents such as experience letters, project reports, employer feedback, certifications, a self-reflection report etc. Application must be submitted before the commencement of the internship semester.

18.1.10 A student selected for an Internship / In-plant Training / Skill-based Program / IM / RPL in an industry / company, government bodies, academic / research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

The performance will be assessed and grades awarded as per the university's academic grading policy. It may be included as a non-GPA course (Grade-based Satisfactorily Completed / Not Completed). The student must secure a minimum of 50% of the total marks to be declared as having successfully completed the course.

18.1 ***Mini-Project***

A student may opt to do a Project Work for a period of 4-6 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship 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 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 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 project work confirms to the University that the 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 in 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 I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.3.5 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 3.7 : Professional Electives Courses/Specialization Tracks – Minimum of 12 credits is to be earned by the student in a particular track and overall 18 credits.

Track -1 Artificial Intelligence, Machine Learning and Data Science									
Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	**Type of Skills**	**Prerequisite**
1	CSE3500	Intelligent Systems with Machine Learning	2	0	2	3	4	S/EM	CSE1700
2	CSE3501	Advanced Deep Learning Techniques	3	0	0	3	3	S/EM	CAI2502
3	CSE3502	Computational Optimization for Intelligent Systems.	3	0	0	3	3	S/EM	CSE1700
4	CSE3503	Reinforcement Learning for AI Systems	2	0	2	3	4	S/EM	CAI3409
5	CSE3505	Synergistic Neural Fuzzy Computing	2	0	2	3	4	S/EM	CSN2508
6	CSE3509	Emerging Technologies in Big Data	2	0	2	3	4	S/EM	CSE3156
7	CSE3510	Statistical Techniques of Data Science	2	0	2	3	4	S/EM	MAT1003
8	CSE3511	Predictive Analytics and Applications	2	0	2	3	4	S/EM	MAT1003
9	CSE3512	Data Mining	3	0	0	3	3	S/EM	MAT1003
10	CSE3514	Applied Data Intelligence	2	0	2	3	4	S/EM	Nil
11	COM3506	Bioinformatics	3	0	0	0	3	S	-

Track - 2 Cloud, Security & Systems									
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Contact Hours**	**Type of Skills**	**Prerequisite**
1	CSE3516	Federated Learning	2	0	2	3	4		CSE3155
2	CSE3517	Edge Computing	2	0	2	3	4	S/EM	CSE3155
3	CSE3518	Network Security and Firewall Management	2	0	2	3	4	S/EM	CSE3155
4	CSE3519	Information Security and Management	3	0	0	3	3	S/EM	CSE3155
5	CSE3520	Network Intrusion Detection and Prevention	3	0	0	3	3	S/EM	CSE3155
6	CSE3521	Principles and Practices of Web Security	2	0	2	3	4	S/EM	CSE3155
7	CSE3522	Penetration Testing and Risk Assessment	3	0	0	3	3	S/EM	CSE3155
Track -3 Programming									
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Contact Hours**	**Type of Skills**	**Prerequisite**
1	CSE3523	Go Programming	3	0	0	3	3	S/EM	CSE1004
2	CSE3524	Advanced Database Management Systems	2	0	2	3	4	S/EM	CSE3156
3	CSE3525	Programming in C# and .NET	1	0	4	3	5	S/EM	CSE1006
4	CSE3426	Front End Full Stack Development *	2	0	2	3	4	S/EM	CSE1006
5	CSE3427	Java Full Stack Development *	2	0	2	3	4	S/EM	CSE1006
6	CSE3428	.Net Full Stack Development *	2	0	2	3	4	S/EM	CSE1006
7	COM3401	Advanced Computer Architecture	3	0	0	3	3	S/EM	CSE2501
Special Basket									
1	CAI3427	Language Models for Text Mining +	2	0	2	3	4	S/EM	--
2	CAI3428	Practical Deep Learning with tensor Flow +	2	0	2	3	4	S/EM	--

3	CAI3429	Deep Learning Techniques for Computer Vision +	2	0	2	3	4	S/EM	--
Total # of Credits to be earned from DE = 18. 12 Credits from program specialization baskets and 6 from other baskets.									

- **Mandatory Discipline Electives**

+ Applicable for Samsung students

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

Course Caters to:
GS - Gender Sensitization
ES - Environment and sustainability
HP - Human values and Professional Ethics

Table 3.8 : Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 9

Sl. No.	Course Code	Course Name	L	T	P	C	Type of Skill/ Focus	Course Caters to	Prerequisites/ Corequisites	Antirequisites	Future Courses that need this as a Prerequisite
Chemistry Basket											
1	CHE1003	Fundamentals of Sensors	3	0	0	3	S	ES	-	-	-
2	CHE1004	Smart materials for IOT	3	0	0	3	S	ES	-	-	-
3	CHE1005	Computational Chemistry	2	0	0	2	S	ES	-	-	-
4	CHE1006	Introduction to Nano technology	3	0	0	3	S	ES	-	-	-
5	CHE1007	Biodegradable electronics	2	0	0	2	S	ES	-	-	-
6	CHE1008	Energy and Sustainability	2	0	0	2	S	ES	-	-	-
7	CHE1009	3D printing with Polymers	2	0	0	2	S	ES	-	-	-
8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES	-	-	-
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES	-	-	-
10	CHE1012	Introduction to Composite materials	2	0	0	2	S	ES	-	-	-
11	CHE1013	Chemistry for Engineers	3	0	0	3	S	ES	-	-	-
12	CHE1014	Surface and Coatings technology	3	0	0	3	S	ES	-	-	-
13	CHE1015	Waste to Fuels	2	0	0	2	S	ES	-	-	-
14	CHE1016	Forensic Science	3	0	0	3	S	ES	-	-	-
Civil Engineering Basket											
1	CIV1001	Disaster mitigation and management	3	0	0	3	S	-	-	-	-
2	CIV1002	Environment Science and Disaster Management	3	0	0	3	FC	-	-	-	-
3	CIV2001	Sustainability Concepts in Engineering	3	0	0	3	S	-	-	-	-
4	CIV2002	Occupational Health and Safety	3	0	0	3	S	-	-	-	-
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	-	-	-	-
6	CIV2004	Integrated Project Management	3	0	0	3	EN	-	-	-	-
7	CIV2005	Environmental Impact Assessment	3	0	0	3	EN	-	-	-	-
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	-	-	-	-
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	-	-	-	-
10	CIV2045	Environmental Meteorology	3	0	0	3	S	-	-	-	-
11	CIV3046	Project Problem Based Learning	3	0	0	3	S	-	-	-	-
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	-	-	-	-
Commerce Basket											
1	COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS	-	-	-
2	COM2002	Finance for Non-Finance	2	0	0	2	S	-	-	-	-
3	COM2003	Contemporary Management	2	0	0	2	F	-	-	-	-
4	COM2004	Introduction to Banking	2	0	0	2	F	-	-	-	-
5	COM2005	Introduction to Insurance	2	0	0	2	F	-	-	-	-
6	COM2006	Fundamentals of Management	2	0	0	2	F	-	-	-	-
7	COM2007	Basics of Accounting	3	0	0	3	F	-	-	-	-
Computer Science Basket											
1	CSE2002	Programming in Java	2	0	2	3	S/EM	-	-	-	-
2	CSE2003	Social Network Analytics	3	0	0	3	S	GS	-	-	-
3	CSE2004	Python Application Programming	2	0	2	3	S/ EM	-	-	-	-
4	CSE2005	Web design fundamentals	2	0	2	3	S/ EM/EN	-	-	-	-
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	Choice in Virtual Fashion	1	0	2	2	F	ES, GS,			

21.List of MOOC Courses

21.1 Presidency University students are given the opportunity to study abroad in International Universities through a selection process coordinated by the Office of International Affairs (OIA). Such selected students need to complete their credits for the semester that they are abroad in the following way:

21.1.1 The student needs to study and complete School Core and Program Core Courses in offline mode only.

21.1.2 Massive Open Online Course (MOOC) courses maybe given for Open Elective and Discipline Elective Courses. These courses need to be approved by the concerned BOS and Academic Council from time to time.

21.1.3 SWAYAM/NPTEL/ other approved MOOCs shall be approved by the concerned Board of Studies and placed in the concerned PRC.

21.1.4 Student shall register for these courses in the ERP of Presidency University.

21.1.5 For these MOOC courses faculty coordinators are identified. These faculty should have undergone similar MOOC courses and therefore should be familiar with the mode of class conduction, types of assessments and evaluation procedures.

21.1.6 Study materials shall be provided to the students as video lectures shared by the MOOCs Coordinator(s), or the students may access the approved MOOCs Portal directly. The mode of class conduction is determined by the MOOCs coordinator(s) as detailed in the Course Catalogue and Course Plan.

21.1.7 The question paper shall be prepared by the MOOCs coordinator(s).

21.1.8 Students write the exams in online mode. These exams are scheduled and conducted by the School.

21.1.9 Results are evaluated by School and given to the Office of the Controller of Examinations (CoE).

21.1.10 The details of the duration, credits and evaluation are given below:

Sl#	Duration	Credits
1.	12 weeks	3
2.	8 weeks	2
3	4 weeks	1

21.2 MOOC - Discipline Elective Courses for B. Tech. (Computer Engineering)

Table 3.9 : MOOC Discipline Elective Courses				
Sl.No	**Course Code**	**Course Name**	**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	CSE505	The Joy of Computing Using Python	3	3-0-0-3
7	CSE3119	Coding Skills in Python	3	3-0-0-3
8	CSE3121	Parallel Computer Architecture	3	3-0-0-3
9	CSE3124	Games and Information	3	3-0-0-3
10	CSE3140	Introduction to Industry 4.0 and Industrial Internet of Things	3	3-0-0-3
11	CSE3142	Affective Computing	3	3-0-0-3
12	CSE3196	Foundations of Cyber Physical Systems	3	3-0-0-3
13	CSE3197	Getting Started with Competitive Programming	3	3-0-0-3
14	CSE3198	GPU Architectures and Programming	3	3-0-0-3
15	CSE3199	Artificial Intelligence: Knowledge Representation and Reasoning	3	3-0-0-3
16	CSE3200	Programming in Modern C++	3	3-0-0-3
17	CSE3201	Circuit Complexity Theory	3	3-0-0-3
18	CSE3202	Basics of Computational Complexity	3	3-0-0-3
19	CSE3212	Introduction to Computer and Network Performance Analysis using Queuing	1	1-0-0-1
20	CSE3213	C Programming and Assembly Language	1	1-0-0-1
21	CSE3214	Python for Data Science	1	1-0-0-1
22	CSE3215	Software Conceptual Design	1	1-0-0-1
23	CSE3117	Industrial Digital Transformation	3	3-0-0-3
24	CSE3118	Blockchain for Decision Makers	3	3-0-0-3
25	CSE3349	Technology for Lawyers	3	3-0-0-3
26	CSE3430	Deep Learning for Natural Language Processing	3	3-0-0-3
27	CSE3431	Machine Learning for Engineering and Science Applications	3	3-0-0-3

28	CSE3432	Algorithms in Computational Biology and Sequence Analysis	3	3-0-0-3
29	CSE3433	Introduction to Large Language Models (LLMs)	3	3-0-0-3
30	CSE3434	Quantum Algorithms and Cryptography	3	3-0-0-3
31	CAI3430	Responsible & Safe AI Systems	3	3-0-0-3
32	CCS3416	Practical Cyber Security for Cyber Security Practitioners	3	3-0-0-3
33	IST3409	Design & Implementation of Human-Computer Interfaces	3	3-0-0-3

21.3 MOOC - Open Elective Courses for B. Tech. (Computer Engineering)

Table 3.10: MOOC Open Elective Courses

Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)

Sl. No.	Course Code	Course Name	Total Credits	L-T-P-C
1	BBA2022	Supply Chain digitization	3	3-0-0-3
2	BBA2021	E Business	3	3-0-0-3
3	BBB2016	Business Analytics for Management Decisions	3	3-0-0-3
4	BBB2015	Artificial Intelligence for Investments	3	3-0-0-3
5	MEC3001	Design and Development of Product	1	1-0-0-1
6	ENG3004	Perspectives of Neurolinguistics	1	1-0-0-1
7	PPS4009	Working in Contemporary Teams	1	1-0-0-1
8	MGT3001	Data Analysis and Decision Making	3	3-0-0-3
9	MEC3001	Design and Development of Product	1	1-0-0-1
10	EEE3105	Microsensors and Nanosensors	3	3-0-0-3
11	CIV3065	Drone Systems and Cont¯rol	3	3-0-0-3
12	ECE3183	Neural Networks for Signal Processing - I	3	3-0-0-3
13	CIVXXXX	Disaster Management	3	3-0-0-3

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

Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**	**Contact Hours**	**Type of Skill**	**Pre-requisite**	**Type of Course**
Semester 1 - Physics Cycle			**12**	**0**	**14**	**19**	**26**			
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	F	Nil	BSC
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	F	Nil	BSC
3	MEC1006	Engineering Graphics	2	0	0	2	2	S	Nil	ESC
4	CSE1004	Problem Solving Using C	1	0	4	3	5	S	Nil	ESC
5	ENG1002	Technical English	1	0	2	2	3	S	Nil	HSMC
6	PPS1001	Introduction to soft skills	0	0	2	1	2	S	Nil	HSMC
7	DES1146	Introduction to Design Thinking	1	0	0	1	1	F	Nil	HSMC
8	ECE2007	Digital Design	2	0	2	3	4	F/S	Nil	ESC
Semester 2 - BES Cycle			**11**	**0**	**12**	**15**	**23**			
1	MAT1003	Applied Statistics	2	0	0	2	2	EM	Nil	BSC

2	CIV1008	Basic Engineering Sciences	2	0	0	2	2	S	Nil	ESC
3	CSE1006	Problem Solving using JAVA	1	0	4	3	5	S	CSE1004	ESC
4	EEE1007	Basics of Electrical and Electronics Engineering	3	0	2	4	5	F	Nil	ESC
5	ENG2001/ FRL1002	Advanced English / Foreign Language courses	1	0	2	2	3	S	ENG1002	HSMC
6	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	S	Nil	HSMC
7	CHE1018	Environmental Science	1	0	2	0	3	F	Nil	MAC
8	LAW1007	Indian Constitution and Professional Ethics for Engineers	1	0	0	0	1	F	Nil	MAC
9	ECE2010	Innovative Projects Using Arduino	-	-	-	1	0	S	Nil	ESC
Semester 3			**17**	**1**	**8**	**22**	**28**			
1	MAT2501	Integral Transforms and Partial Differential Equations	3	1	0	4	4	F	MAT1001	BSC
2	CSE2253	Data Structures	3	0	0	3	3	S	Nil	PCC
3	CSE2258	Web Technologies	3	0	0	3	3	S/EM	Nil	PCC
4	CSE1500	Computational Thinking using Python	2	0	2	3	4	S/EM	Nil	ESC
5	CSE2251	Data	3	0	0	3	3	S	Nil	PCC

		Communication and Computer Networks								
6	CSE2257	Computer Organization and Architecture	3	0	0	3	3	S	Nil	PCC
7	CSE2254	Data Structures Lab	0	0	2	1	2	S	Nil	PCC
8	CSE2259	Web Technologies Lab	0	0	2	1	2	S/EM	Nil	PCC
9	CSE2252	Data Communication and Computer Networks Lab	0	0	2	1	2	S	Nil	PCC
10	CIV7601	Universal Human Values and Ethics	0	0	0	0	0	S	MMAC	MAC
11	APT4002	Introduction to Aptitude	0	0	2	0	2		AT	MAC
Semester 4			**21**	**2**	**12**	**28**	**36**			
1	MAT2503	Discrete Mathematics	3	1	0	4	4	F	Nil	BSC
2	CSE2260	Database Management Systems	3	0	0	3	3	S	Nil	PCC
3	CSE2261	Database Management Systems Lab	0	0	2	1	2	S	Nil	PCC
4	CSE2262	Analysis of Algorithms	3	1	0	4	4	S	Nil	PCC
5	CSE2263	Analysis of Algorithms Lab	0	0	2	1	2	S	Nil	PCC
6	CSE2264	Essentials of AI	3	0	0	3	3	S	Nil	PCC
7	CSE2265	Essentials of AI Lab	0	0	2	1	3	S	Nil	PCC
8	CSE2503	Scalable Application Development using Java	3	0	0	3	3	S/EM	CSE1006	PCC

9	CSE2504	Scalable Application Development using Java Lab	0	0	2	1	2	S/EM	CSE1006	PCC
10	CSE2269	Operating Systems	3	0	0	3	3	S	Nil	PCC
11	FIN1002	Essentials of Finance	3	0	0	3	3	S	HSMC	HSMC
12	CSE2270	Operating Systems Lab	0	0	2	1	2	S	Nil	PCC
13	APT4004	Aptitude Training - Intermediate	0	0	2	0	2	S	AT	MAC
Semester 5			**20**	**0**	**10**	**26**	**30**			
1	CSE2266	Theory of Computation	3	0	0	3	3	S	Nil	PCC
2	CSE2502	Cryptography and Network Security	3	0	0	3	3	S	CSE2002	PCC
3	CAI2500	Machine Learning	3	0	0	3	3	S/EM	Nil	PCC
4	CAI2501	Machine Learming Lab	0	0	4	2	4	S/EM	Nil	PCC
5	CAI2504	Natural Language Processing	3	0	0	3	3	S	Nil	PCC
6	CAI2505	Natural Language Processing Lab	0	0	2	1	2	S		PCC
7	CSE2272	Cloud Computing	2	0	0	2	2	S	CSE2022	PCC
8	CSE2	Cloud Computing Lab	0	0	2	1	2	S	CSE2023	PCC
9	ECE3111	Microprocessor and Microcontroller	3	0	0	3	3	S	ECE2007	PCC
10	CSEXXXX	Professional Elective – I	3	0	0	3	3	S	Nil	PEC
12	CSE7000	Internship	0	0	0	2	0	S/EM	Nil	PRW
13	APT4006	Logical and	0	0	2	0	2	S	AT	MAC

		Critical Thinking								
Semester 6			**21**	**0**	**12**	**24**	**32**			
1	CSE2274	Competitive Programming and Problem Solving	0	0	4	2	4	S/EM	Nil	ESC
2	COM2502	Applied Machine Learning	2	0	0	2	2	S	Nil	PCC
3	COM2503	Applied Machine Learning Lab	0	0	2	1	2	S/EM	Nil	PCC
	COM2500	Computer Vision and LLMs	2	0	0	2	2	S/EM	Nil	PCC
5	COM2501	Computer Vision and LLMs Lab	0	0	2	1	2	S/EM	Nil	PCC
6	PPS3026	Industry Readiness Program VI	2	0	0	0	2	F		MAC
7	CSE2276	Introduction to IoT	3	0	0	3	3	F		PCC
8	CSE2271	Software Design and Development	3	0	0	3	3	S/EM	Nil	PCC
9	CSE2277	Introduction to IoT Lab	0	0	2	1	1	F		PCC
10	APT4026	Aptitude for Employability	0	0	2	0	2	S	AT	MAC
11	CSEXXXX	Professional Elective – II	3	0	0	3	3	S	Nil	PEC
12	CSEXXXX	Professional Elective – III	3	0	0	3	3	S	Nil	PEC
13	XXXXXXX	Open Elective – I	3	0	0	3	3	S	Nil	OEC
Semester 7			**12**	**0**	**0**	**16**	**14**			
1	CSEXXXX	Professional Elective – IV	3	0	0	3	3	S	Nil	PEC
2	CSEXXXX	Professional	3	0	0	3	3	S	Nil	PEC

		Elective – V								
3	CSEXXXX	Professional Elective – VI	3	0	0	3	3	S	Nil	PEC
4	XXXXXXX	Open Elective – II	3	0	0	3	3	S	Nil	OEC
5	CSE7100	Mini Project	0	0	0	4	0	S/EM	Nil	PRW
6	PPS4027	Preparedness for Interview	0	0	2	0	2	S	AT	MAC
Semester 8			**0**	**0**	**0**	**10**	**0**			
1	CSE7300	Capstone Project	0	0	0	10	0	S/EM	Nil	PRW
						160				

Course Catalogues:

Course Code: MAT1001_v03	**Course Title:** Calculus and Linear Algebra **Type of Course:** School Core Lab Integrated	**L-T- P-C**	**3**	**0**	**2**	**4**
Version No.	3.0					
Course Pre-requisites	--					
Anti-requisites	**NIL**					
Course Description	The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software.					
Course Objective	The objective of the course is **Skill Development** of student by using **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. 5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems.					
Course Content:						
Module 1	**Linear Algebra**				**10 Classes**	
Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) AX = O and AX = B using rank method. **Linear Algebra:** Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Engineering Applications of Linear Algebra.						
Module 2	**Partial Derivatives**				**10 CLASSES**	

Review: Differential calculus with single variable.

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

Module 3	**Advanced Integral calculus**			**12 Classes**

Review: Integral calculus for single integrals.

Advanced Integral calculus:
Beta and Gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates.
Engineering applications of partial derivatives.

Module 4	**Ordinary Differential Equations**	**Assignment**	**Programming**	**12 Classes**

Review: First order and first-degree Ordinary Differential Equations, Method of separation of variables, Homogeneous and Non- Homogeneous Equations reducible to Homogeneous form.

Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non- Exact Differential Equations, Higher order Differential Equation with constant coefficients and with right hand side of the form e^{ax}, sinax, cosax, $e^{ax}f(x)$, $x^nf(x)$ etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, D-operators and Inverse D- operators, Method of Variation of Parameters.
Engineering applications of differential equations.

List of Laboratory Tasks:

Introductory Task: Introduction to usage of the software and simple programming tasks. [3 Sessions]
Experiment N0 1: Solution of Simple differentiation with single variable and use of chain Rule.
Experiment No. 2: Solution based on application of Tailors' Series using software
Experiment No. 3: Application of Maxima and Minima condition using software.

Experiment No. 4 Computation of different functions for a specific problem
Experiment No. 5 Computation of Area under a curve.
Experiment No. 6 Solution of a set of simultaneous equations in matrix method
Experiment No. 7 Computation of Eigen Values and Eigen Vectors.
Experiment No. 8 Solution of Partial Differential equation
Experiment No. 9 solution using Cauchy Equation and Lagrange's Equation

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: MatLab, Zylink.

Assignment:

List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using MATLAB.

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

Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011

B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013.

Walter Ledermann, Multiple integrals, Springer, 1st edition

Lay, Linear Algebra ansd its applications, 3rd Ed., 2002, Pearson Education India.

Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition

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 the development of Foundation Skills: **All solution methods**

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

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	**The course content are detailed as follows**		

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.
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.
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.
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.
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:

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.

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

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:

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live
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: 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: Demonstrate competency of Engineering Graphics as per BIS conventions and standards. Comprehend the theory of projection for drawing projections of Points, Lines and Planes under different conditions. Prepare multiview orthographic projections of Solids by visualizing them in different positions. 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	Assignment	Projection methods Analysis	**10 Sessions**
	Points, Straight Lines and Plane Surfaces			
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:

K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.

D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

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: **ENG1002**	**Course Title:** **Technical English** **Type of Course:** **1] School Core** **2] Laboratory integrated**			**L-T-P-C**	1-0-2-2
Version No.	V. 3				
Course Pre-requisites	--				
Course Anti-requisites	NIL				
Course Description	Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology.				
Course Objectives	The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.**				
Course Outcomes	**On successful completion of the course, the students shall be able to:** Develop proficiency in using technical vocabulary and terminology. Apply language skills for better speaking skills in technical fields. Write technical descriptions 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	**Technic**	**Present**	**Speaking Skills**	**12 Classes**	

2	**al Presentation**	**ations**		

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:

Module-1

Level 1: Worksheets

Level 2: Worksheets

Module 2

Level 1: Preparing Presentation

Level 2: Giving Presentation (Individual)

Module-3

Level 1: Product Description & User Manual

Level 2: Process Description & Transcoding
Module 4
Level 1: Email Writing
Level 2: Report Writing

Targeted Applications & Tools that can be used:

Flipgrid
Quizzes
Youtube Videos
Podcast

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

Bring out the essence of technical communication with reference to the conventions of technical communication, with examples

Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.

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

Presentation

Describing a product/process

Individual Reports

Text Books

Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers.* Oxford University Press. 2018.

Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf

Reference Book:

Chauhan, Gajendra Singh, and Kashmiramka, Smita, ***Technical Communication.*** Cengage Publication. 2018.

Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.

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.

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.

<table>
<tr><td>Course Code: PPS 1001</td><td colspan="2">Course Title: Introduction to Soft Skills

Type of Course: Practical Only Course</td><td>L- T-P-C</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="7">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">Students are expected to understand Basic English.

Students should have desire and enthusiasm to involve, participate and learn.</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">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.</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is to familiarize the learners with the concepts of “Soft Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="7">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</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td>INTRODUCTION TO SOFT SKILLS</td><td colspan="3">Classroom activity</td><td colspan="3">04 Hours</td></tr>
</table>

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			
Individual Assessment 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: 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:** Write algorithms and to draw flowcharts for solving problems Demonstrate knowledge and develop simple applications in C programming constructs Develop and implement applications using arrays and strings Decompose a problem into functions and develop modular reusable code Solve applications in C using structures and Union 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): **Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.** **ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.** **Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015** **Schildt Herbert, "C: The Complete Reference", Tata McGraw Hill Education, 4th Edition, 2014.** **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	--					
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:** **Describe** the concepts of number systems, Boolean algebra and logic gates. **Apply** minimization techniques to simplify Boolean expressions. **Demonstrate** the Combinational circuits for a given logic					

	Demonstrate the Sequential and programmable logic circuits **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):

Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education, 6th edition

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)

eBook1: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
{[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download
}

eBook2: Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.

NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits

Digital Logic Design PPT Slide 1 (iare.ac.in)

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:

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.

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)

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.
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.

Course Code: DES1146	**Course Title:** Introduction to Design Thinking **Type of Course:** Theory	**L-T-P- C**	1	0	0	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The course aims to introduce students to the fundamental principles and processes of Design Thinking and will learn to apply Design Thinking methodologies to real-world challenges. The course emphasizes empathy, creativity, and collaboration, equipping students with essential skills for successful engineering practice.					
Course Objective	This course is designed to develop and familiarize the learners with the concepts of creating thinking and attain Entrepreneurship by using Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: Understand the concept and importance of Design Thinking. Differentiate between traditional problem-solving and Design Thinking. Identify the core stages of the Design Thinking process.					
Course Content:	All assignments and projects must be developed using the reference materials available from the PU e-resource database – JSTOR, EBSCO, Library OPAC, NPTEL Videos, etc.					
Module 1	Introduction to Design Thinking	Visual journal, book of essa		Visual output generation, by Visual Journal and narrative development.		**3 hours**

		ys, cont ext-speci fic assig nme nt/pr oject			
Topic Definition and Introduction to Design Thinking Understand the Design Thinking Process					
Module 2	Design Thinking in Action	Visu al jour nal, book of essa ys, cont ext-speci fic assig nme nt/pr oject		Visual output generation, by visual journal and narrative development.	**12 hours**
Topics: Introduction to the steps of Design Thinking Process Understand use cases of Design thinking Design Thinking and Research Tools pertaining to Consumer Tech. , Home Tech. , Personal Tech. , Auto Tech. or Extended Reality.					

	Targeted Application & Tools that can be used: Design ideation tools like Miro , SCAMPER etc. Research Tools for Human Centric Design using forecasting tools like WGSN Feedback tools like Google Forms , etc. Expert Lectures
	Text Book Thinking Design by S Balaram. New Delhi [India]: Sage Publications Pvt. Ltd. 2010. eBook., Database: eBook Collection (EBSCOhost) https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=6&sid=18ab1f43-1f92-4d02-ae2e-a9c06dc06d8c%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=354920&db=nlebk
	References Design Thinking by Clarke, Rachel Ivy. Series: Library Futures, Vol. 4. Chicago: ALA Neal-Schuman. 2020. eBook., Database: eBook Collection (EBSCOhost) https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=4&sid=c80a7d79-eda4-4b7e-a0d6-afafe437962b%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=2433506&db=nlebk The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions by Bruce Hanington; Bella Martin. Minneapolis: Rockport Publishers. 2017. eBook., Database: eBook Collection (EBSCOhost) https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=11&sid=f086b8c2-260e-4caa-8c48-d732c21a7724%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=1638693&db=nlebk What Is Design Thinking and Why Is It Important? By Rim Razzouk and Valerie Shute - Review of Educational Research, Vol. 82, No. 3 (September 2012), pp. 330-348 (19 pages), Published by: American Educational Research Association https://puniversity.informaticsglobal.com:2054/stable/23260048?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3Acb1be24976e25734cb5fc13a8af6fdfb&seq=1#metadata_info_tab_contents Abductive Thinking and Sensemaking: The Drivers of Design Synthesis by John Kolko, Design Issues, Vol. 26, No. 1 (Winter, 2010), pp. 15-28 (14 pages), Published by: The MIT Press

	https://puniversity.informaticsglobal.com:2054/stable/20627839?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0b89336ea274d63c010536b01316d7bb&seq=1#metadata_info_tab_contents Designerly Ways of Knowing: Design Discipline versus Design Science by Nigel Cross, Design Issues, Vol. 17, No. 3 (Summer, 2001), pp. 49-55 (7 pages), Published by: The MIT Press https://puniversity.informaticsglobal.com:2054/stable/1511801?Search=yes&resultItemClick=true&searchText=design+thinking&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddesign%2Bthinking%26so%3Drel&ab_segments=0%2FSYC-6168%2Ftest&refreqid=fastly-default%3A0d5b607b163f60876ca973ed90e22b1c&seq=1#metadata_info_tab_contents

Course Code: **MAT1003**	**Course Title:** **Applied Statistics** **Type of Course:** School Core	**L T P C**	2	0	0	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	At the end of this course, students will be in a position to					

<table>
<tr><td>Outcome:</td><td colspan="4">apply the techniques of descriptive statistics effectively
interpret the ideas of probability and conditional probability
demonstrate the knowledge of probability distributions
Compute statistical parameters, correlation and regression, probability and sampling distributions using R software.</td></tr>
<tr><td>Module 1</td><td>Descriptive Statistics</td><td>Assignment</td><td>Coding needed</td><td>10 classes</td></tr>
<tr><td colspan="5">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 .</td></tr>
<tr><td>Module 2</td><td>Probability</td><td></td><td></td><td>6 classes</td></tr>
<tr><td colspan="5">Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye’s theorem with examples</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Module 3</td><td>Random Variables and Probability Distributions</td><td></td><td>Coding needed</td><td>14 classes</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

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

Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.

References

James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018.

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020.

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019.

Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.

Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.

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: 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

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

Web-resources:

Basic Civil Engineering
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live
Post-parametric Automation in Design and Construction
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live
Smart Cities : Introducing Digital Innovation to Cities
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live
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
Mechanical Engineering

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705

Additive Manufacturing: Opportunities, Challenges, Implications
https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live

Society of Petroleum Engineers (SPE)
https://www.spe.org/en/

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

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: 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					
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**
https://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q
https://puniversity.informaticsglobal.com:2229/login.aspx

Topics relevant to development of "Skill Development":

Static Polymorphism
Method overloading, constructors
constructor overloading
this keyword
static keyword and Inner classes
Inheritance and Polymorphism.

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

ENG2001	**Advanced English**	**L- T- P- C**	1	0	2	2

Version No.	1.3
Course Pre-requisites	ENG1002
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: Develop a critical and informed response reflectively, analytically, discursively, and creatively to their reading. Communicate effectively, creatively, accurately and appropriately in their writing. Deliver technical presentations 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 Presentatio**	**Pres**	**Oral Skills**	**3 Classes**

	n	**entation**		
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**	
Reading and Analyzing Level 1 – Annotation Level 2 - Assumptions Writing Narrative Essays Level 1 – Draft 1 Level 2 – Draft 2				
Module 2	**Technical Presentation**		**10 Classes**	

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

Technical Group Presentation

Module 3	**Writing Reviews**	**Classes**

Practice Worksheets

Level 1 – Eliminating the Passive Voice

Level 2 – Simple, compound and complex sentences

Writing Short Film Reviews

Module 4	**Starting your Career**	**Classes**

Collaborative Project

Job search and writing report

Writing Resume

Module 1-4	**Academic Journal**	**2 Classes**

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

Hering, Heik. *How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation*. Springer.

Johnson, Richard. (2010) *Technical Communication Today*. Pearson, 2015
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.
The Princeton Review. (2010) *MCAT Verbal Reasoning & Writing*. The Princeton Review, Inc.
https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021
https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021

Course Code: **PPS 1012**	**Course Title: Enhancing Personality through 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 the desire and enthusiasm to be involved, participate and learn.					
Anti-requisites	NIL					
Course Description	This course is designed to enable students to 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 "Enhancing Personality through 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:** CO 1 **Identify the stages of** team formation (Remember) CO 2 **Demonstrate** effective presentation skills (Apply) CO3 **Prepare** professional social media profile (Apply)					

Course Content:			
Module 1	Professional Brand Building	Brand Framework Activity	**6 Hours**
Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies, Leveraging AI tools for developing content for brand visibility. **Activity:** Create a post and enhancing LinkedIn profile			

Module 2	Art of Questioning	Role plays	**4 Hours**
Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions			
Module 3	Presentation Skills	Practice and evaluation of individual/group presentation	**12 Hours**
Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges. **Activity:** Individual presentations or team presentation			
Module 4	Team Building	Team building activities	**6 Hours**
Topics: Importance of team, stages of Team Formation, Trust and collaboration. **Activity: Team Building Activity**			
Module 5	Recap / Revision /Feedback Session	Discussion, Quiz	**2 Hours**
Targeted Applications & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Activities			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
1) Presentation Evaluation 2) LinkedIn assessment			
Targeted Applications & Tools that can be used: 1. TED Talks 2. YouTube Links **3.** Videos by L&D Team shared on Edhitch/YouTube.com **4.** LMS			

Assignments proposed for this course

1. Evaluation on Presentation
2. Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z__jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

1. "Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1- 250-04112-8
2. "The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014
3. "The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006
4. "Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

1. https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills

https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/

2. https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to the development of "SKILL": Art of Presentation, Team building, Art of questioning, and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: **PPS 1012**	**Course Title:** **Enhancing Personality through 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 "Personality Development through Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.					
Course Out	**On successful completion of this course the students shall be able to:** CO 1 **Identify the stages of** team formation (Remember) CO 2 **Demonstrate** effective presentation skills (Apply)					1

Comes	CO3 **Prepare** professional social media profile (Apply)		
Course Content:			
Module 1	Team Building	Classroom and outbound team building activities.	6 Hours
Topics: Importance of team, stages of Team Formation, Trust and collaboration, Virtual Team. **Activity: Team Building outbound activity**			
Module 2	Art of Questioning	Role plays	**4 Sessions**
Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions			
Module 3	Presentation Skills	Practice and evaluation of individual / group presentation	**10 Sessions**
Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges. **Activity:** Individual presentations and team presentation			
Module 4	Professional Brand Building	Brand Framework Activity	4 Sessions
Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies. **Activity:** Create a basic online profile			
Module 5	Recap / Revision /Feedback		1 Session

	Session		

Targeted Application & Tools that can be used:

TED Talks
You Tube Links
Activities

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

Presentation Evaluation

Targeted Application & Tools that can be used:

TED Talks
YouTube Links
Videos by L&D Team shared on Edhitch/YouTube.com
LMS

Assignments proposed for this course

Evaluation on Presentation
Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z__jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

"Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8

"The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014

"The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006

"Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills
https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/

https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to development of "SKILL": Art of Presentation, Team building, Art of questioning and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: EEE1007	**Course Title: Basics of Electrical and Electronics Engineering.** **Type of Course: Engineering Science - Theory & Integrated Laboratory**	**L-T-P-C**	3	1 0	2	4

Version No.	1.0			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	This is a fundamental Course which is designed to know the use of basics of electrical and electronics engineering principles occurs in various fields of Engineering. The course emphasis on the characteristics and applications of Electrical and Electronics devices, working, analysis and design of electrical circuits using both active & passive components, fundamentals of electrical machines and basics of transistors and its application. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to visualize the real system performance, using both hardware and simulation tools.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Basics of Electrical and Electronics Engineering and attain Skill Development through Experiential Learning techniques.			
Course Outcomes	**On successful completion of this course the students shall be able to:** **Explain** basic laws of Electrical Engineering to compute voltage, currents and other parameters in the circuits. **Discuss** various fundamental parameters appearing in the characteristics of semiconductor devices and their applications. **Summarize** the operations of different biasing configurations of BJTs and amplifiers. **Summarize**the performance characteristics and applications of various electrical Machines. **Demonstrate** the working of electrical machines to observe performance characteristics **Demonstrate** the working of electronic circuits to obtain the V-I Characteristics of various semiconductor devices.			
Course Content:				
Module 1	**Introduction to Electrical Circuits**	Assignment/ Quiz	Numerical solving Task	**10 Sessions**
DC Circuits: Concept of Circuit and Network, Types of elements, Network Reduction Techniques- Series and parallel connections of resistive networks, Star–to-Delta Transformations, Mesh Analysis, Numerical examples. **AC Circuits:** Fundamentals of single phase circuits - Series RL, RC and R-L-C Circuits, Concept of active power, reactive power and Power factor, Numerical examples. Introduction to three phase system and relation between line and phase values in Star & Delta connection, Numerical examples.				
Module 2	**Semiconductor and Diode applications**	Assignment/ Quiz	Memory Recall based Quizzes	**11 Sessions**
Mass Action Law, Charge densities in a semiconductor, Types of SC, Junction diodes -Ideal and practical behaviour, Modelling the Diode Characteristic, and Diode applications like rectifiers, Clipping and clamping circuits. Zener diode, characteristics and its applications like voltage regulator.				
Module 3	**Fundamentals of Electrical Machines**	Assignment/ Quiz	Memory Recall-based Quizzes	**12 Sessions**
Electrical Machines: Single phase transformers: principle of operation and EMF equation, Numerical examples. DC Motor: principle of operation, Back EMF, torque equation, Numerical examples. AC Motor: Principle operation of Induction Motors and its Applications. **Special Machines:** Introduction to special electrical machines and its applications.				
Module 4	**Transistors and its Applications**	Assignment/ Quiz	Numerical solving Task	**12 Sessions** 1
Transistor characteristics, Current components, BJT Configurations (CB, CC, CE configurations) and their current gains. Operating point, Biasing & stabilization techniques: Fixed Bias, Voltage divider bias and its stability factor and load line analysis. Single and multistage amplifier, Darlington pair.				

JFET (Construction, principal of Operation and Volt –Ampere characteristics). Pinch- off voltage, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes.

List of Laboratory Tasks:

Experiment No 1: Verification of KVL and KCL for a given DC circuit.
Level 1: Study and Verify KVL and KCL for the given electrical Circuit.
Level 2: For the same circuit considered in level 1, perform the simulation using NI LabVIEW/Multisim/MATLAB.

Experiment No 2: Analyse AC series circuits – RL, RC and RLC .
Level 1: Conduct an experiment to perform and verify the impedance, current and power of Series RL and RC circuits
Level 2:

Experiment No 3: Calculation of power and power factor of the given AC Circuit.
Level 1: Conduct an experiment to measure the power and power factor for given resistive load.
Level 2: Conduct an experiment to measure the power and power factor for given inductive load.

Experiment No 4: Perform the experiments on given Transformer.
Level 1: Verify the EMF equation of a transformer and compute the voltage transformation ratio.
Level 2: Study the effect of load on the secondary side of the transformer and verify the EMF equation under load conditions.

Experiment 5: Load test on DC shunt motor
Level 1: Conduct load test on DC shunt motor and find its efficiency at different loads
Level 2: Conduct load test on DC shunt motor and plot the performance characteristics.

Experiment 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.
Level 1: Carry out an experiment to plot VI Characteristics and hence find the cut-in voltage on forward characteristics for the Silicon P-N Junction diode.
Level 2: Carry out an experiment to plot VI Characteristics of Zener diode and hence find the zener voltage on reverse characteristics for the Silicon P-N Junction zener diode.

Experiment 7: To observe the output waveform of half wave and full wave rectifier circuit and compute ripple factor and efficiency
Level 1: Identify the components required for a rectifier circuit, rig up the circuit, and sketch the output waveforms without filter.
Level 2: Rig up the rectifier circuit with RC filter, observe the output waveforms, determine the efficiency and ripple factor.

Experiment 8: To construct clipping and clamping circuits for different reference voltages and to verify the responses.
Level 1: Identify the components required for building a Clipper / Clamper circuit. Rig up the circuit according to the circuit diagram given and sketch the output waveform.
Level 2: Given a sinusoidal input of 10 V p-p, implement a positive / negative clipper with output clipped at 2 V.

Experiment 9: To calculate various parameters of emitter follower circuit using BJT
Level 1: Identify the components required to implement an emitter follower circuit. Rig up the circuit and observe the variations in output waveform with respect to the variations in input waveform.
Level 2: Determine the values of Z_{in} input impedance and Z_{out} output impedance for Emitter Follower.

Experiment 10: To Implement RC Coupled amplifier using a BJT and sketch the frequency response.
Level 1: Identify the components required to implement an RC coupled amplifier circuit. Rig up the circuit and sketch the frequency response.

Level 2: From the frequency response curve determine the value of the mid band gain and the bandwidth.

Targeted Application & Tools that can be used:

Targeted Applications: Application Area includes all electrical and electronic circuits (power supply unit, regulator unit, embedded devices, hardware electronics etc.). The students will be able to join a profession which involves basics to high level of electronic circuit design.

Professionally Used Software: Matlab/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..

Text Book(s):

Kothari D. P. &Nagrath I. J., "Basic Electrical and Electronics Engineering", Tata McGraw-HillEducation.

Theraja B.L. and Theraja A.K., "A Textbook of Electrical Technology: Basic Electrical Engineering" in S.I. System of Units, 23rd ed., New Delhi: S. Chand, 2002.

A.P.Malvino, Electronic Principles,7thEdition, Tata McGraw Hill,2007

J. Millman, C. C. Halkias and C. D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education, 2nd Edition.

Basics of Electrical & Electronics Laboratory Manual.

Reference Book (s):

John Hiley, Keith Brown and Ian McKenzie Smith, "HUGHES Electrical and Electronic Technology", 10th Edition (Indian Edition published by Dorling Kindersley), Pearson,2011

Samarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, Prentice Hall India, 2007.

K Uma Rao, A Jaya Lakshmi, "Basic Electrical engineering" IK International publishing house Pvt. Ltd

R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education India 7th Edition.

A K. Maini, V. Agrawal, "Electronic Devices & Circuits", Wiley, 2nd Edition

A.S Sedra, K. C. Smith, "Microelectronic Circuits", Oxford University Press, 6th Edition

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

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

https://www.digimat.in/nptel/courses/video/108105112/L01 "Fundamentals of Electrical Engineering-Basic Concepts, Examples"

Seminar Topic: https://nptel.ac.in/courses/108/105/108105153/ "Electrical Measurements"

Video lectures on "Electronic Devices" by Prof.Dr. A. N. Chandorkar, IIT Bombay
http://www.satishkashyap.com/2013/03/video-lectures-on-electron-devices-by.html

Video lectures on "Analog Electronics" by Prof. S.C. Dutta Roy, IIT Delhi
https://nptel.ac.in/courses/108/102/108102095/

Video lectures on "Diodes", by Prof.ChitralekhaMahanta, IIT Guwahati,
https://nptel.ac.in/courses/117/103/117103063/

"Introduction to Electrical Machines https://nptel.ac.in/courses/108/102/108102146/"

M. -Y. Kao, H. Kam and C. Hu, "Deep-Learning-Assisted Physics-Driven MOSFET CurrentVoltageModeling," in IEEE Electron Device Letters, vol. 43, no. 6, pp. 974-977, June 2022, doi: 10.1109/LED.2022.3168243
https://ieeexplore-ieee-org-resiuniv.knimbus.com/document/9758727

F. Bonet, O. Aviñó-Salvadó, M. Vellvehi, X. Jordà, P. Godignon and X. Perpiñà, "Carrier Concentration Analysis in 1.2 kV SiCSchottky Diodes Under Current Crowding," in IEEE Electron DeviceLetters, vol. 43, no. 6, pp. 938-941, June 2022, doi: 10.1109/LED.2022.3171112. https://ieeexplore-ieeeorg- presiuniv.knimbus.com/document/9764749

M. Chanda, S. Jain, S. De and C. K. Sarkar, "Implementation of Subthreshold Adiabatic Logic for Ultralow-Power Application," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. .23, no. 12, pp. 2782-2790, Dec. 2015.
https://ieeexplore.ieee.org/document/7018053

R. Raut and O. Ghasemi, "A power efficient wide band trans-impedance amplifier in submicron CMOS integrated circuit technology," 2008 Joint 6th International IEEE Northeast Workshop on Circuits and Systems and TAISA Conference, 2008, pp. 113-116, doi: 0.1109/NEWCAS.2008.4606334.
https://ieeexplore.ieee.org/document/4606334

Topics relevant to "SKILL DEVELOPMENT": Performing suitable experiments to compute the Electrical and electronics circuit parameters, performance operation of Machines, and semiconductor devices for Skill

Development through Experiential Learning techniques. This is attained through assessment component mentioned in course plan.

Course Code: LAW1007	**Course Title: Indian Constitution and Professional Ethics for Engineers** **Type of Course: Theory**	**L-T-P-C**	1			0
Version No.						
Course Prerequisites						
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students to the theory, concepts and practice of Constitution of India which is the law of the land. Further, the course aims at acquainting the students with basic approaches and methodologies to analyse and decide on the ethical dilemma in the field of engineering. The course is both conceptual and analytical. comprehend the conceptual and legal framework of Constitution of India. Ethics and values are very beautifully weaved into the tapestry of the Indian Constitution. Therefore, the course provides an introduction to the essential theoretical basis of engineering ethics and its application through a range of industry rele responsibility for safety and risks, responsibility of employers, rights of engineers etc.					
Course Objective	To introduce the students to the conceptual framework of Constitution of India and engineering ethics. To enhance the practical knowledge on responsibility of engineering professionals as citizens of India. To acquaint the student with the relevant contemporary issues surrounding constitutional values and professional ethics. To orient the students about the ethical concepts and frameworks enabling them to identify the codes and moral values relevant to the professional world.					

Course Outcomes	**On successful completion of this course the students shall be able:** To understand foundational Indian constitutional law concepts and values. To identify the different pillars of democracy and their functions. society and the employer.

Module 1	**Introduction to the Indian Constitution**	Knowledge	Quiz	**5 Classes**
Course Content:				

Meaning of Constitution, Constitutional Law and Constitutionalism, India before and after adoption of Constitution, Preamble, Salient Features, Concept and Relevance of Fundamental Rights, Fundamental Duties and Directive Principles of State Policy in brief.				
Module 2	**Pillars of Democracy: Legislature Executive and Judiciary**	Knowledge	Short Essay	**5 Classes**
Federalism, Union and State Executive, Parliament and State Legislature, Union and State Judiciary, Amendment of the Constitution				
Module 3	**Engineering Ethics**	Analysis	Presentation on conceptual understanding and problem based scenarios	**5 Classes**
Scope & Aims of Engineering & Professional Ethics, Code of Ethics as defined in the website of Institution of Engineers (India), Profession, Professionalism, and Professional Responsibility, Conflicts of Interest, Engineering Standards, the impediments to Responsibility, IPRs (Intellectual Property Rights), Necessity of responsible experimentation ,Case Studies on Challenger, Chernobyl, and Boeing.				

Project work/Assignment: Quiz on Fundamental Rights, Short Essay on Judicial Activism in India, Problem based assignments of engineering ethics.
Resources: M.P. Jain, Indian Constitutional Law, 8th Edition, Lexis Nexis, 2022. M.W.Martin and R. Schinzinger, Ethics in Engineering, 4thEdition, McGraw Hill Education, 2015.

References: Durga Das Basu, Commentary on the Constitution of India, 9th Edition, Lexis Nexis, 2019. Rowan, John, and Zinaich Jr., Ethics for the Professions, Wadsworth, 2003. R.C. Sekhar, Ethical Choices in Business, Response Books, Sage Publications, 1997.

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: Appreciate the historical context of human interactions with the environment and the need for eco-balance. Describe basic knowledge about global climate change with particular reference to the Indian context. Understand biodiversity and its conservation					

	Develop an understanding on types of pollution and ways to protect the environment 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 ℃ and 2.0 ℃ 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

Determination of total alkalinity of a water sample (knowledge)
Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
Estimation of copper from industrial effluents by colorimetric method (Comprehensive)
Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)
Estimation of nickel from industrial effluents by titrimetric method (Comprehensive)
Estimation of chloride in drinking water by titrimetric method (Comprehensive)
Estimation of fluoride in ground water by colorimetric method (Comprehensive)
Determination of calcium in aqueous solution (Comprehensive)
Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
Biological oxygen demand of waste water sample (Comprehensive)
Determination of dissolved oxygen of an industrial effluent (Comprehensive)
Quality monitoring analysis of a soil sample (knowledge)
Flame photometric estimation of Sodium and potassium (Application)
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

G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA

Krishnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.

Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

Reference Books

Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.

William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.

Sinha N., (2020) Wild and Wilful. Harper Collins, India.

www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/

Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.

Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

E-resources:

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_18126

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_8761

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_3333

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3063

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_20719

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_16824

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3954

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_491

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER_INDEST_1_171
https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129
https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_395&xIndex=4
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: CSE2252	**Course Title:** Data Communication and Computer Networks Lab **Type of Course:** **LAB**	**L- T-P- C**	0	**0**	2	1
Version No.	1.0					
Course Pre-requisites	ECE2007					
Anti-requisites	**NIL**					
Course Description	This lab-based course provides hands-on experience in the principles and practices of data communications and computer networking. It is designed to complement theoretical concepts covered in the associated lecture course. Through a series of structured experiments and practical exercises, students will gain proficiency in configuring, analyzing, and troubleshooting computer networks. Key topics include network topology design, IP addressing and subnetting, Ethernet and LAN technologies, routing and switching, TCP/IP protocol suite, and basic network security measures. Students will work with industry-standard tools and equipment, including routers, switches, protocol analyzers, and network simulation software such as Cisco Packet Tracer or Wireshark.					
Course Objective	The objective of this lab course is to provide students with practical, hands-on experience in the configuration, operation, and troubleshooting of data communication systems and computer networks. Through guided experiments and real-world scenarios, students will reinforce theoretical knowledge, develop essential technical skills, and gain a deeper understanding of networking concepts, protocols, and devices used in modern					

	communication systems.			
Course Outcomes	On successful completion of the course, the students shall be able to: 1. Design and configure basic network topologies using routers, switches, and end devices to meet specified requirements. Analyze and troubleshoot network connectivity and performance issues using tools such as Wireshark and network simulators. Demonstrate understanding of key networking protocols (e.g., TCP/IP, ARP, ICMP, DHCP) through practical implementation and observation. Apply IP addressing and subnetting techniques to efficiently allocate and manage network resources in various networking scenarios.			
Course Content:				
Module 1,2,3,4	Physical Layer, Network Layer, Transport Laye	Lab Assignment	Problem Solving	**24 Sessions**

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

Problem Solving: Choose and appropriate devices and implement various

network concepts.

Programming: Simulation of any network using NS2.

Text Book(s):

1. 1. Behrouz A. Forouzan, “Data Communications and Networking 5E”, 5 th Edition,

Tata McGraw-Hill, 2017.

2. Andrew S Tanenbaum, Nick Feamster & David J Wetherall, “Computer

Networks” Sixth Edition, Pearson Publication, 2022

Reference(s):

1.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

6. https://puniversity.informaticsglobal.com/login

Course Code:	Course Title: Data Structures	L-T- P-	3	0	0	3

CSE2253	**Type of Course:** Theory		**C**			
Version No.	1.0					
Course Pre-requisites	CSE1004					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Describe the concept of basic data structure, stacks, queues, and arrays and their operations. **[Understand]** **CO2:** Utilize linked lists for real-time scenarios. **[Apply]** **CO3:** Apply an appropriate non-linear data structure for a given scenario. **[Apply]** **CO4:** Demonstrate different searching and sorting techniques. **[Apply]**					
Course Content:						
Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**	Assignment	Program activity			**9 Hours**
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack -** Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -** Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.						
Module 2	**Linear Data Structure-Linked List**	Assignment	Program activity			**12 Hours**
Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. **Recursion** - Recursive Definition and Processes.						

Module 3	**Non-linear Data Structures – Trees**	Assignment	Program activity	**12 Hours**

Topics: Trees - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post - Order traversal, Binary Serach Tree, AVL Trees - Red Black Tree, Expression Tree , Heaps.

Module 4	**Non-linear Data Structures - Graphs and Hashing**	Assignment	Program activity	**6 Hours**

Topics: Graphs: Basic Concept of Graph Theory and its Properties, Representation of Graphs . ADT, Elementary graph operations, Minimum Cost spanning trees, Shortest path and Transitive closure.

Hashing: Introduction, Static Hashing, Dynamic Hashing

Module 5	**Searching & Sorting**	Assignment	Program activity	**6 Hours**

Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort, Quick sort, Merge Sort, Bubble sort.

List of Laboratory Tasks:

Lab sheet -1

Level 1: Prompt the user, read input and print messages.Programs using class, methods and objects

Level 2: Programming Exercises on fundamental Data structure - Arrays based on Scenario.

Lab sheet -2

Level 1: Programming Exercises on Stack and its operations

Level 2: Programming Exercises on Stack and its operations with condition

Lab sheet -3

Level 1: Programming on Stack application infix to postfix Conversion

Level 2: -

Lab sheet -4

Level 1: Programming on Stack application – Evaluation of postfix

Lab sheet -5

Level 1: Programming Exercises on Queues and its operations with conditions

Level 2: -

Lab sheet -6

Level 1: Programming Exercises on Linked list and its operations.
Level 2: Programming Exercises on Linked list and its operations with various positions

Lab sheet -7
Level 1: Programming Exercises on Circular Linked list and its operations.
Level 2: Programming Exercises on Circular Linked list and its operations with various positions

Lab sheet -8
Level 1: Programming Exercises on factorial of a number
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -9
Level 1: -
Level 2: Programming the tower of Hanoi using recursion

Lab sheet -10
Level 1: Programming Exercise on Doubly linked list and its operations
Level 2: -

Lab sheet -11
Level 1: Program to Construct Binary Search Tree and Graph
Level 2: Program to traverse the Binary Search Tree in three ways(in-order, pre-order and post-order) and implement BFS and DFS

Lab sheet -12
Level 1: Program to Implement the Linear Search & Binary Search
Level 2: Program to Estimate the Time complexity of Linear Search

Lab sheet -13
Level 1: Program to Implement and Estimate the Time complexity of Selection Sort
Level 2: Program to Implement and Estimate the Time complexity of Insertion Sort

Lab sheet -14 (Beyond syllabus activity)
Level 1: Program to Construct AVL Tree
Level 2:

Lab sheet -15 (Beyond syllabus activity)
Level 1: Program to Construct RED BLACK Tree

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Modern IDE like VS Code and Eclipse for lab programs to execute.

Project work/Assignment:

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

Text Book

T1 Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, reprint 2018.

T2 Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

References

R1 Data structures and program design in C by Robert Kruse, Tondo C L, Bruce Leung, Pearson education publishers, 2017.

R2 Programming and Data Structure by Jackulin C Salini etal., Ane books publishers, 2019.

Web resources:

For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview

https://puniversity.informaticsglobal.com/login

Topics relevant to development of "Skill Development":

Linked list and stacks

Topics relevant to development of "Environment and sustainability: Queues

Course Code: CSE2254	**Course Title:** Data Structures Lab **Type of Course:** Integrated	0	0	2	1
Version No.	1				
Course Pre-requisites	**CSE1004**				
Anti-requisites	NIL				
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.				
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques				
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Implement the basic operations of stacks, queues, **[Understand]** **CO2:** Utilize linked lists for real-time scenarios. **[Apply]** **CO3:** Apply an appropriate non-linear data structure for a given scenario. **[Apply]** **CO4:** Demonstrate different searching and sorting techniques. **[Apply]**				

List of Laboratory Tasks:

1. Implement the operations on Stack and Queue, Circular Queue

2. Programming on Stack application

a.Infix to postfix conversion.

b.Infix to prefix conversion.

3. Write a program using linked list to Simulate memory allocation and Garbage collectio.

4. Programming Exercises on Circular Linked list and its operations

5. Implement Doubly Linked List (DLL) of Professor Data with the fields: ID, Name, Branch, Area of specialization.

6.Given an array of elements, construct a complete binary tree from given array.

8.Construct a menu driven program for traversing a binary search tree.

	9. Construct a program for Red Black Tree. **10.Develop a program for graph for implementing shortest path.** **11.Develop a program for static and dynamic hashing.** **12.Design and develop a program that uses Hash Function H:K->L as H(K)=K mod m(reminder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.** **13.Construct a program to perform selection sort.** **14.Implement Sequential and Binary Search** **15.Create an array of N elements and perform quick sort and bubble sort.**
	Targeted Application & Tools that can be used Use of PowerPoint software for lecture slides and use of Modern IDE like VS Code and Eclipse for lab programs to execute.
	Text Book **T1** Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, reprint 2018. **T2** Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
	References **R1** Data structures and program design in C by Robert Kruse, Tondo C L, Bruce Leung, Pearson education publishers, 2017. **R2** Programming and Data Structure by Jackulin C Salini etal., Ane books publishers, 2019. **Web resources:** For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview https://puniversity.informaticsglobal.com/login
	Topics relevant to development of "Skill Development": Linked list and stacks **Topics relevant to development of "Environment and sustainability: Queues**

Course Code: COM1701	**Course Title: Introduction to Bioinformatics** **Type of Course: General CSE Basket, Theory based**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	Basics of Biology, basics of Computers.					
Anti-requisites	NIL					
Course Descriptio	This course is designed to provide the knowledge of the concepts related to bioinformatics. The course is aimed at understanding the DNA and Protein sequences					

n	and databases. It also deals with Pairwise comparison and calculating the scoring matrix. Further, it focuses on Sequence Alignment techniques, discovering the Motifs in the sequence. Students will also learn the overview of Structural Bioinformatics and Genome sequencing.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Introduction to Bioinformatics** and attain **Employability** through **Participative Learning** techniques.			
Course Outcomes	**C.O.1:** Understand the DNA Protein sequence and structures. (Bloom's Level: **Knowledge) C.O.2:** Explain the file formats and sequence alignments of DNA sequence. (Bloom's Level: **Comprehension)** **C.O.3:** Apply the techniques of the motifs discovery for the analysis of Protein Sequence. (Bloom's Level: **Application)**			
Course Content:				
Module 1	**Fundamentals of Bioinformatics**	Quiz	Comprehension based Quizzes and assignments;	**9 Classes**

Topics: **Introduction to Bioinformatics**: Introduction to molecular biology, Cell, DNA, RNA, Transcription, Translation, Folding, Gene Structure, Introduction to Bioinformatics, Components and fields of bioinformatics, Omics, basic principles of structural/functional analysis of biological molecules, Biological Data Acquisition, Types of DNA sequences,Genomic DNA ,Mitochondrial DNA,DNA Sequencing tools, Protein sequencing and structure determination methods, Finding Reverse complement of a sequence.				
Module 2	**Genome databases and Sequence Similarity**	Quizzes and assignments	Comprehension based Quizzes and assignments	**8 Classes**
Topics: Types and classification of genome databases, DNA sequence retrieval system, various DNA and protein sequence file formats, Common sequence file formats; Files for multiple sequence alignment; Files for structural data, Frequent words and k-mers in Text, String Reconstruction problem, Sequence Similarity searching, Sequence Similarity searching tools, NCBI BLAST, PSI BLAST, Significance of sequence alignments, Alignment scores and gap penalties.				
Module 3	**DNA sequence analysis and applications**	Quizzes and assignments	Comprehension based Quizzes and assignments	**10 Classes**
Sequence similarity searches and alignment tools, Finding alignment using Needleman-Wunsch and Smith- Waterman algorithm, Heuristic Methods of sequence alignment, Pair-wise and multiple sequence alignments, DNA sequence analysis, Motif in protein sequence ,Motif discovery using Gibbs sampling,Motif finding, Gene Prediction models: Hidden Markov model(HMM), Generalized Hidden Markov model(GHMM), Bayesian method.				3
Targeted Application & Tools that can be used: BLAST, FastA, , ClustalW, MEGA				

Project work/Assignment:
Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments
Textbook(s): Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2004. Introduction to Bioinformatics, Arthur Lesk, Fifth Edition, Oxford University Press, 2019
References Bioinformatics Methods and Applications, S. C. Rastogi, N.Mendiratta, P.Rastogi, Fourth Edition, Prentice Hall India. Bioinformatics Algorithms- An Active Learning Approach, Phillip Compeau & Pavel Pevzner, 2nd Edition, Vol. I & II, Active Learning Publishers, 2015 E-References 1. https://puniversity.informaticsglobal.com:2229/login.aspx
Topics related to development of "Employability skills": Batch wise presentations on selected topics String Reconstruction problem Sequence Similarity searching Alignment scores and gap penalties Protein sequencing Gene Prediction models: Hidden Markov model(HMM) Finding similarities by performing pairwise and multiple sequence alignment, Evaluating phylogenetic trees. for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: MAT2004	**Course Title: Discrete Mathematical Structures** **Type of Course: Program Core& Theory Only**		**L-T-P-C**	4	0	0	4
Version No.		2.0					
Course Pre-requisites		**NIL**					
Anti-requisites		**NIL**					
Course Description		This course highlights the basics of discrete structures and develop ability to solve problems involving mathematical logic, sets, functions, relations, principles of counting, pigeonhole principles, recurrence relations, Principles of Inclusion and Exclusion. forces, and moments with their applications in allied subjects. It is a prerequisite for several Courses involving Compiler Design, Artificial Intelligence. This course is both conceptual and analytical in nature that would help the student to use the concepts of discrete structures to solve and prediction of data analytics. The students should have prior knowledge of basic mathematics pursue						

		the Course, After successful completion of the Course, the students would acquire knowledge to solve problems involving mathematical logic, sets, functions, relations, principles of counting, pigeon hole principles, recurrence relations, Principles of Inclusion and Exclusion with an emphasis on real-world engineering applications and problem solving.
Course Objective		The objective of the course is to familiarize the learners with the concepts of Discrete Mathematics and attain SKILL DEVELOPMENT through PROBLEM SOLVING Methodologies techniques.
Course Out Comes		On successful completion of the course the students shall be able to: Describe a logic sentence in terms of predicates, quantifiers, and logical connectives. Solve problems on Functions and Relations using basic principles of Set Theory. Explain the concepts of Boolean Algebra. Apply basic counting techniques to combinatorial problem.
Course Content:		

Module 1	**Foundations of Logics and Proofs**	Assignment	Problem Solving		**10 Sessions**
	Topics: Propositional Logic, Propositional Logic Equivalences, Inference rules, Normal forms, Introduction to Proofs, Resolution by Refutation, Predicates and Quantifiers, Introduction to Proofs. **Assignment: Problems.**				
Module 2	**Basic Structures: Sets, Functions,**	Assignment	Problem Solving		**10 Sessions**
	Relations				
Topics: Sets and set-operations, Venn Diagram, Cardinality of Sets, Functions: Types, Invertible Functions, Composition, Sequences and Summations, Relations and their properties & representations, Equivalence Relations, Closure of Relations. **Assignment:** Problems and applications					
Module 3	**Posets, Lattices and Boolean Algebra**	Assignment	Problem Solving		**10 Sessions**
Topics: Partial ordering, Posset, Hasse Diagram, Lattices & Algebraic structures, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra,Topological					

Sorting. Assignment: Problems and Applications				
Module 4	**Principles of Counting Techniques**	Assignment	Problem Solving	**12 Sessions**

Topics:

Number Theory: Integers and Division, GCD, Chinese Remainder Theorem, Solving Congruences, Pigeon Hole Principle, Mathematical Induction, Generalized Permutations and Combinations, Recurrence Relations, Applications of Recurrence Relations, Generating Functions, Principle of Inclusion and Exclusion, Applications of Inclusion and Exclusion.

Assignment: Problems and Applications

Targeted Application & Tools that can be used:

NIL

Project work/Assignment:

Problems on all the topics and relevance with field of computer science

Text Book

T1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill,s 7th Edition,2018.

References

R1: Susanna EPP, "Discrete Mathematics with Applications", Cengage Learning, 4th Edition, 2010 R2. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier, India, 2009.

R3: Discrete mathematics for Computer Scientists and Mathematicians, Paperback (Rs. 533), Joel Mott, Abraham Kandel, Theodore Baker; Pearson Education India; 2 edition (2015), **ISBN-13:** 978-9332550490 **Weblinks:**

W1: https://puniversity.informaticsglobal.com:2229/login.aspx

W2: https://www.youtube.com/playlist?list=PLBlnK6fEyqRhqJPDXcvYlLfXPh37L89g3

Topics relevant to development of "SKILL": Mathematical Logic, Permutation and Combinations for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE2262	**Course Title: Analysis of Algorithms** **Type of Course: THEORY Only**	**L- T-P-C**	3	1	0	4
Version No.	1.0					
Course Pre-requisites	**CSE2253**					
Anti-requisites	Nil					
Course Description	This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies searching solution space. The core concepts of analyzing algorithms and classifying them into various complexity classes is covered in the end.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Analysis of Algorithms** and attain **Skill Development** through **Problem Solving** Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Compute efficiency of a given algorithm. [Applying]					

	2. Apply divide and conquer technique for searching and sorting Problems. [Applying] 3. Apply the Dynamic Programming technique for a given problem. [Applying] 4. Apply greedy technique for solving a Problem. [Applying] 5. Demonstrate Back tracking technique and limitations of Algorithms.[Applying]			
Course Content:				
Module 1	**Introduction**	Assignment	Simulation/Data Analysis	**10 Sessions**
Introduction, Asymptotic Notations and its properties, Best case, worst case and average case- Sequential search, Sorting; Mathematical analysis for Recursive and Non-recursive algorithms: Substitution method and Master's Theorem.				
Module 2	**Divide-and-conquer**	Assignment	Simulation/Data Analysis	**08 Sessions**
Introduction. Insertion Sort; Merge sort, Quick sort, Binary search.				
Module 3	**Dynamic programming**	Term paper/Assignment	Simulation/Data Analysis	**10 Sessions**
Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Chain Matrix Multiplication.				
Module 4	**Greedy technique**	Term paper/Assignment	Simulation/Data Analysis	**09 Sessions**
Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm				
Module 5	**Complexity Classes**	Term paper/Assignment	Simulation/Data Analysis	**08 Sessions**
Complexity Classes- P,NP- NP Hard and NP Complete - Boolean Satisfiability Problem (SAT). Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.				

Text Book

Anany Levitin, "*Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018.

Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "*Introduction to Algorithms*", 4th edition, MIT Press, 2022.

References

J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005.

Tim Roughgarden, "*Algorithms Illuminated*" (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019.

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

Donald E. Knuth, "*The Art of Computer Programming*", Volumes 1and 3 Pearson.

Web-Resources

NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview

Coursera: Analysis of Algorithms by Princeton University

Algorithms Specialization in Coursera by Stanford University(Group of 4 courses).

Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University

Topics relevant to "SKILL DEVELOPMENT": knapsack, prim's, kruskal's algorithm, quick sort, binary search for **Skill Development** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSE2261	**Course Title: Database Management Systems Laboratory** **Type of Course: 1) Laboratory**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CSE1509					
Anti-requisites	NIL					
Course Description	The Database Management Systems (DBMS) Laboratory is designed to provide students with hands-on experience in database design, implementation, and management using SQL and database management tools such as MySQL. The lab complements theoretical concepts learned in database courses by allowing students to practice database creation, querying, and optimization techniques. The DBMS Lab enables students to develop industry-relevant skills in database management, preparing them for careers in **software development, data engineering, and database administration**.					
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: Demonstrate the database concepts, practice, and SQL queries. [Apply] Design and implement database schemas while applying normalization techniques to optimize structure. [Apply]] Develop and implement stored procedures, triggers, and views for automation and efficiency. [Apply] To Design and build database applications for real world problems. [Apply]					

Course Content:

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]
7. To study and implement Functions, and Triggers in MySQL DB.
Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.
Level 2: Determine the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-6 [4 Practical Sessions]
Experiment No. 8: [2 Sessions]
8. To implement the concept of forms and reports.
Level 1: Implement the concept of forms and reports.
Level 2: Examine the schema relationship.

Experiment No. 9: [2 Sessions]
9. Create the database using the given schema. (Flight Management)
Level 1: Implement a relational database based on the provided schema for the Flight Management system, including the creation of tables, relationships, and constraints.
Level 2: Demonstrate schema relationships by defining primary and foreign keys to ensure data integrity within the Flight Management database.

Labsheet-7 [4 Practical Sessions]
Experiment No. 10: [2 Sessions]
10. Create the database using the given schema. (Company database)
Level 1: Implement the database schema by defining tables, relationships, and constraints according to the given Company Database schema.
Level 2: Demonstrate the schema's relationships and data integrity by creating and linking tables as per the specified requirements.
Experiment No. 11: [2 Sessions]
11. Create the database using the given schema. (Student Library)
Level 1: Implement forms and reports based on the provided Student Library database schema, ensuring effective data entry and reporting mechanisms.
Level 2: Demonstrate the schema relationships within the Student Library database, demonstrating how these relationships influence the creation and functionality of forms and reports.

Labsheet-8 [1 Sessions]
12. 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.
Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra. Programming: Implementation of any given scenario using MySQL.
Text Books: T1. Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018. T2. RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education. T3. 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 R1 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019. R2 M. Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly, 2017.
Topics relevant to development of "FOUNDATION SKILLS": S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB. Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil

Course Code: CSE2269	**Course Title: Operating Systems** **Type of Course:** **Theory & Integrated Laboratory**	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**CSE2501**					
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	The objective of the course is to familiarize the learners with the concepts of Operating					

Objective	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:** **Explain** the structure and functions of OS **Solve** problems on various CPU Scheduling Algorithms **Apply** different techniques to various synchronization problems **Discuss** various memory management techniques **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: P**ipe, 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): Silberschatz A, Galvin P B and Gagne G, "Operating System Concepts", 9th edition Wiley, 2013 Sumitabha Das, "Unix concept and Programming", McGraw Hill education, 4th Edition, 2015
References Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, Linux in a Nutshell, O'Reilly Media, Inc, 2009 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: CSE2259	**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		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:		

Module 1	**Introduction to XHTML Features**	Quizzes and Assignments	Quizzes on various features of XHTML, simple applications		**8 Sessions**
	Standard XHTML Document Structure, Basic Text Markup such as headings, paragraphs, lists, tables, forms, and semantic tags.				
Module 2	**CSS Styling**	Quizzes and assignments	Comprehension based Quizzes and assignments; Application of CSS in designing webpages		**10 Sessions**
	Apply CSS3 to style HTML elements, including layout techniques, color schemes, typography, and responsive design principles.				

XML: Basics, Demonstration of applications using XML with XSLT.				
Module 3	**PHP – Application Level**	Quizzes and assignments	Application of PHP in web designing	**12 Sessions**
PHP: Introduction to server-side Development with PHP, Arrays, Superglobal Arrays, $GET and $ POST, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object Oriented Design, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP, Applications.				
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.

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:						
		Quizzes and Assignments	Quizzes on various features of XHTML, simple			

Module 1	**Introduction to XHTML**		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.

Course Code: CSE 3015	**Course Title: ADVANCED NATURAL LANGUAGE PROCESSING** **Type of Course: Integrated**			**L-T-P-C**	2	0	2	3
Version No.	1.0							
Course Pre-requisites	CSE 3014 – Fundamentals of Natural Language Processing							
Anti-requisites								
Course Description	This course is an advanced course for Natural Language Processing. As a part of the course, students will be introduced to solving multiple problems in natural language processing, such as sentiment analysis, machine translation, cognitive natural language processing, etc. **Topics include:** Machine translation, Text summarization, Sentiment analysis, Cognitive NLP, Gaze behaviour, Evaluation Metrics, etc.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Advanced Natural Language Processing**and attain **Employability** through E**xperiential Learning** techniques.							
Course Out Comes	**On successful completion of the course the students shall be able to:** • **Understand** how to solve different problems in natural language processing. [Comprehension] • **Solve** natural language generation problems such as machine translation and text summarization. [Application] • **Perform** sentiment analysis on reviews to discern the stance of the writer. [Application] • **Use** public gaze behaviour data to improve the performance of different NLP systems. [Application]							
Course Content:								
Module 1	**Pre-trained Language Models**			**4 Sessions**				
Topics: Introduction to Pre-Trained Language Models. BERT. Multi-lingual variants of BERT. Introduction to NLTK and Huggingface Transformers.								
Module 2	**Machine Translation and Text Summarization**			**7 Sessions**				
Topics: Introduction to machine translation – source and target languages. Pivot-based machine translation. Using Transformers for machine translation. Monolingual machine translation examples. Machine translation evaluation metrics – BLEU. Implementation of BLEU score calculation using NLTK in Python. Other MT metrics – METEOR, TER, etc. Text summarization – definition. Types of summarizations – Extractive and Abstractive Summarization. Summarization evaluation metrics – ROUGE score.								
Module 3	**Sentiment Analysis**			**6 Sessions**				
Topics: Introduction to Sentiment Analysis. Solving sentiment analysis using text classification. Classification of sentiment analysis based on different levels – polarity-based and intensity-based.								

Challenges in sentiment analysis – sarcasm, thwarting, negations. Case studies in sentiment analysis – Reviewer rating prediction, short-text classifications, etc.				
Module 4	**Cognitive NLP Using Gaze Behaviour**			**7 Sessions**
Topics: Eye-Mind Hypothesis and gaze behaviour terminology. Using gaze behaviour for prediction of translation complexity, sentiment analysis complexity, sarcasm understandability, text complexity, text quality prediction, etc. Challenges with recording gaze behaviour at run time. Comparison of gaze behaviour across different people – normalization and binning. Gaze behaviour datasets. Mitigation of recording gaze behaviour at run time using type aggregation.				
List of Laboratory Tasks: 1. Familiarization with Python. Using Python to read text files, basic tokenization and other preprocessing. 2. Introduction to NLTK and Huggingface Transformers in Python. 3. Using Huggingface Transformers to create a simple MT application. 4. Implementation of pivot-based machine translation using Huggingface Transformers. 5. Calculation of BLEU using NLTK – difference between sentence_bleu and corpus_bleu methods. 6. Implementation of extractive summarization.				

7. Polarity classification of text using VADER.
8. Intensity prediction of text using Weighted Normalized Polarity Intensity.
9. Estimating gaze behaviour for a user using normalization and binning.
10. Calculating gaze behaviour for a text based on type aggregation in multiple languages.
11. Complex word identification using gaze behaviour.

Targeted Application & Tools that can be used:

1. **Google Colab**
2. **Python IDE (Eg. PyCharm)**
3. **Huggingface Transformers**
4. **NLTK**

Project work/Assignment:

Assignment: Students will have to do a **course group assignment** over the course of the semester. The assignment topics can be taken from Modules 2 or 3 as per the instructor-in-charge.

Text Books

T1 Daniel Jurafsky, and James Martin. "*Speech and Language Processing*" (3rd edition draft, 2022).

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

References

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

R2 Chris Manning, and Heinrich Schutze. "*Foundations of Statistical Natural Language Processing*". MIT Press. 1999.

E book link R1: https://www.nltk.org/book/

E book link R2: https://nlp.stanford.edu/fsnlp/

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

Topics relevant to "EMPLOYABILITY SKILLS": Calculation of BLEU and ROUGE scores using NLTK , Estimating gaze behaviour through type aggregation, Using Hugging face Transformers for machine translation **for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE2266	**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	MAT2503
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**	Assign ment	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**	Assign ment	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**	Assign ment	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**	Assign ment	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**	Assign ment	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: CSE2272	**Course Title: Cloud Computing** **Type of Course: Theory**	**L-T- P- C**	2	0	0	2
Version No.	1					
Course Pre-requisites	CSE2251					
Anti-requisites	Nil					
Course Description	This Course is designed to impart the knowledge of Cloud Computing as a new computing paradigm. The course explores various Cloud Computing terminology, principles and applications. The course also demonstrates the different views of the Cloud Computing such as theoretical, technical and commercial aspects.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cloud Computing** and attain **Employability** through **Participative Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** • **Describe fundamentals of cloud computing, virtualization and cloud computing services.** • **Explain security and standards in cloud computing.** Discuss Cloud mechanisms to optimize the QoS parameters. Develop applications using Cloud services and VM instances.					
Course Content:						

Module 1	**10 Sessions**
Introduction to Cloud Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Technology Examples, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Economics of Cloud	
Module 2	**10 Sessions**
Virtualization Techniques Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization.	
Module 3	**09 Sessions**

Cloud QoS and Management Cloud Infrastructure Mechanisms, SLAs, Specialized Cloud Mechanisms, Cloud Management Mechanisms, Cloud Security Mechanisms.	
Module 4	**09 Sessions**
Cloud Platforms, Advances in cloud: introduction to **Amazon Web Services**: Introduction to Google **App Engine,** Introduction to **Microsoft Azure.** **Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Cloud**	
Text Book 1. John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press. 2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education.	
References 1. David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press. 2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw-Hill. **Web resources:** https://puniversity.informaticsglobal.com:2229/login.aspx	
Topics relevant to development of "Skill Development Aws, Azure, APIs, Aneka Cloud Platform, EC2, Installation of VM Workstation, Infrastructure Security Challenges for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.	

Course Code: CSE 3189	**Course Title:Deep Learning** **Type of Course:Program Core Theory and Laboratory Integrated**	**L-T-P-C**	3	0	3	3
Version No.	1.0					
Course Pre-requisites	• Data Mining and Machine Learning fundamentals • Basic working knowledge of Statistics and Probability • Familiarity with programming languages and hands on coding					
Anti-requisites	NIL					
Course Description	The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Deep Learning and attain **Skill Development** through **Experiential Learning** techniques.					

Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply basic concepts of Deep Learning to develop feed forward models 2. Apply Supervised and Unsupervised Deep Learning techniques to build effective modelsfor prediction or classification tasks 3. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. 4. Analyze performance of implemented Deep Neural models			
Course Content:				
Module 1	Introduction to Deep Learning	Assignment	Programming	**No. of Classes: 10**
Topics: Machine Learning in a nutshell, Fundamentals of deep learning and neural networks,Deep Neural Network,Feedforward Neural Network, , Perceptron, MLP Structures, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, Deep Neural Network for Classification.				
Module 2	Improving Deep Neural Networks	Assignment	Programming	**No. of Classes: 09**
Topics: Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization				
Module 3	Deep Supervised Learning Models	Assignment	Programming	**No. of Classes: 10**
Topics: Convolutional neural network,Prediction of image using Convolutional Neural Networks,Deep learning in Sequential Data, RNN & LSTM, GRU, Sentiment Analysis				

Module 4	Deep Unsupervised Learning	Assignment	Programming	**No. of Classes: 10**

Topics:

Basics of Deep unsupervised learning, Auto encoders,Restricted Boltzmann Machine, Recommender systems

Text Book

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2017

References

1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013

2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015

3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013

4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008.

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

https://nptel.ac.in/courses/105105157

Topics relevant to "SKILL DEVELOPMENT": Real time Data Analysis, Naming and coding for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3082	**Course Title:** Object Oriented analysis and Design with UML **Type of Course: Integrated Only**			**L-T-P-C**	3	0	0	3
Version No.	2.0							
Course Pre-requisites	Object Oriented Programming fundamentals, Software Engineering							
Anti-requisites								
Course Description	This course deals with producing detailed object models and designs from system requirements; using the modeling concepts provided by UML; identifying use cases and expanding them into full behavioral designs; expanding the analyzing into a design ready for implementing and constructing designs that are reliable. The course begins with an overview of the object oriented analysis and design.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of **A** Object Oriented analysis and Design with UML and attain SKILL DEVELOPMENT through EXPERENTIAL LEARNING techniques							
Course Out Comes	CO1 : Ability to analyze and model software specifications. CO2 : Ability to abstract object-based views for generic software systems. CO3 : Ability to deliver robust software components.							
Course Content:								
Module 1	Introduction to Object oriented system-Knowledge level	Assignment	SRS	**20 Sessions**				
Object Basics-Object Oriented System Development Life Cycle- Use case driven approach-Rumbaugh Object Model- Booch Methodology-Jacobson Methodology-Unified Approach, Framing problem statement and SRS document.								
Module 2	**Object oriented analysis-Comprehensive Level**	Assignment	Class diagram	**10 Sessions**				
Identifying use cases-Object Analysis-Classification: Theory-Approaches for Identifying Classes: Noun Phrase approach, Common Class pattern approach, Use case driven approach, Classes, Responsibilities and Collaborators- Identifying Object relationships: Associations, Super–sub class relationships, Aggregation.								
Module 3	**Object oriented design-Comprehensive Level**	Term paper/Assignment	Object Diagram	**11 Sessions**				
Object Oriented Design Axioms-Designing Classes -Class visibility -Redefining attributes -Designing methods and protocols -Packages and managing classes -Access Layer- Object Storage Persistence - Object oriented Database System-Designing view layer classes -Macro level process -Micro level process-Prototyping the user interface –Quality Assurance Tests-Testing Strategies.								
Module 4	**Object oriented UML Modeling-**	Term paper/Assignmen	Dynamic Diagrams	**9**				

	Application level	t	Sessions

Static and Dynamic Modeling-Unified Modeling Language -UML diagrams: Class Diagrams-Use case Diagram- UML Dynamic modeling: Interaction diagram, Sequence diagram, Collaboration diagram, State-chart diagram,
Activity diagram

Targeted Application & Tools that can be used: Star UML

Text Book

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

References

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

E-Resources

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

Topics relevant to the development of SKILLS:

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

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

Course Code: CSE 3050	**Course Title:** Software Project Management **Type of Course: Theory Only Course**	**L-T- P- C**	3	0	0	3
Version No.	1					
Course Pre-requisites	Basics of Programming					
Anti-requisites						
Course Description	Effective software project management is crucial to the success of any software development or maintenance project. The roles and responsibilities of the project manager is numerous and varied. However, at the broad level, these can be classified in to the project planning and monitoring and control activities. Project planning involves making cost, effort, and duration estimation and preparing various types of plans such as schedule, configuration management, risk management, quality management. Staffing plan etc. The monitoring and control activities encompass keeping track of progress and removing bottlenecks using techniques such as PERT, GANTT, and also effective risk management, team building etc.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Software Project Management and attain **Employability** through **Participative Learning** techniques.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the different project contexts and appropriate management strategy. • Practice the role of professional ethics in successful software development. • Identify the key phases of project management. • Determine an appropriate project management approach through an evaluation of the business context and scope of the project.			
Course Content:				
Module 1	**Conventional & Modern Software Management**	Assignment	Case studies	**9 Sessions**
Topics: Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, Reducing software product size, Improving software processes. Principles of Conventional Software Engineering, Principles of Modern Software Management, Transitioning to an interactive Process.				
Module 2	**Software Management Process Framework**	Case studies / Case let	Case studies	**9 Sessions**
Topics: Life cycle phases, The artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; ModelBased Software Architectures - A management perspective and A technical perspective.				
Module 3	**Project Organization and Planning**	Quiz	Case studies	**10 Sessions**
Topics: Work breakdown structures, Planning guidelines, The cost and schedule estimating process, The iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.				
Module 4	**Project Control and Process Instrumentation**	Quiz	Case studies	**10 Sessions**
Topics: PROJECT CONTROL AND PROCESS INSTRUMENTATION :The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.				
Targeted Application & Tools that can be used:				
Project work/Assignment:				
Assignment:				

Text Book

T1. Walker Royce, "Software Project Management : A unified Framework", 1st Edition, Pearson Education, 2021

References

R1. Bob Hughes and Mike Cotterell, "Software Project Management", 3rd Edition, Tata McGraw Hill Edition, 2005.

R2. Joel Henry, "Software Project Management", 1st Edition, Pearson Education, 2006.

E book link T1: https://www.edutechlearners.com/download/Software%20Project%20Management.pdf

Web resources: https://onlinecourses.nptel.ac.in/noc19_cs70/preview

brary resources: https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=doc_titl e_str&topresult=false&content=*software%20project%20management*&sub_category_name=Computer%20Scie nce%20and%20IT

Topics relevant to development of "EMPLOYABILITY SKILLS": Life cycle Phases, Seven Core Metrics, for development of Employability Skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in the course handout.

Course Code: CSE3011	**Course Title: Reinforcement Learning** **Type of Course: Theory Only**	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	• Knowledge of programming in Python is required. • Knowledge of probabilities/statistics, calculus and linear algebra is required. • Machine learning background, as provided for example by COMP-551 or COMP-652 is required.					
Anti-requisites	NIL					
Course Description	The goal of this class is to provide an introduction to reinforcement learning, a very active research sub-field of machine learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as power plant optimization or dynamical system control, to game playing, inventory control, and many other fields. Notably, reinforcement learning has also produced very compelling models of animal and human learning. During this course, we will study theoretical properties and practical applications of reinforcement learning. We will follow the second edition of the classic textbook by Sutton & Barto (available online for free, or from MIT Press), and supplement it as needed with papers and other materials.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Reinforcement Learning** and attain **Skill Development** through **Problem Solving** Methodologies.					

Course Out Comes	On successful completion of the course the students shall be able to: 1. Knowledge of basic and advanced reinforcement learning techniques. 2. Identification of suitable learning tasks to which these learning techniques can be applied. 3. Appreciation of some of the current limitations of reinforcement learning techniques. 4. Formulation of decision problems, set up and run computational experiments, evaluation of results from experiments.			
Course Content:				
Module 1	Introduction	Assignment	Programming	**No. of Classes:10**
Topics: Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. **Probability Primer** Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions.Correlation and independence.				
Module 2	Markov Decision Process	Assignment	Programming	**No. of Classes:10**
Topics: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.				
Module 3	Prediction and Control by Dynamic Programing	Assignment	Programming	**No. of Classes:10**
Topics: Overview of dynamic programing for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions **Monte Carlo Methods for Model Free Prediction and Control** Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.				
Module 4	TD Methods and Policy Gradients	Assignment	Programming	**No. of Classes:10**
Topics: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants. Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.				
Targeted Application & Tools that can be used: While Convolution Neural Network (CNN) and Recurrent Neural Network (RNN) are becoming more important for businesses due to their applications in Computer Vision (CV) and Natural Language Processing (NLP), Reinforcement Learning (RL) as a framework for computational neuroscience to model decision making process seems to be undervalued. Besides, there seems to be very little resources				

detailing how RL is applied in different industries. Despite the criticisms about RL's weaknesses, RL should never be neglected in the space of corporate research given its huge potentials in assisting decision making.

Tools: Torch, Google Colaboratory, Spider, Jupiter Notebook

Project work/Assignment:

This part is written for general readers. At the same time, it will be of greater value for readers with some knowledge about RL.

- **Resources management in computer clusters**

Designing algorithms to allocate limited resources to different tasks is challenging and requires human-generated heuristics. The paper "Resource Management with Deep Reinforcement Learning" [2] showed how to use RL to automatically learn to allocate and schedule computer resources to waiting jobs, with the objective to minimize the average job slowdown.

State space was formulated as the current resources allocation and the resources profile of jobs. For action space, they used a trick to allow the agent to choose more than one action at each time step. Reward was the sum of (- 1/duration of the job) over all the jobs in the system. Then they combined REINFORCE algorithm and baseline value to calculate the policy gradients and find the best policy parameters that give the probability distribution of actions to minimize the objective.

- **Traffic Light Control**

Researchers tried to design a traffic light controller to solve the congestion problem. Tested only on simulated environment though, their methods showed superior results than traditional methods and shed a light on the potential uses of multi-agent RL in designing traffic system.

Five agents were put in the five-intersection traffic network, with a RL agent at the central intersection to control traffic signalling. The state was defined as eight-dimensional vector with each element representing the relative traffic flow of each lane. Eight choices were available to the agent, each representing a phase combination, and the reward function was defined as reduction in delay compared with previous time step. The authors used DQN to learn the Q value of the {state, action} pairs.

- **Robotics**

There are tremendous works on applying RL in Robotics. Readers are referred to for a survey of RL in Robotics. In particular, trained a robot to learn policies to map raw video images to robot's actions. The RGB images were fed to a CNN and outputs were the motor torques. The RL component was the guided policy search to generate training data that came from its own state distribution.

- **Web System Configuration**

There are more than 100 configurable parameters in a web system and the process of tuning the parameters requires a skilled operator and numerous trail-and-error tests. The paper "A Reinforcement Learning Approach to Online Web System Auto-configuration" showed the first attempt in the domain on how to do autonomic reconfiguration of parameters in multi-tier web systems in VM-based dynamic environments.

The reconfiguration process can be formulated as a finite MDP. The state space was the system configuration, action space was {increase, decrease, keep} for each parameter, and reward was defined as the difference between the given targeted response time and measured response time. The authors used the model-free Q-learning algorithm to do the task.

Text Book

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition
2. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon- Garcia
3. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy

References

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019.

2. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).

3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012):

Course Code: COM3403	Course Title: Bioinformatics Type of Course: Lab Integrated course	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 introduce students to this interdisciplinary field ... analyze and interpret biological data. This course is designed to give students both theoretical background and working knowledge of the techniques employed in bioinformatics. Topics include: DNA and Protein sequences, bioinformatics databases, sequence similarity measures, sequence alignment, motif finding, and phylogenetic. Emphasis will be placed on biological sequence analysis and its applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Introduction to Bioinformatics and attain Skill Development through Participative Learning techniques.		
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the fundamentals of bioinformatics related to sequences [Understand] CO2: Identify the different types of bioinformatics database [Understand] CO3: Interpret biological sequences and sequence similarity [Apply] CO4: [illegible] [Apply]		
Course Content:			
Module 1	Fundamentals of Molecular Biology and Bioinformatics		9 sessions

Topics: Introduction to molecular biology: Cell, DNA, RNA, Transcription, Translation, Folding, Gene Structure; Introduction to Bioinformatics: Components and fields of bioinformatics, Omics, Basic principles [illegible] Data Acquisition, Types of Sequences, Protein sequencing [illegible] methods, Finding Reverse complement of a sequence.

Module 2	Genome databases and Sequence Similarity		9 sessions

Topics: Bioinformatic Resources - Types and classification of genome databases, file formats, Frequent words and k-mers in Text, Substitution matrices, PAM, BLOSUM, Gap penalties, Similarity search, BLAST, Significance of sequence alignments, Alignment scores and gap penalties.

Module 3	DNA Sequence analysis		12 sessions

Topics: Dynamic Programming Algorithms for Sequence Alignment, Needleman-Wunsch and Smith-Waterman [illegible] Common [illegible]

Module 4	[illegible]		10 sessions

Targeted Application & Tools that can be used:

Course Code: COM3404	**Course Title:** Cloud Security and Governance **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		**Cloud Computing**
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 Software.
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. **Explain** the fundamentals of cloud security and governance frameworks. **[Knowledge]** 2. **Analyze** cloud security architectures and apply identity and access management principles. **[Comprehension]** 3. **Evaluate** cloud data security, encryption techniques, and compliance standards. **[Evaluation]** 4. **Apply** network security, virtualization security, and threat management techniques in cloud environments. **[Application]** 5. **Assess** cloud security risks and propose mitigation strategies for different cloud service models. **[Analysis]** 6. **Develop** security policies and disaster recovery plans for cloud-based systems. **[Synthesis]**
Course Content:		

Module 1:	**Introduction to Cloud Security and Governance**	**Quiz**		Knowledge-based Quiz	**10 Sessions**
	Topics: Fundamentals of Cloud Security, Cloud Governance Frameworks and Compliance, Shared Responsibility Model in Cloud Security, Security Considerations in Cloud Deployment Models, Risk Management and Threat Landscape in Cloud, Cloud Service Models and Security Implications (SaaS, PaaS, IaaS), Compliance Standards and Regulations (GDPR, HIPAA, ISO 27001)				
Module 2:	**Cloud Security Architecture and Identity Management**	**Quiz**		Comprehension based Quiz	**10 Sessions**
	Topics: Cloud Security Architecture and Design Principles, Identity and Access Management (IAM) in Cloud, Zero Trust Security Model for Cloud Environments, Role-Based and Attribute-Based Access Control, Authentication and Authorization in Cloud, Security Policy and Governance Best Practices, Cloud Security Automation and Orchestration				

Module 3	**Data Security, Privacy, and Compliance in Cloud**	**Assignment**		Batch-wise Assignments	**9 Sessions**
	Topics: Cloud Data Security Challenges and Best Practices, Data Encryption and Key Management in Cloud, Secure Data Storage and Transmission Techniques, Data Loss Prevention (DLP) in Cloud, Privacy-Preserving Techniques in Cloud Computing, Regulatory Compliance for Data Protection (CCPA, GDPR), Cloud Forensics and Incident Response				
Module 4:	**Cloud Infrastructure Security and Threat Management**	Assignment and Presentation		Batch-wise Assignment and Presentations	**9 Sessions**
	Topics: Cloud Network Security and Secure Configurations, Virtualization and Container Security in Cloud, Securing APIs and Microservices in Cloud Environments, Cloud Security Threats: DDoS, Malware, Insider Threats, Cloud Security Monitoring, Logging, and Threat Intelligence, Incident Response and Disaster Recovery in Cloud, Future Trends in Cloud Security and Governance				
	Targeted Application & Tools that can be used: **Use of CloudSim simulator.**				
	Project work/Assignment: **Survey on Cloud Service Providers**				
	Text Book 1. Tim Mather, Subra Kumaraswamy, and Shahed Latif **, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", Publisher:** O'Reilly Media, **ISBN:** 978-0596802769 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 the development of "FOUNDATION": Cloud computing architecture, Security policy implementation. Topics related to the development of "EMPLOYABILITY": Infrastructure security and Data security.				
Catalogue prepared by					
Recommended by the Board of Studies on					
Date of Approval by the Academic Council					

REFERENCE MATERIALS:

TEXTBOOKS

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

REFERENCES

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

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and Learning Systems

https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385

2. IEEE Transactions on Pattern Analysis and Machine Intelligence

https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf

3. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x

SWAYAM/NPTEL/MOOCs:

4. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview
5. Coursera – Neural Networks and Deep Learning Andrew Ng
6. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Code: CAI3427	**Course Title: Language Models for Text Mining** **Type of Course: Discipline Elective - Theory & Integrated Laboratory**	**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	This course introduces the basics of Text Mining and Natural Language Processing. The course will teach students different concepts such as text mining, NLP, Sequence Labeling, etc. Topics: Text Mining, NLP, Tokenization, Lemmatization, Stemming, One-hot encoding, Language modelling, Bag-of-words, Term-document Matrix, Cosine similarity, Viterbi Algorithm, etc.					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 1. **Process** text data to derive information from text. [Apply] 2. **Apply** insights from textual information to real-world business. [Apply] 3. **Develop** solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply] 4. **Utilize** different NLP tools and packages. [Apply]					

Course Content:

Module 1	**Text Mining**	**Adversarial Quiz Tests**	**Module Tests**	**No. of Sessions: 09**

Introduction to Text Mining. Text Mining vs. NLP. Text Mining Algorithms. Steps in Text Mining - Extraction, Preprocessing, Analysis and Evaluation. Lexical Resource Creation (NEW). Data collection. String Manipulation to Clean Data. Natural Language Processing. Research Paradigms in NLP. Sequential Data. Sequence Labeling (NEW). Viterbi Algorithm (NEW). Corpus. Building a HMM using a Corpus (NEW). Unknown word handling (NEW).

Module 2	**Text Preprocessing**	**Adversarial Quiz Tests**	**Module Tests**	**No. of sessions: 06**

Introduction to Preprocessing. Tokenization. Stop Words Removal. Lemmatization and Stemming. PoS

COURSE TITLE & CODE : **Artificial Intelligence and Machine Learning & CSE3157**

COURSE CREDIT STRUCTURE : 3-0-2-4

CONTACT SESSIONS : 45 + 30 = 75

Asad Mohammed Khan, SAPTARSI SANYAL, Dr. Zafar Ali Khan N

COURSE PREREQUISITES:CSE1005 – Innovative Project – Python Programming

COURSE DESCRIPTION:

This course introduces the basic concepts of artificial intelligence. It introduces students to the basic concepts and techniques of Machine Learning (ML), a subset of Artificial Intelligence (AI), is an important set of techniques and algorithms used for solving several business and social problems. The objective of this course is to discuss machine learning model development using Python.

Topics include: Working with Collections and Data Frames; Regression algorithms; Classification algorithms; Optimization techniques – Gradient Descent algorithm, Gradient Descent for simple Linear Regression; Ensemble Learning – Random Forest, Boosting techniques – AdaBoost and Gradient Boosting; Grid Search for optimal parameters; Clustering algorithms; Forecasting with Time-Series data : Auto-Regressive Integrated Moving Average Models, Recommender Systems : Association Rule Mining, Collaborative Filtering, Text Analytics – Sentiment Classification using Naïve Bayesian model.

COURSE OBJECTIVES: The objective of the course is to familiarize the learners with the concepts of

COURSE CONTENT (SYLLABUS):

Module 1: Introduction to Artificial Intelligence and Searching
[L-10 P-6 Total: 16 sessions] [Understand]
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. [L-12, P-6 Total: 18 sessions] [Apply]

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 and Supervised & Unsupervised Learning [L-12 P-10 Total: 22 sessions] [Apply]

Introduction to the Machine Learning (ML) Framework, types of ML, types of variables/features used in ML algorithms, Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm.

Supervised Learning – Classification & Regression - Decision Tree Learning, Random Forest - Support Vector Machines ; Simple Linear Regression Algorithm, Multivariate Regression Algorithm

Module 4: Machine Learning & Neural Network [L-11 P-8 Total: 19 sessions][Apply]

Neural and Belief networks - Perceptron - Multi-layer feed forward networks - Bayesian belief networks, Back propagation algorithm.

Unsupervised Learning – Clustering & Association - K-Means Clustering algorithm , Mean-shift algorithm , Apriori Algorithm, FP-growth algorithm

REFERENCE MATERIALS:

Textbook(s):

T1 Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall 2021.

T2 Tom Mitchell, "Machine Learning", First Edition, Tata McGraw Hill India, 2017.

Course Code: CAI3428	**Course Title: Practical Deep Learning with TensorFlow** **Type of Course: Integrated**	**L- T-P- C**	**2**	**0**	**2**	**3**
Version No.	1.0					
Course Pre-requisites	CSE 3001-Artificial Intelligence and Machine Learning					
Anti-requisites	NIL					
Course Description	This course introduces students to the concepts of deep neural networks and state of the art approaches to develop deep learning models. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. It will help to design and develop an application-specific deep learning models and also provide the practical knowledge handling and analyzing end user realistic applications.					
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. Implement backpropagation and gradient descent techniques to train neural networks effectively. (Apply) 2. Build and train deep learning models using Python libraries such as TensorFlow and Keras for real-world applications. (Apply) 3. Utilize deep learning techniques for image classification, object detection, sentiment analysis, and language modeling. (Apply)					
Course Content:						
Module 1	**Basics of Neural Networks**	Assignment				**18[8L+ 10P] Sessions**
Topics: Understanding Perceptron with Excel, Understanding Multilayer Perceptron with Excel, From Multilayer Perceptron to Deep Learning, Error Backpropagation and Gradient Descent to reduce errors, Activation Functions, Deep Learning, Problems with Deep Learning with solutions.						

Module 2	**TensorFlow Basics**	Assignment		**14[7 L+7 P] Sessions**

Topics:
Introduction to TensorFlow, TensorFlow dataset, Machine Learning with TensorFlow

Module 3	**Deep Learning methods with Tensor Flow and Keras**	Assignment		**14[6 L+8 P] Sessions**

Topics:

Main Features of TensorFlow, Keras basics, AI with Keras.

Project work/Assignment:

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

List of Lab Tasks:

Lab 1: Working with Deep Learning Frameworks

Objective: Explore various Deep Learning Frameworks

Tasks: Identify deep learning frameworks (Keras, Tensorflow, Matplotlib, etc)

Activity: Practice with various methods available in DL Frameworks to develop a Model.

Lab 2: Build a Basic Artificial Neural Network

Objective: Create a ANN with DL frameworks.

Task: Identify suitable ANN Layers using Keras and Tensorflow.

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

Lab 3: Build a MultiLayer Perceptron

Objective: Create a MLP for classification task.

Task: Identify suitable model for house price prediction.

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

Lab 4: Create a Tensor in TensorFlow using List or Numpy array.

Objective: To understand how to create a tensor in TensorFlow using a Python list or NumPy array

Task: Create a simple tensor using both a Python list and a NumPy array in TensorFlow.

Activity: Create a tensor using a Python list and Numpy array

Lab 5: Apply math operations on tensor using various mathematical functions.

Objective: To learn how to apply mathematical operations on tensors using various TensorFlow mathematical functions.

Task: Perform basic mathematical operations (addition, subtraction, multiplication, division) and advanced functions (square, square root, exponential) on tensors.

Activity: Perform basic math operations: Add, Subtract, Multiply, Divide and Apply advanced math functions: Square, Square root, Exponential.

Lab 6: Connecting two tensors in dataset.

Objective: Combine two tensors using concatenation and stacking operations in TensorFlow.

Task: Combine two tensors using concatenation and stacking operations in TensorFlow

Activity: Concatenate them along a specific axis and Stack them along a new axis.

Lab 7: Building dataset from a file stored in a local drive

Objective: To learn how to build a dataset in TensorFlow from a file stored in a local drive.

Task: Load a dataset from a CSV file stored on the local drive and process it using TensorFlow

Activity: Load the file using TensorFlow's tf.data API and Process the dataset (e.g., convert it into tensors)

Lab 8: Loading Dataset from TensorFlow.dataset Library

Objective: To learn how to load a dataset from the tensorflow_datasets library and use it in machine learning models.

Task: Load a dataset from TensorFlow Datasets (tfds), preprocess it, and display sample data

Activity: Load a dataset (e.g., MNIST, CIFAR-10, IMDB Reviews) and Split the dataset into training and testing sets.

Lab 9: Build a Convolutional Neural Network

Objective: Create a CNN model.

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

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

Lab 10: **Build a Time-Series Model**

Objective: Create a RNN and LSTM Model

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

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

REFERENCE MATERIALS:

TEXTBOOKS

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

REFERENCES

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

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385
2. IEEE Transactions on Pattern Analysis and Machine Intelligence https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf
3. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x

SWAYAM/NPTEL/MOOCs:

4. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview
5. Coursera – Neural Networks and Deep Learning Andrew Ng

Course Code: CSE3216	**Course Title:** Mastering Object- Oriented Concepts in Python **Type of Course:** Lab	**L- T- P- C**	0	0		2
Version No.	1					
Course Pre-requisites	CSE1005					
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

1. Dr. R Nageshwara Rao, "Core Python Programming", Dreamtech Press, 3rd Edition, 2021.

References

1. Alex Martelli, Anna Ravenscroft & Steve Holden, "Python in a Nutshell The Definitive Reference", O'Reilly Media, 3rd edition, 2017.
2. Luciano Ramalho, "Fluent Python Clear, Concise, and Effective Programming", O'Reilly Media, 2nd edition, 2022.
3. Mark Lutz, "Learning Python: Powerful Object-Oriented Programming", O'Reilly Media, 5th edition, 2013.
4. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media, 3rd edition, 2013.

Weblinks:

1. www.learnpython.org
2. https://realpython.com/python3-object-oriented
3. 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: **COM3401**	**Course Title:** Advanced Computer Architecture **Type of Course: Discipline Elective - Theory**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2501					
Anti-requisites	NIL					
Course Description	This course explores the design and analysis of modern computer architectures beyond the basics of conventional systems. It emphasizes high-performance architectures such as superscalar, VLIW, and multicore processors. Topics include instruction-level parallelism, memory hierarchy optimization, cache coherence protocols, interconnection networks, and parallel programming models. The course also covers emerging trends like heterogeneous computing, GPU architectures, and domain-specific accelerators. Through analytical techniques and simulation tools, students gain insights into performance evaluation and architectural trade-offs critical for designing next-generation computing systems.					
Course Objectives	The objective of the course is to familiarize students with sophisticated memory subsystems including multi-level caches, virtual memory, memory consistency models, and optimization strategies.					
Course Out Comes	On successful completion of this course the students shall be able to: **1:** Recall fundamental concepts of computer organization and architecture. *(Knowledge)* **2:** Evaluate processor performance using quantitative metrics such as CPI, MIPS, and Amdahl's Law. *(Evaluation)* **3:** Explain the basics of instruction pipelines and the RISC architecture principles. *(Comprehension)* **4:** Analyze the impact of pipelining on instruction throughput and performance. *(Analysis)*					
Course Content:						
Module 1	Review of Basic Computer Organization	**Assignment**			**No. of sessions: 10**	

Review of Basic Computer Organization, Performance Evaluation Methods, Introduction to RISC Instruction Pipeline, Instruction Pipeline and Performance.				
Module 2	Pipeline Hazards	**Assignment**		**No. of sessions: 10**
Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations.				
Module 3	Compiler Techniques	**Assignment**		**No. of sessions: 10**
Compiler Techniques to Explore Instruction Level Parallelism, Dynamic Scheduling with Tomasulo's Algorithm and Speculative Execution.				
Module 4	Advanced Pipelining	**Assignment**		**No. of Sessions : 10**
Advanced Pipelining and Superscalar Processors, Exploiting Data Level Parallelism: Vector and GPU Architectures, Architectural Simulation using gem5.				

Targeted Application & Tools that can be used:

1. **OpenMP / MPI libraries** – For writing and analyzing parallel code
2. **CUDA Toolkit** – To explore GPU architecture and GPGPU computing

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

1. Group project on some NLP Task like text classification (Creating a Simple Text Classifier: Use Scikit-learn to classify positive vs. negative reviews from a dataset), sentiment analysis, etc.

Textbook(s):

1. Computer Architecture - A Quantitative Approach,5th edition, John L. Hennessy, David A. Patterson.
2. Computer Systems Design and Architecture, 2nd Edition, Vincent P. Heuring
3. Computer Organization and Architecture, 6th Edition, William Stallings
4. Advanced Computer Architectures-A Design Space Approach, Dezsosima, Terence Fountain, Peter Kacsuk.

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Date of Approval by the Academic Council	

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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
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education. **This course is designed to cater to Environment and Sustainability**					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.**					
Course Outcomes	On successful completion of this course the students shall be able to: 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 Willful, 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.	
Catalog prepared by	Faculties of Department of Chemistry
Recommended by the Board of Studies on	PU/SOE/CHE/BOS-07/2022-23 9th BOS held on 10/07/23
Date of Approval by the Academic Council	21st Academic council dated: 6th September 2023

Course Code: **CSN2508**	**Course Title:CSN2508 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: **COM2504**	**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, multilayer Perceptrons and the Backpropagation algorithm using Gradient Descent.				
Module 4	Unsupervised Learning	Assignment	Programming using Keras/Sklearn	**No. of Classes L-6 P -6**
Topics: **Unsupervised Learning** – simple k Means clustering- simple and mini-batch**;** updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhoutte coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) **Competitive Learning** - Clustering using Kohenen's Self Organising Maps (SOM), **Density Based Spatial Clustering – DBSCAN**; clustering using Gaussian Mixture Models (GMM) with EM algorithm ; Outlier Detection methods – **Isolation Forest, Local Outlier Factor(LOF)**				

List of Laboratory Tasks:

Experiment N0 1: Methods for handling missing values
Level 1: Given a data set from UCI repository, implement the different ways of handling missing values in it using Scikit-learn library of Python.
Level 2: Implement one of these methods using a custom defined function in Python.

Experiment No. 2: Data Visualization
Level 1 Perform Exploratory Data Analysis for a given data set by creating Scatter Plot, Pair Plot, Count Plot using Matplotlib and Seaborn
Level 2 Create Heat Maps, WordCloud

Experiment No. 3: Regression learning
Level 1 Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the models parameters and the performance metrics. Plot the learning curves.
Level 2 Implement the polynomial regression algorithm. Compare the learning curves of Polynomial and Linear Regression.

Experiment No.4: Logistic regression
Level 1 Write custom code for generating the logistic/sigmoid plot for a given input
Level 2 Given a data set from UCI repository, implement the Logistic regression algorithm. Estimate the class probabilities for a given test data set. Plot and analyze the decision boundaries.

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

Experiment No.6: Support Vector Machine(SVM)
Level 1 Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.

Experiment No. 7: Ensemble Learning
Level 1 : Implement Ensemble Learning algorithms such as Bagging, Pasting and Out-of Bag Evaluation
Level 2 : Random Patches and Random Subspace Method

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

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

Experiment No. 10: Unsupervised Learning
Level 1 : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhoutte Coefficient . Compare the inertia of both as k increases. Tuning the hyperparameter 'k' using GridSearchCV.
Level 2 : – Using clustering for Image segmentation and Preprocessing. Kmeans++

Experiment No. 11: Density Based Clustering

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

Experiment No. 12: Outlier Detection

Level 1 Outlier Detection using Isolation Forest and Local Outlier Factor

Targeted Application & Tools that can be used :

1. Execution of the ML algorithms will be done using the Google's cloud service namely "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
2. The data sets will be from the bench marking repositories such as UCI machine learning repository available at : https://archive.ics.uci.edu/ml/index.php
3. Laboratory tasks will be implemented using the libraries available in Python such as Scikit learn, matplotlib, seaborn, perceptron and the deep learning framework namely Keras.

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

Students can be assigned a mini project to develop a machine learning application for real-life problems in various domains such as health care, business intelligence, environmental modeling, etc.

Text Book

There are a number of useful textbooks for the course, but each cover only a part of the course syllabus. Following is an indicative list of textbooks.

1. Aurélien Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Oreilly, Second Edition, 2019.
2. Andreas C Muller, Sarah Guido, "Introduction to Machine Learning with Python :A Guide for Data Scientists", Oreilly, First Edition, 2018
3. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.

References In references apart from the books and web links, mention a few standards &Hand books relevant to the Laboratory tasks used by the professionals.

1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining*"**, Pearson Education, 2016.
2. **https://towardsdatascience.com/machine-learning/home**
3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/
4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Course Code: COM2503	**Course Title: Applied Machine Learning Lab** **Type of Course: Program Core - Laboratory**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CAI2500					
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	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 1. **Apply** advanced supervised machine learning methods for predictive modeling. [Apply] 2. **Produce** machine learning models with better predictive performance using meta learning algorithms [Apply] 3. **Create** predictive models using Perceptron learning algorithms [Apply] 4. **Employ** advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection [Apply] 5. **Implement** machine learning based intelligent models using Python libraries. [Apply]

Course Content:
No. of Sessions: 15 (30 hours)

Experiment No. 1: File Handling Using Python
Level 1: Read a CSV file using Python
Level 2: Read a text file using Python

Experiment No. 2: 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. 3: 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. 4: 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. 5: 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. 6: Bayesian Learning
Level 1: Given a data set from UCI repository, implement a classification model using the Bayesian algorithm.
Level 2: Implement a Naïve Bayes classifier using 5-fold cross-validation

Experiment No. 7: Support Vector Machine (SVM)
Level 1: Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.
Level 2: Construct kernels with 5-fold cross-validation for SVM.

Experiment No. 8 & 9: 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, Adaboost and Gradient Boosting, Stacking.

Experiment No. 10: Perceptron Learning
Level 1: Implement the Perceptron Classifier
Level 2: An Image Classifier Using the Sequential API of Keras

Experiment No. 11 & 12: 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. 13: Density Based Clustering
Level 1: Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.
Level 2: Outlier Detection using Isolation Forest and Local Outlier Factor

Experiment No. 14: Association Rule Mining
Level 1: Implement the Apriori Algorithm for Association Rule Mining
Level 2: Implement the Dynamic Itemset Counting Algorithm for Association Rule Mining.

Experiment No. 15: Collaborative Filtering **Level 1:** Implement Collaborative Filtering using Item-Based Filtering **Level 2:** Implement Collaborative Filtering using User-Based Filtering
Targeted Application & Tools that can be used: 3. Google Colab 4. Python IDEs like PyCharm
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.
Textbook(s): **1.** Aurélien Géron. *Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow*, Oreilly, 3rd Edition, 2022.
References: R1. Andreas C Muller, and Sarah Guido. *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'Reilly, 1st Edition, 2016. **Weblinks** **W1**. NPTEL Courses: https://nptel.ac.in/courses/106106139 (IIT M), https://nptel.ac.in/courses/106105152 (IIT Kgp)

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)
Catalogue prepared by	Mr. Md Ziaur Rahman
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CSE 7100	**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)
Catalogue prepared by	Dr. Sampath A K
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

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)
Catalogue prepared by	Dr. Sampath A K
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: **CAI2505**	**Course Title:** **Natural Language Processing** **Type of Course:** **Program Core - Laboratory**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CAI2501					
Anti-requisites	NIL					
Course Description	This course introduces the basics of Natural Language Processing methods with specific emphasis on modern applications. The course will teach students different concepts of natural language processing, such as word representations, text representations, part-of-speech tagging, word sense disambiguation, parsing, etc. Topics: Word representations, Part-of-Speech tagging, chunking, parsing, text classification, sentiment analysis, named entity recognition, and machine translation.					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 6. Define different problems related to natural language processing. [Understand] 7. Discuss using NLP techniques for different applications. [Apply] 8. Propose solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply] 9. Learn to use different NLP tools and packages. [Apply]					

Course Content:
No. of Sessions: 15 (30 hours)

Experiment No. 1: File Handling
Level 1: Read text files using Python and extract meaningful content.
Level 2: Parse text files using Python to preprocess the data for NLP tasks.

Experiment No. 2: Introduction to NLP Tools
Level 1: Install and use NLTK for basic text processing.
Level 2: Install and use SpaCy for tokenization, PoS tagging, and Named Entity Recognition.

Experiment No. 3: Corpus Cleaning Techniques
Level 1: Use NLTK for corpus cleaning techniques such as tokenization, stopword removal, and stemming.
Level 2: Prepare cleaned text data for downstream NLP tasks like classification or

translation.

Experiment No. 4: Word Vector Usage
Level 1: Download and use pre-trained word vectors (e.g., Word2Vec, GloVe, or FastText).
Level 2: Compute similarity between two words, find the most similar word, and complete word analogies (e.g., king - man + woman = queen).

Experiment No. 5 & 6: Language Identification
Level 1: Build a simple language identifier using Bag-of-Words (BoW) features.
Level 2: Predict the language of a given text using the trained model.

Experiment No. 7 & 8: Lexical Simplification
Level 1: Implement a lexical simplifier to replace complex words with simpler alternatives.
Level 2: Generate a simplified version of a given word or sentence while preserving meaning.

Experiment No. 9 & 10: Sentiment Analysis
Level 1: Implement a basic sentiment classifier using a lexicon-based or machine learning approach.
Level 2: Compare the performance of an existing sentiment classifier (e.g., VADER, TextBlob, or a pre-trained Transformer model).

Experiment No. 11: Named Entity Recognition (NER)
Level 1: Extract named entities from a text using NLTK.
Level 2: Extract named entities using SpaCy and compare results.

Experiment No. 12 & 13: Implement a Hidden Markov Model (HMM)
Level 1: Implement a generic HMM for sequence prediction.
Level 2: Calculate the forward probability of a given sequence using HMM.

Experiment No. 14: Linguistic HMM
Level 1: Develop a Hidden Markov Model (HMM) for NLP tasks such as PoS tagging.
Level 2: Evaluate the performance of the HMM on a specific NLP task (e.g., Named Entity Recognition or Chunking).

Experiment No. 15: Machine Translation
Level 1: Implement Machine Translation (MT) using a pre-trained model from Hugging Face Transformers.
Level 2: Evaluate the quality of MT output via Round-Trip Translation (translate text to another language and back to check accuracy).

Targeted Application & Tools that can be used:

5. Execution of the NLP task will be done using the Google's cloud service namely "Colab", available at https://colab.research.google.com/, Anaconda Navigator.

6. Laboratory tasks will be implemented using the libraries available in Python such as NLTK, Gensim, Spacy and Huggingface Transformers.

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

To enhance their understanding and gain practical exposure to NLP concepts, students are encouraged to complete a certification related to Natural Language Processing (NLP).

- Natural Language Processing - NPTEL
- Deep Learning for NLP - NPTEL
- Applied Natural Language Processing - NPTEL

Textbook(s):

2. Daniel Jurafsky, James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech, Pearson Publication, 2024 (3rd Edition Draft).
3. Aditya Joshi, Pushpak Bhattacharyya. "Natural Language Processing", Wiley Publication, 2023 (1st Edition).

References:

R1. Chris Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", 1st Edition, MIT Press. 1999.
R2. Pawan Goyal. "Natural Language Processing". 1st Edition, 2016.

Weblinks

W1. E-Book link or R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBgAvLd1WscI0RqC/view
W2. Web Resource for T1: https://web.stanford.edu/~jurafsky/slp3/ - VERY VERY IMPORTANT!!!
W3. NPTEL Courses: https://nptel.ac.in/courses/106106211 CMI), https://nptel.ac.in/courses/106105158 (IIT Kgp), https://nptel.ac.in/courses/106101007 (IITB), https://nptel.ac.in/courses/106105572 (IIT Kgp - NEW)

Catalogue prepared by	Dr. Sandeep Albert Mathias Ms. Devi.S
Recommended by the Board of Studies on	BOS NO: SOCSE 2nd BOS held on 17/03/25
Date of Approval by the Academic Council	Academic Council Meeting No 21, Dated 17/03/25

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Course Code:	**Course Title:** Cloud computing	**L- T-P- C**	0	**0**	2	**1**

CSE2025	**Type of Course :** Lab					
Version No.	1.0					
Course Pre-requisites	CSE1507					
Anti-requisites	**NIL**					
Course Description	This course is designed to give hands-on experience with cloud platforms, services, and deployment models. Students will learn to set up, configure, and manage cloud environments using platforms like AWS, Microsoft Azure, and Google Cloud. The course covers virtualization, containerization, serverless computing, cloud storage, security, and scalability. Through practical assignments, students will develop skills in deploying cloud applications, managing cloud resources, automating cloud workflows, and implementing cost-effective cloud solutions.					
Course Objective	The objective of the course is to Understand Cloud Infrastructure, deploy and manage virtual machines, implement cloud storage, develop and deploy cloud applications, optimize cost and performance.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1· Deploy and Manage Cloud Resources. CO2. Develop and Deploy Cloud-based Applications CO3. Optimize Performance and Cost in the Cloud CO4. Implement Security and Automation in Cloud Environments					
Course Content:						
Module 1	Introduction to Cloud and Virtualization	Assignment	Virtualization	**10 Sessions**		

Lab Assignment 1: Setting Up Virtual Machines on Cloud

- Create a **Virtual Machine (VM)** on AWS/Azure/GCP
  Configure OS, storage, and network settings
- Connect to the VM using SSH/RDP
  Install web server (Apache/Nginx) and deploy a static webpage

Lab Assignment 2: Containerization Using Docker

- Install **Docker** on a local or cloud VM
- Create and run a **Docker container**
- Build a **custom Docker image** with a simple Python/Node.js application
- Push the image to **Docker Hub** and deploy it on a new VM

Module 2	High Throughput and Data Intensive Computing	Assignment	Virtualization	**10 Sessions**

Lab Assignment 1: Setting Up a Distributed Computing Environment

- Launch a **Hadoop or Spark cluster** on AWS EMR / Azure HDInsight / Google Dataproc
- Configure **HDFS (Hadoop Distributed File System)** for big data storage
- Run a **basic MapReduce job** on sample data

Lab Assignment 2: Data Preprocessing with Cloud Storage

- Store large datasets in **Amazon S3 / Azure Blob Storage / Google Cloud Storage**
- Use **Apache Spark or Hadoop** to read, clean, and process data
- Convert datasets into **Parquet or Avro formats** for efficient storage

Lab Assignment 3: Batch Processing with Apache Spark

- Load large datasets (e.g., logs, tweets, transaction data) into **Spark DataFrame**
- Perform **ETL (Extract, Transform, Load) operations** on the data
- Use **SparkSQL** for querying large datasets

Lab Assignment 4: Real-Time Data Processing with Spark Streaming

- Set up **Kafka / AWS Kinesis / Google Pub/Sub** for real-time data ingestion

- Process streaming data using **Spark Streaming**
- Perform windowed aggregations and visualize real-time trends

Lab Assignment 5: Cloud-Based Machine Learning with Big Data

- Use **Google BigQuery ML / AWS SageMaker / Azure Machine Learning** for model training
- Train a **linear regression or classification model** on a large dataset
- Deploy the trained model as an API for real-time predictions

Lab Assignment 6: Running Parallel Machine Learning Workloads

- Implement **distributed ML training** using **Spark MLlib or TensorFlow on Cloud TPUs**
- Train models on a large dataset and optimize performance using distributed execution

Lab Assignment 7: Auto-Scaling and Load Balancing for Data Processing

- Deploy a **serverless Spark job** using **AWS Glue / Azure Synapse**
- Implement **auto-scaling for high-throughput jobs**
- Measure performance improvements using cloud monitoring tools

Lab Assignment 8: Cost Optimization for High-Throughput Data Processing

- Analyze **cloud cost reports** for data-intensive workloads
- Optimize cloud storage and compute resources for cost-efficiency
- Compare **on-demand vs. reserved vs. spot instances** for cost savings

Module 3	Cloud Security and Standards	Assignment	Virtualization	**9 Sessions**

Lab Assignment 9: Configuring Identity and Access Management (IAM)

- Set up **IAM roles and policies** in AWS / Azure / Google Cloud
- Create and assign users with **least privilege access**
- Implement **Multi-Factor Authentication (MFA)** for added security
- Audit IAM policies using **AWS IAM Access Analyzer / Azure Security Center**

Lab Assignment 10: Setting Up Single Sign-On (SSO) and Role-Based Access Control (RBAC)

- Configure **AWS Cognito / Azure Active Directory / Google IAM** for authentication
- Implement **Role-Based Access Control (RBAC)** for users and groups
- Integrate **OAuth 2.0 / OpenID Connect (OIDC) / SAML** for secure authentication

Lab Assignment 11: Encrypting Data at Rest and in Transit

- Encrypt **cloud storage (S3, Blob, Cloud Storage)** using **KMS (Key Management Service)**
- Set up **TLS/SSL certificates** for secure web traffic encryption
- Enable **database encryption (AWS RDS, Azure SQL, GCP Cloud SQL)**

Lab Assignment 12: Implementing Compliance & Governance in Cloud

- Enable **GDPR, HIPAA, ISO 27001 compliance tools** in cloud platforms
- Use **AWS Config / Azure Policy / GCP Security Command Center** to enforce compliance
- Conduct **security audits and generate compliance reports**

Lab Assignment 13: Implementing Cloud Monitoring & Threat Detection

- Configure **AWS CloudTrail / Azure Monitor / GCP Operations Suite** for activity logging
- Set up **intrusion detection systems (IDS) & anomaly detection**
- Analyze security logs using **Amazon GuardDuty / Azure Sentinel / Chronicle Security**

Lab Assignment 14: Automating Security Incident Response

- Deploy a **Serverless Lambda / Azure Logic App** to automatically respond to security

incidents

- Implement **automated alerts** for suspicious activity
- Test a **denial-of-service (DDoS) simulation** and implement mitigation strategies

Module 4	Cloud Platforms	Assignment	Virtualization	**9 Sessions**

Lab Assignment 15: Getting Started with Cloud Platforms

- Create a **free-tier account** on AWS, Azure, or Google Cloud
- Navigate the **Cloud Console, CLI, and SDKs**
- Explore and configure **dashboard, billing, and IAM settings**

Lab Assignment 16: Launching a Virtual Machine (VM) on Cloud

- Deploy a **VM instance** using **AWS EC2, Azure Virtual Machines, or Google Compute Engine**
  Configure **OS, storage, networking, and security groups**
  Connect to the instance using **SSH (Linux) or RDP (Windows)**

Lab Assignment 17: Cloud Storage and File Management

- Create **Object Storage (AWS S3 / Azure Blob Storage / Google Cloud Storage)**
  Upload, download, and set access permissions for files
  Implement **Lifecycle Policies and Versioning**

Lab Assignment 18: Cloud Database Management

- Deploy a **Relational Database (AWS RDS / Azure SQL Database / Cloud SQL)**
  Connect and query the database using **MySQL/PostgreSQL clients**
  Set up database **backups and automatic scaling**

Lab Assignment 19: Configuring Virtual Networks in Cloud

- Set up a **Virtual Private Cloud (VPC) / Azure Virtual Network / GCP VPC**
  Configure **subnets, firewalls, and security groups**
  Test **network communication between two VMs**

Lab Assignment 20: Deploying a Web Application on Cloud

Deploy a Python/Node.js/Java web app using:

- **AWS Elastic Beanstalk**
- **Azure App Service**
- **Google App Engine**

Connect the app to Cloud Database (RDS, CosmosDB, Firestore)
Monitor application performance and logs

Targeted Application & Tools that can be used:

Text Book(s):

1. John Rittinghouse and James Ransome, “Cloud Computing, Implementation, Management and Security”, CRC Press.

2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education.

Reference(s):

1. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press.

2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill. Web resources: https://presiuniv.knimbus.com/user#/home

Catalogue prepared by	
Recommended by the Board of Studies on	
Date of Approval by	

the Academic Council	

Course Code: CSE2274	**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	CSE2004					
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 coding solution of Sieve Method, Inverse Module, Euclidian Method of factorization; efficient coding 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; problem-solving using arrays and strings such as rotation on sorted arrays, duplicate removal, string matching algorithms; Kadane's algo, stacks, priority-queues and hashing based efficient coding; 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 problems such as finding loops in a linked list, memory efficient DLL, block reversal in LL; problem solving using trees and binary trees, Catalan numbers, applications of graphs, spanning tree and path 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 representation, algorithmic approaches such as Greedy, Backtracking, Dynamic Programming and 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

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Course Code: CSE2260	**Course Title: Database Management Systems** **Type of Course: Theory**	**L-T-P-C**	3	0	0	3
Version No.						
Course Pre-requisites	CSE1508					
Anti-requisites	NIL					
Course Description	This course introduces the foundational principles of database management systems, including data models, schemas, and architectures. This course provides a solid foundation on the relational model of data and the use of relational algebra. It develops skills in SQL for data definition, manipulation, and control, enabling students to construct and execute complex queries. The course also introduces the concept of object oriented and object relational databases and modern database technologies like **NoSQL.** The also course allows the students to gain insights into data storage structures and indexing strategies for optimizing query performance.					
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. Describe the fundamental elements of relational database management systems. [Understand] 2. Examine databases using SQL query processing and Optimization. [Apply] 3. Design simple database systems applying the normalization constraints and demonstrate the database transaction processing, recovery, and security. [Apply] 4. Interpret the concept of advanced databases and its applications. [Apply]					
Course Content:						
Module 1	**Introduction to Database Modelling and Relational Algebra (Understand)**	Assignment	**Problem Solving**		**10 Sessions**	

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 (Apply)**	Assignment	**Programming**	**11 Sessions**

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 (Apply)**	Assignment	**Problem Solving**	**12 Sessions**

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 (Apply)**	**Assignment**	**Case Study**	**12 Sessions**

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.

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.

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 Books:

T1. Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.

T2. RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.

T3. 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

R1 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.

R2 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

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Course Code: **CSE2264**	**Course Title:** Essentials of AI **Type of Course:** PCC	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	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	Assign ment	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:

- **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): ● "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

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Course Code: CSE2265	**Course Title: Essentials of AI Lab** **Type of Course: Lab**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	MAT2503					
Anti-requisites	NIL					
Course Description	This course introduces the student to the basics of artificial intelligence. In this course, the student first learns the various search methods for problem-solving, followed by knowledge-based logic representations. After that, the student will learn about uncertainty in AI, as well as approaches to solve such challenges such as Naïve Bayes Classifier and Hidden Markov Models. Topics: Uninformed search, Heuristic search, Local search, Adversarial search,					

	Constraint satisfaction, logic, First Order Resolution, Probability, Naïve Bayes Classifier, and Hidden Markov Model (HMM).
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 10. Explain different methods of searching, proving, and analysis in AI [Understand] 11. Implement various graphical and adversarial search algorithms. [Apply] 12. Prove, by resolution, different situations using First Order Logic [Apply] 13. Solve sequence labeling problems using HMM [Apply]

Course Content: **No. of Sessions: 30 (60 hours)**

NOTE: Each experiment will be run across **TWO** lab sessions. In the first lab session, the students will have to do a preliminary experiment (Eg. Implement an uninformed search algorithm like BFS). In the second lab session, they will have to test their solution using a given input which is read from a file.

Experiment No. 1: File Handling
Level 1: Read text files using Python
Level 2: Parse text files using Python

Experiment No. 2: Implementation of Graph Representations
Level 1: Implement graph representations by taking input from the console
Level 2: Implement graph representations by taking input from files.

Experiment No. 3 & 4: Implementation of Uninformed Search Algorithms
Level 1: Implement uninformed search algorithms – BFS and DFS – on unweighted graphs.
Level 2: Implement uninformed search algorithms – Uniform Cost Search and Dijkstra's SSSP – on weighted graphs

Experiment No. 5: Implementation of Heuristic Search Algorithms
Level 1: Calculate the upper-bounds of admissible heuristics using Dijkstra's SSSP.
Level 2: Implement Greedy Best-First Search and A* Search Algorithms.

Experiment No. 6 & 7: Implementation of Adversarial Search
Level 1: Implement a Game Tree
Level 2: Perform Alpha-Beta Pruning and Ideal Ordering

Experiment No. 8 & 9: Implementation of a CSP Solver
Level 1: Implement a CSP solver to solve a cryptarithmetic problem
Level 2: Implement a CSP solver for map colouring

Experiment No. 10: Using Python Packages for CSP
Level 1: Implement a CSP solver for Sudoku

Level 2: Implement a CSP solver for Addoku

Experiment No. 11: Implement a Family Tree Parser
Level 1: Perform logic programming using logpy.
Level 2: Implement a family tree parser

Experiment No. 12 & 13: Implement a Decision Maker
Level 1: Implement a Minesweeper solver
Level 2: Implement a Battleship solver

Experiment No. 14 & 15: Hidden Markov Model
Level 1: Implement a generic HMM
Level 2: Build a PoS Tagger using a HMM with the Brown Corpus and the Universal Dependencies Tagset.

Targeted Application & Tools that can be used:

7. Google Colab
8. Python IDEs like PyCharm

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

The course is a lab-based course with all the assessments centrally evaluated. Every experiment consists of **two sessions**. The first session involves exploring a solution to the problem. The second session involves solving a particular problem.

Textbook(s):

4. Stuart Russel and Peter Norvig. *Artificial Intelligence: A Modern Approach*. 4th Edition. Pearson Education. 2022.
5. Prateek Joshi and Alberto Artasanchez. *Artificial Intelligence with Python*. 2nd Edition. Packt. 2020.

References:

1. Deepak Khemani. *A First Course in Artificial Intelligence*. 1st Edition. 6th Reprint, 2018.
2. Munesh Chandra Trivedi. *A Classical Approach to Artificial Intelligence*. 2nd Edition. Khanna Publishers. 2018.

Course	Course Title: Machine Learning	L-T-P-	0	0	2	1

Code: CSE1703	**Techniques** **Type of Course: Program Core - Laboratory**	**C**				
Version No.	1.0					
Course Pre-requisites						
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	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 14. **Apply** advanced supervised machine learning methods for predictive modeling. [Apply] 15. **Produce** machine learning models with better predictive performance using meta learning algorithms [Apply] 16. **Create** predictive models using Perceptron learning algorithms [Apply] 17. **Employ** advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection [Apply] 18. **Implement** machine learning based intelligent models using Python libraries. [Apply]					
Course Content: **No. of Sessions: 15 (30 hours)**						
Experiment No. 1: File Handling Using Python **Level 1:** Read a CSV file using Python **Level 2:** Read a text file using Python **Experiment No. 2: 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. 3: 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. 4: 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. 5: 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. 6: Bayesian Learning
Level 1: Given a data set from UCI repository, implement a classification model using the Bayesian algorithm.
Level 2: Implement a Naïve Bayes classifier using 5-fold cross-validation

Experiment No. 7: Support Vector Machine (SVM)
Level 1: Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.
Level 2: Construct kernels with 5-fold cross-validation for SVM.

Experiment No. 8 & 9: 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, Adaboost and Gradient Boosting, Stacking.

Experiment No. 10: Perceptron Learning
Level 1: Implement the Perceptron Classifier
Level 2: An Image Classifier Using the Sequential API of Keras

Experiment No. 11 & 12: 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. 13: Density Based Clustering

Level 1: Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.
Level 2: Outlier Detection using Isolation Forest and Local Outlier Factor

Experiment No. 14: Association Rule Mining
Level 1: Implement the Apriori Algorithm for Association Rule Mining
Level 2: Implement the Dynamic Itemset Counting Algorithm for Association Rule Mining.

Experiment No. 15: Collaborative Filtering
Level 1: Implement Collaborative Filtering using Item-Based Filtering
Level 2: Implement Collaborative Filtering using User-Based Filtering

Targeted Application & Tools that can be used:

9. Google Colab
10. Python IDEs like PyCharm

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.

Textbook(s):

6. Aurélien Géron. *Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow*, Oreilly, 3rd Edition, 2022.

References:

R1. Andreas C Muller, and Sarah Guido. *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'Reilly, 1st Edition, 2016.

Weblinks

W1. NPTEL Courses: https://nptel.ac.in/courses/106106139 (IIT M), https://nptel.ac.in/courses/106105152 (IIT Kgp)

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Course Code: **CSE2275**	**Course Title: Software Design and Development** **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 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		**10 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	**12 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		**10 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	**13 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] R1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", VII Edition, McGraw-Hill, 2017. 2] B2. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGraw-Hill, 2018.				
References 1. Rajib Mall, "Fundamentals of Software Engineering", VI Edition, PHI learning private limited, 2015.				

2. Ian Sommerville, "Software Engineering", IX Edition, Pearson Education Asia, 2011.
3. 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

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Course Code: **CSE2503**	**Course Title:** Scalable Application Development using Java **Type of Course:** Theory	**L- T-P- C**	3	**0**	0	**3**
Version No.	2.0					
Course Prerequisites	CSE1006					
Anti-requisites	**NIL**					
Course Description	This course provides a comprehensive guide to designing, developing, and deploying scalable Java applications, covering high-performance architectures, distributed systems, microservices, cloud deployment, and DevOps integration.					
Course Objective	The objective of the course is to Understand Scalability Principles, developing high performance Java applications, design and implement scalable architecture, deploy and manage scalable data.					
Course Outcomes	On successful completion of the course the students shall be able to:					

	CO 1: Design and Develop Scalable Java Applications CO 2: Design and Implement Scalable Architectures and Micro services CO 3: Implement Scalable Data Management Techniques CO 4: Deploy and Monitor Applications in Cloud Environments			
Course Content:				
Module 1	Foundations of Scalable Java Applications	Assignment	Implementation	**10 Sessions**
Topics: **Introduction to Scalability -** Defining scalability: vertical vs. horizontal scaling, Monolithic vs. Microservices Architecture, Performance bottlenecks and solutions. **Java Performance Optimization -** JVM internals and tuning, Garbage Collection (GC) strategies, Profiling and monitoring Java applications **Concurrency and Multithreading -** Java concurrency model and thread management, Executor framework, ForkJoinPool, Thread safety, locks, and synchronization.				
Module 2	Scalable Architectures and Microservices	Assignment	Implementation	10 Sessions
Topics: **Microservices and Distributed Systems -** Principles of microservices, Service-to-service, communication (REST, gRPC, Kafka), API Gateway, Service Discovery, and Load Balancing **Design Patterns for Scalability -** Singleton, Factory, and Builder patterns, CQRS (Command Query Responsibility Segregation), Circuit Breaker and Retry patterns (Resilience4j) **Event-Driven Architecture & Asynchronous Processing -** Event Sourcing with Kafka, WebSockets and Reactive Programming, Handling failures in distributed systems.				
Module 3	Scalable Data Management and Caching	Mini - Project	Implementation	10 Sessions

Topics:

Database Scalability - SQL vs. NoSQL databases (MySQL, PostgreSQL, MongoDB, Cassandra), Sharding, Replication, and Partitioning strategies, Optimizing queries (Indexing, Query Caching)

Caching Strategies - In-memory caching with **Redis, Memcached,** Distributed caching techniques, Cache Invalidation and Eviction Policies

Data Streaming & Batch Processing - Apache Kafka for event-driven data pipelines, Apache Spark for large-scale data processing.

Module 4	Cloud Deployment and DevOps for Scalability	Quiz	Implementation	10 Sessions

Topics:

Cloud-Native Development - Containerization with **Docker,** Kubernetes for scaling and orchestration, Cloud deployment strategies (AWS, GCP, Azure),

CI/CD & DevOps for Scalable Applications - Building CI/CD pipelines (Jenkins, GitHub Actions), Canary & Blue-Green Deployments, Infrastructure as Code (Terraform, Kubernetes Helm)

Security & Reliability - Securing APIs with **OAuth2, JWT, API Gateway,** Load Balancing & Rate Limiting, Monitoring with **Prometheus, ELK Stack**

Targeted Application & Tools that can be used:

Applications:

The course will focus on building and scaling the following types of applications:

- **E-Commerce Platforms** – Handling high traffic, product catalogs, and real-time inventory.
- **Banking & FinTech Applications** – Secure and high-availability transactions.
- **Streaming & Event-Driven Applications** – Using Kafka for real-time data processing.
- **Social Media & Messaging Platforms** – Scalable messaging and real-time updates.
- **SaaS & Cloud-Native Applications** – Multi-tenant, API-based scalable solutions.
-

Tools:

Programming & Frameworks

- **Java 17+** – Core programming language for scalable applications.
- **Spring Boot** – Microservices development, REST APIs, and dependency injection.
- **Spring Cloud** – Service discovery, load balancing, and resilience patterns.
- **Quarkus** – Lightweight, high-performance microservices alternative.

Database & Caching

- **SQL Databases:** MySQL, PostgreSQL – Scalable relational data management.
- **NoSQL Databases:** MongoDB, Cassandra – High-availability distributed databases.
- **Redis / Memcached** – In-memory caching for faster response times.

Messaging & Event-Driven Architecture

- **Apache Kafka** – Real-time event streaming and asynchronous communication.
- **RabbitMQ** – Message brokering for decoupling services.
- **gRPC** – High-performance inter-service communication.

Cloud & Deployment

1. **Docker** – Containerization for application portability.
2. **Kubernetes** – Scaling, orchestration, and auto-recovery.
3. **AWS / GCP / Azure** – Cloud deployment and auto-scaling.

CI/CD & DevOps

- **GitHub Actions / Jenkins** – Automated build and deployment pipelines.
- **Terraform** – Infrastructure as Code for cloud provisioning.
- **Helm** – Kubernetes package management for scalable applications.

Text Book(s):

T1: "Designing Data-Intensive Applications" – *By Martin Kleppmann*

T2: "Java Concurrency in Practice" – *By Brian Goetz*

T3: "Spring Microservices in Action" – *By John Carnell*

T4. "Cloud Native Java" – *By Josh Long & Kenny Bastani*

Reference(s):

- **"Designing Data-Intensive Applications"** – *Martin Kleppmann*
- **"Java Performance: The Definitive Guide"** – *Scott Oaks*
- **"Spring Microservices in Action"** – *John Carnell*
- **"Kubernetes Up & Running"** – *Kelsey Hightower, Brendan Burns, Joe Beda*

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Course Code: **CSE2504**	**Course Title:** Scalable Application Development using Java Lab **Type of Course:** Lab	**L- T-P- C**	0	**0**	2	**1**
Version No.	2.0					
Course Prerequisites	CSE1006					
Anti-requisites	**NIL**					
Course Description	This course provides a hands-on, practical approach to building scalable, high-performance applications using Java and related technologies. This course is designed to complement theoretical concepts by offering real-world lab exercises focused on the development of microservices architectures, cloud-native applications, and distributed systems. In this lab-intensive course, students will work on building and deploying scalable applications using Spring Boot, Spring Cloud, Docker, Kubernetes, and Apache Kafka. Students will gain experience in implementing RESTful APIs, asynchronous messaging, data caching, and load balancing to ensure that applications can handle increased traffic and scale efficiently. The course will also cover essential techniques for optimizing performance, including JVM tuning, database optimization, and memory management.					

Course Objective	The primary objectives of the course are to Develop hands-on expertise in building scalable applications using Java and modern frameworks like Spring Boot, Spring Cloud, and Apache Kafka, Implement microservices architectures that enable applications to handle increasing loads efficiently through distributed systems and cloud-native practices, Gain practical experience in optimizing performance by leveraging tools for JVM tuning, database optimization, and memory management to improve application responsiveness and scalability., Work with containerization technologies such as Docker and Kubernetes to deploy Java applications in cloud environments with automated continuous integration/continuous deployment (CI/CD) pipelines, Master service discovery, load balancing, and caching mechanisms to ensure high availability, fault tolerance, and low-latency operations in production-grade applications and Apply event-driven architectures to build scalable and resilient systems using tools like Apache Kafka for real-time data processing and messaging.			
Course Outcomes	On successful completion of the course the students shall be able to: ● Implement Performance Optimization Techniques ● Design and Build Scalable Microservices ● Integrate Event-Driven Architectures and Caching. ● Deploy and Scale Applications in Cloud Environments.			
Course Content:				
Module 1	Foundations of Scalable Java Applications	Assignment	Implementation	**10 Sessions**

Lab Assignment 1: Setting Up Development Environment

Objective: Set up the Java development environment and configure a Spring Boot project for scalability testing.
Tasks:

- Install **Java 17**, **Maven**, and **IDE** (IntelliJ or Eclipse).
- Set up a basic **Spring Boot project** using **Spring Initializr** with **RESTful endpoints**.
- Verify application functionality by running a **local server** and testing API responses via **Postman** or **curl**.
- Add a basic **Spring Boot Actuator** to monitor application health and performance.
  Deliverables:
- Working **Spring Boot application** with basic endpoints.

- Screenshots of successful tests (Postman or curl).

Lab Assignment 2: Performance Optimization with JVM

Objective: Profile and optimize a Java application for better performance.
Tasks:

1. Implement a **simple Java application** that performs a memory-intensive task (e.g., sorting a large dataset).
2. Use **VisualVM** to monitor **JVM memory usage, CPU usage, and garbage collection**.
3. Optimize the application by adjusting **JVM flags** (e.g., **heap size**, **garbage collection strategy**).
4. Measure the impact of optimizations on **execution time and memory usage**.
   Deliverables:
5. Profiled and optimized **Java application** with performance comparison charts.
6. Detailed report on **JVM tuning** and optimization strategies.

Lab Assignment 3: Implementing Multi-threading

Objective: Understand Java's concurrency model and implement multi-threading for parallel tasks.
Tasks:

1. Implement a **multi-threaded Java application** that simulates multiple tasks (e.g., processing large files, image processing).
2. Use the **Executor framework** to manage thread pools.
3. Measure the **execution time** and compare the performance of **single-threaded** vs **multi-threaded** approaches.
   Deliverables:
4. Source code for **multi-threaded application** with explanations of thread management.
5. Execution time comparison chart.

Module 2	Scalable Architectures and Microservices	Assignment	Implementation	10 Sessions

Lab Assignment 4: Building a Simple Microservice with Spring Boot

Objective: Develop a **basic microservice** with Spring Boot.
Tasks:

1. Create a **Spring Boot microservice** that provides a RESTful API (e.g., a book or customer service).
2. Implement **basic CRUD operations** (Create, Read, Update, Delete).

3. Use **Spring Data JPA** to interact with an **SQL database** (e.g., MySQL).
4. Write unit tests using **JUnit** for API endpoints.
   Deliverables:
5. Working **Spring Boot microservice** with API documentation.
6. Source code with unit tests.

Lab Assignment 5: Implementing Service Discovery & Load Balancing

Objective: Enable **service discovery** and **load balancing** using **Spring Cloud Eureka**.
Tasks:

- Set up a **Spring Cloud Eureka server** for service discovery.
- Create two **Spring Boot microservices** that register with the Eureka server.
- Implement **load balancing** with **Spring Cloud Ribbon** by making API calls to different instances of the microservices.
- Test and verify load balancing behavior using **Postman** or **curl**.
  Deliverables:
- Spring Cloud **Eureka server** and two **microservices**.
- Load balancing validation and test results.

Lab Assignment 6: Building an Event-Driven System with Kafka

Objective: Implement an **event-driven architecture** using **Apache Kafka** for inter-service communication.
Tasks:

- Set up **Apache Kafka** locally or in Docker.
- Create two Spring Boot applications: one as a **Kafka producer** and the other as a **consumer**.
- Implement asynchronous message communication where the producer sends messages (e.g., order events) and the consumer processes them.
- Add error handling and retry logic using **Spring Kafka**.
  Deliverables:
- Kafka producer and consumer applications with **message processing logic**.

- Screenshots or logs showing messages being passed from producer to consumer.

Module 3	Scalable Data Management and Caching	Mini - Project	Implementation	10 Sessions

Lab Assignment 7: Integrating SQL and NoSQL Databases

Objective: Learn to integrate **relational (SQL)** and **non-relational (NoSQL)** databases with Spring Boot applications.

Tasks:

- Integrate a **MySQL** database into a **Spring Boot microservice** and implement CRUD operations.
- Set up a **MongoDB** instance (locally or via Docker) and create a second microservice using **Spring Data MongoDB**.
- Compare the performance and scalability aspects of both databases.
  Deliverables:
- Source code for Spring Boot microservices using **MySQL** and **MongoDB**.
- Database performance comparison with benchmarks.

Lab Assignment 8: Implementing Redis Caching

Objective: Improve application performance using **Redis** as an in-memory cache.
Tasks:

1. Integrate **Redis** with your Spring Boot application.
2. Cache frequently accessed data (e.g., product information, user profiles) in Redis.
3. Implement **cache expiration** and **cache invalidation** strategies.
4. Measure the performance improvement by comparing **cache hits vs. misses**.
   Deliverables:
5. Redis-integrated Spring Boot application with caching logic.
6. Performance comparison between cached and non-cached operations.

Lab Assignment 9: Data Streaming with Kafka

Objective: Implement a **data streaming pipeline** with Kafka for real-time data processing.
Tasks:

- Build a **data pipeline** where **Kafka producers** stream events (e.g., logs, transactions) to **Kafka brokers**.
- Use **Kafka consumers** to process these events in real-time (e.g., updating a database or triggering a workflow).
- Implement **Kafka Streams** to process data within the Kafka ecosystem.
  Deliverables:
- Kafka producer-consumer setup with real-time data flow.

Module 4	Cloud Deployment and DevOps for Scalability	Quiz	Implementation	10 Sessions

Lab Assignment 10: Dockerizing a Spring Boot Application

Objective: Containerize a Spring Boot application using **Docker** for scalability.
Tasks:

- Write a **Dockerfile** for your Spring Boot application.
- Build a **Docker image** and run the application in a Docker container.
- Test the application running in the container and compare performance to local deployment.

Deliverables:

- Dockerized **Spring Boot application** with a functional test.
- Docker image and run command documentation.

Lab Assignment 11: Deploying with Kubernetes

Objective: Deploy a Spring Boot microservice to a **Kubernetes cluster** for horizontal scaling.
Tasks:

- Deploy the **Dockerized Spring Boot application** to a **Kubernetes cluster** (local Minikube or cloud-based).
- Set up **Kubernetes Pods, Services, and Deployments** to scale the microservice.
- Implement **auto-scaling** based on CPU or memory usage.

Deliverables:

- Kubernetes **deployment YAML files** for Spring Boot application.
- Running Kubernetes cluster with auto-scaling behavior.

Lab Assignment 12: Setting Up CI/CD for Scalable Applications

Objective: Automate the deployment process using **CI/CD pipelines**.
Tasks:

- Set up a **Jenkins** or **GitHub Actions** CI/CD pipeline to automate the build, test, and deployment process.
- Implement **continuous deployment** (CD) for deploying a **Dockerized microservice** to a Kubernetes cluster.
- Test the pipeline by pushing changes to a GitHub repository and triggering the deployment process automatically.

Deliverables:

- **CI/CD pipeline configuration** (Jenkins or GitHub Actions).
- Deployment automation logs and screenshots.

Targeted Application & Tools that can be used:

Applications:

The course will focus on building and scaling the following types of applications:

- **E-Commerce Platforms** – Handling high traffic, product catalogs, and real-time inventory.
- **Banking & FinTech Applications** – Secure and high-availability transactions.
- **Streaming & Event-Driven Applications** – Using Kafka for real-time data processing.
- **Social Media & Messaging Platforms** – Scalable messaging and real-time updates.
- **SaaS & Cloud-Native Applications** – Multi-tenant, API-based scalable solutions.

Tools:

Programming & Frameworks

1. **Java 17+** – Core programming language for scalable applications.
2. **Spring Boot** – Microservices development, REST APIs, and dependency injection.
3. **Spring Cloud** – Service discovery, load balancing, and resilience patterns.
4. **Quarkus** – Lightweight, high-performance microservices alternative.

Database & Caching

- **SQL Databases:** MySQL, PostgreSQL – Scalable relational data management.
- **NoSQL Databases:** MongoDB, Cassandra – High-availability distributed databases.
- **Redis / Memcached** – In-memory caching for faster response times.

Messaging & Event-Driven Architecture

- **Apache Kafka** – Real-time event streaming and asynchronous communication.
- **RabbitMQ** – Message brokering for decoupling services.
- **gRPC** – High-performance inter-service communication.

Cloud & Deployment

- **Docker** – Containerization for application portability.
- **Kubernetes** – Scaling, orchestration, and auto-recovery.
- **AWS / GCP / Azure** – Cloud deployment and auto-scaling.

CI/CD & DevOps

- **GitHub Actions / Jenkins** – Automated build and deployment pipelines.
- **Terraform** – Infrastructure as Code for cloud provisioning.
- **Helm** – Kubernetes package management for scalable applications.

Text Book(s): T1: "Spring in Action" by Craig Walls T2: "Java Performance: The Definitive Guide" by Scott Oaks T3: "Designing Data-Intensive Applications" by Martin Kleppmann T4. "Spring Microservices in Action" by John Carnell
Reference(s): 4. **"Designing Data-Intensive Applications"** – *Martin Kleppmann* 5. **"Java Performance: The Definitive Guide"** – *Scott Oaks* 6. **"Spring Microservices in Action"** – *John Carnell* 7. **"Kubernetes Up & Running"** – *Kelsey Hightower, Brendan Burns, Joe Beda*

Catalogue prepared by	
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MAT2011	**Course Title: Numerical Computation** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Calculus, Linear Algebra, Differential Equations					
Anti-requisites	**NIL**					
Course Description	The course explores mathematical techniques used to approximate solutions to complex problems that are difficult to solve analytically, often utilizing computers to perform calculations, including methods for root finding, interpolation, numerical differentiation and integration, solving systems of linear equations, and approximating solutions to differential equations, with applications across various scientific and engineering fields. It focuses on understanding the theoretical basis behind these methods, their implementation in programming languages, and analyzing their accuracy and stability.					
Course Objective	The objective of the course is to equip students with understanding and ability to					

		apply various numerical techniques to approximate solutions to complex mathematical problems that are difficult or impossible to solve analytically, particularly focusing on areas like solving systems of equations, finding roots of functions, interpolation, numerical differentiation, and integration, often utilizing computational tools to implement these methods.	
Course Out Comes		On successful completion of the course the students shall be able to: CO1 - Calculate errors induced in the values by truncation of a series expansion. CO2 - Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices. CO3 - Apply the knowledge of numerical methods in modelling of various physical and engineering phenomena. CO4 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field.	
Course Content:			
Module 1	**Solution of Linear Systems of Equation**		**(12 Classes)**
Numerical Computation: Motivation and Objectives, Number Representation, Machine Precision, Round-of Error, Truncation Error, Random Number Generation. Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving $f(x,y) = 0$ and $g(x,y) = 0$, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.			
Module 2	**Interpolation and Approximation**	**Assignment**	**(8 Classes)**
Interpolation with equal intervals, Newton's forward and backward difference formulae, Interpolation with unequal intervals, Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines, Difference operators and relations.			
Module 3	**Numerical Differentiation and Integration**		**(10 Classes)**
Numerical differentiation, Approximation of derivatives using interpolation polynomials, Numerical integration using Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Romberg's Method, Two point and three point Gaussian quadrature formulae, Evaluation of double integrals by Trapezoidal rule and Simpson's one-third rule			
Module 4	**Initial & Boundary Value Problems for Ordinary & Partial Differential Equations**	**Assignment**	**(15 Classes)**
Single step methods — Taylor's series method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order equations, Multi step methods, Milne's and Adams, Bash forth predictor corrector methods for solving first order equations. Finite difference methods for solving second order, two-point linear boundary value problems, Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain, One-dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods, One-dimensional wave equation by explicit method.			
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. 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. C.F.Gerald and P.O.Wheatley", Applied Numerical Analysis", McGraw-Hill, 1981.
2. Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998.

References:

1. SRK Iyengar & RK Jain, Numerical Methods, New Age Internationals.
2. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition
3. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

E-resources/ Web links:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727
3. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_217628
4. http://.ac.in/courses.php?disciplineID=111
5. http://www.class-central.com/subject/math(MOOCs)
6. http://academicearth.org/
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 differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

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

Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**		
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity		
Course Content:			
Module 1	INTRODUCTION TO SOFT SKILLS	**Classroom activity**	**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.

Catalogue prepared by	L&D Department Faculty members
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: MAT2501	**Course Title: Integral Transforms and Partial Differential Equations** **Type of Course:1] School Core**	**L-T- P-C**	**3**	**0**	**0**	**3**
Version No.		1.0				
Course Pre-requisites		MAT1001				
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 solutions of different 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 to **familiarize the learners with the concepts of "Transform Techniques, Partial Differential Equations"** and attain **Skill Development through Problem Solving Techniques**.				
Course Out Comes	1. 2.	On successful completion of the course the students shall be able to: CO1 - Express functions in terms of uniformly convergent Fourier series. CO2 - Apply Laplace transform technique to solve differential				

		equations. 3. CO3 - Employ Z-transform techniques to solve difference equations. 4. CO4 - Solve a variety of partial differential equations analytically.		
Course Content:				
Module 1	**Laplace Transforms**			**(12 Classes)**
Definition and Laplace transform of elementary functions. Properties of Laplace transform, and Laplace transform of periodic function, unit-step function and Impulse function – related problems. Inverse Laplace transform of standard functions - problems, initial and final value theorem. Convolution theorem, solution of linear and simultaneous differential equations and LCR Circuit.				
Module 2	**Fourier Series**		**Assignment**	**(8 Classes)**
Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.				
Module 3	**Fourier Transforms and Z - Transforms**			**(13 Classes)**
Fourier Transforms: Definitions, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms, Problems. **Difference equations and Z-transforms:** Z-transforms – Basic definitions, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Difference equations – Basic definitions, Application of Z-transforms to solve difference equations.				
Module 4	**Partial Differential Equations**		**Assignment**	**(12 Classes)**
Formation of PDE, Solution of non-homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect to one independent variable only (Both types with given set of conditions) Method of separation of variables. (First and second order equations) Solution of Lagrange's linear PDE. of the type P p + Q q = R. Applications of PDE: Derivation of one-dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two-dimensional Laplace's equation – various possible solutions. Solution of all these equations with specified boundary conditions (Boundary value problems).				
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 to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.				
Assignment:				
2. Newton-Raphson Methods, Gauss-Seidel Method, LU Decomposition, Trapezoidal Rule, Simpson's rule, Runge-Kutta 4th Order.				
Text Book 1. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 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

E-resources/ Web links:

1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_140238
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7. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_32614
8. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
9. 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 differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Catalogue prepared by		**Dr. Husna**
Recommended by the Board of Studies on		**13th BOS held on 04/01/2025**
Date of Approval by the Academic Council		**24th ACM held in 3rd August 2024**

Course Code: MAT2502	**Course Title: Numerical Methods and Complex Variables** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**0**	**0**	**3**
Version No.	2.0					
Course Pre-requisites	Calculus & Differential Equations					
Anti-requisites	**NIL**					

Course Description		Numerical methods contain solutions of system of linear equations, roots of non-linear equations, interpolation, numerical differentiation and integration. It plays an important role in solving various engineering sciences problems. Complex Variable is functions involving complex numbers as variables, exploring concepts like limits, continuity, differentiation, integration, and series within the complex plane, with a focus on key topics like Cauchy-Riemann equations, complex exponentials, contour integration, residues, and applications to solving real-world problems in physics and engineering.
Course Objective		Numerical methods is to provide approximate, yet accurate solutions to complex mathematical problems that are often difficult or impossible to solve analytically, by using computational techniques to generate solutions through iterative processes, especially when dealing with real-world scenarios involving large datasets or intricate equations. Complex variable is to study the techniques of complex variables and functions together with their derivatives, Contour integration and transformations. To study complex power series, classification of singularities, calculus of residues and its applications in the evaluation of integrals, and other concepts and properties.
Course Out Comes		On successful completion of the course the students shall be able to: CO1 - Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices. CO2 - Interpret the fitted parameters and apply curve fitting techniques to real-world data analysis problems. CO3 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field. CO4 - Apply the Cauchy-Riemann equations to identify analytic functions.
Course Content:		

Module 1	**Solution of Linear Systems of Equation**		***(10 Classes)***
Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving $f(x,y) = 0$ and $g(x,y) = 0$, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.			
Module 2	**Interpolation and Curve Fitting**	**Assignment**	***(10 Classes)***
Newton's forward and backward interpolation, Divided difference method, Lagrange's method. Method of least squares to fit equations of the form $y = ax + b$, $y = ax^2 + bx + c$, $y = ae^{bx}$, $y = ab^x$ and $y = ax^b$.			
Module 3	**Numerical Differentiation and Integration**		***(10 Classes)***
Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Gaussian quadrature rule. Solution of ordinary differential equations: Taylor series method, modified Euler's method, Runge-Kutta method for 4th order. Euler's method - Taylor's method - Runge-Kutta method of fourth order - Numerical solution of Laplace equation - One-dimensional heat flow equation and wave equation by finite difference methods.			
Module 4	**Complex Variables**	**Assignment**	***(15 Classes)***
Introduction, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; Conformal mappings.			

Complex Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Targeted Application & Tools that can be used:

Numerical methods are widely applied in various fields like engineering, physics, finance, and biology, primarily used to solve complex problems where analytical solutions are difficult or impossible to find, allowing for the approximation of solutions through computational algorithms.

Complex variable methods are applied to elliptical problems in fluid mechanics, and linear elasticity. The techniques presented for solving parabolic problems are the Laplace transform and separation of variables, illustrated for problems of heat flow and soil mechanics.

Assignment:

1. Calculate its absolute and relative errors for different input values using a numerical method like the Taylor series approximation.
2. Given sin 45° = 0.7071, sin 50° = 0.7660, sin 55° = 0.8192, sin 60° = 0.8660 find sin 57° *and sin* 52° using an appropriate interpolation formula.
3. Find the equation of the polynomial which passes through the points (4,-43), (7, 83), (9, 327), (12, 1053) using Newton's divided difference interpolation formula.

Text Book

1. Brown & Churchill, Complex Variables and Applications, McGraw Hill Higher Education; 9th edition.
2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

1. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition.
2. 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.
3. Carlos A. Berenstein & Roger Gay, Complex Variables - An Introduction, Springer-Verlag New York Inc.

E-resources/ Web links:

10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_166145
11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727
12. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224
13. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_246791
14. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_190270
15. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
16. 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 differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Course Code: MAT2602	Course Title: Numerical Computations Type of Course:1] School Core	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	MAT1001					
Anti-requisites	**NIL**					
Course Description	The course explores mathematical techniques used to approximate solutions to complex problems that are difficult to solve analytically, often utilizing computers to perform calculations, including methods for root finding, interpolation, numerical differentiation and integration, solving systems of linear equations, and approximating solutions to differential equations, with applications across various scientific and engineering fields. It focuses on understanding the theoretical basis behind these methods, their implementation in programming languages, and analyzing their accuracy and stability.					
Course Objective	The objective of the course is to equip students with understanding and ability to apply various numerical techniques to approximate solutions to complex mathematical problems that are difficult or impossible to solve analytically, particularly focusing on areas like solving systems of equations, finding roots of functions, interpolation, numerical differentiation, and integration, often utilizing computational tools to implement these methods.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 - Calculate errors induced in the values by truncation of a series expansion. CO2 - Demonstrate the applications of numerical methods to find the roots of polynomial equations and eigen values of real symmetric matrices. CO3 - Apply the knowledge of numerical methods in modelling of various physical and engineering phenomena. CO4 - Apply various numerical methods for solving linear Ordinary & Partial differential equations arising in engineering field.					
Course Content:						
Module 1	**Solution of Linear Systems of Equation**					**(12 Classes)**
Numerical Computation: Motivation and Objectives, Number Representation, Machine Precision, Round-of Error, Truncation Error, Random Number Generation. Solution of algebraic and transcendental equations: Various types of errors - Bisection method, Regula-Falsi method, Newton-Raphson method, Graffe's method - Bairstow's method - Newton's method for solving f(x,y) = 0 and g(x,y) = 0, secant method, Fixed point iteration method, Solution of linear system of equations, Gauss elimination method, Pivoting, Gauss Jordan method, Iterative methods of Gauss Jacobi and Gauss Seidel, Sufficient conditions for convergence - LU decomposition method, Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.						
Module 2	**Interpolation and Approximation**	**Assignment**				**(8 Classes)**
Interpolation with equal intervals, Newton's forward and backward difference formulae, Interpolation with unequal intervals, Lagrange's interpolation, Newton's divided difference interpolation, Cubic Splines, Difference operators and relations.						
Module 3	**Numerical Differentiation and Integration**					**(10 Classes)**
Numerical differentiation, Approximation of derivatives using interpolation polynomials, Numerical integration using Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Romberg's Method,						

	Two point and three point Gaussian quadrature formulae, Evaluation of double integrals by Trapezoidal rule and Simpson's one-third rule			
	Module 4	**Initial & Boundary Value Problems for Ordinary & Partial Differential Equations**	**Assignment**	**(15 Classes)**
	Single step methods — Taylor's series method, Modified Euler's method, Fourth order Runge-Kutta method for solving first order equations, Multi step methods, Milne's and Adams, Bash forth predictor corrector methods for solving first order equations. Finite difference methods for solving second order, two-point linear boundary value problems, Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain, One-dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods, One-dimensional wave equation by explicit method.			
	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:			
3.	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 3. C.F.Gerald and P.O.Wheatley", Applied Numerical Analysis", McGraw-Hill, 1981. 4. Cheneg and Kincaid, "Introduction to Numerical Computing", Tata McGraw-Hill, 1998.			
	References: 4. SRK Iyengar & RK Jain, Numerical Methods, New Age Internationals. 5. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 6. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.			
	E-resources/ Web links: 9. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_135224 10. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_141727 11. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_217628 12. http://.ac.in/courses.php?disciplineID=111 13. http://www.class-central.com/subject/math(MOOCs) 14. http://academicearth.org/ 15. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 16. 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 differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.			

Course Code: **CAI2500**	**Course Title: Machine Learning** **Type of Course: 1] Program Core** **2] Theory**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	MAT1003					
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 cover both the theoretical foundations as well as the essential algorithms for the various learning methods. Lectures enable the students to develop intelligent systems for real life 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: Apply advanced supervised machine learning methods for predictive modeling. [Apply] CO2: Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection [Apply] CO3: Build machine learning models with better predictive performance using Ensemble learning algorithms [Apply] CO4: Build predictive models using Perceptron learning algorithms [Apply]					
Course Content:						
Module 1	Supervised Learning	Participative Learning	Brainstorming session/Quiz	**No. of Sessions L – 10**		
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	Unsupervised Learning	Participative Learning	Brainstorming session/Quiz	**No. of Sessions L-8**
Topics: **Unsupervised Learning** – k Means clustering- simple and mini-batch**;** updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhouette coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST), Density Based Spatial Clustering – DBSCAN; Outlier Detection methods – Isolation Forest, Local Outlier Factor(LOF)				
Module 3	Ensemble Learning	Participative Learning	Brainstorming session/Quiz	**No. of Sessions L-6**
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, Stacking.				
Module 4	Perceptron Learning	Participative Learning	Brainstorming session/Quiz	**No. of Sessions L-6**
Topics: **Perceptron Learning** – from biological to artificial neurons, Perceptron, Linear Threshold Units, logical computations with Perceptron, common activation functions – sigmoid, tanh, relu and SoftMax, common loss functions, multi-layer Perceptron and the Backpropagation algorithm using Gradient Descent.				
Targeted Application & Tools that can be used: 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.				
Project work/Assignment: 1. Certification course in Machine Learning through NPTEL 2. Mini Project on (Module 1 to Module 4)				
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

References

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

Course Code: MAT2503	**Course Title: Discrete Mathematics** **Type of Course:1] School Core**	**L-T- P- C**	**3**	**1**	**0**	**4**
Version No.		1.0				
Course Pre-requisites		Linear Algebra				
Anti-requisites		**NIL**				
Course Description		The course explores the study of mathematical structures that are fundamentally discrete (not continuous), focusing on concepts like set theory, logic, graph theory, combinatorics, and number theory, with applications primarily in computer science fields like algorithms, software development, and cryptography; it covers topics such as propositional logic, proof techniques, relations, functions, counting principles, and basic graph algorithms, providing a foundation for analyzing discrete problems and structures within computer science.				
Course Objective		The main objective of the course is that students should learn a particular set of mathematical facts and how to apply them. It teaches students how to think logically and mathematically through five important themes: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, and applications and modeling. A successful discrete mathematics course should carefully blend and balance all five themes.				
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 - Deploy the counting techniques to tackle combinatorial problems CO3 - Comprehend the basic principles of set theory and different types of				

		relations. CO4 - Apply different types of structures of trees for developing programming skills	
Course Content:			
Module 1	**Fundamentals of Logic**		**(10 Classes)**
Basic Connectives and Truth Tables, Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.			
Module 2	**Principle of Counting**	**Assignment**	**(15 Classes)**
The Well Ordering Principle – Mathematical Induction The Basics of Counting, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations Advanced Principle Counting: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.			
Module 3	**Relations and Functions**		**(10 Classes)**
Cartesian Products and Relations, Functions, One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions. Relations, Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders, Lattice, Hasse Diagrams, Equivalence Relations and Partitions.			
Module 4	**Recurrence Relations and Generating Functions**		**(10 Classes)**
Homogeneous and inhomogeneous recurrences and their solutions - solving recurrences using generating functions - Repertoire method - Perturbation method - Convolutions - simple manipulations and tricks.			
Module 5	**Graph Theory & Algorithms on Networks**	**Assignment**	**(15 Classes)**
Definitions and basic results - Representation of a graph by a matrix and adjacency list - Trees - Cycles - Properties - Paths and connectedness - Sub graphs - Graph Isomorphism - Operations on graphs - Vertex and edge cuts - Vertex and edge connectivity, Euler and Hamilton Paths, Shortest-Paths. Tree - Definitions, Properties, and Examples, Routed Trees, Binary search tree, Decision tree, spanning tree: BFS, DFS. Algorithms on Networks - Shortest path algorithm- Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm.			
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.			
Assignment:			
4. Assignment 1: Logic Equivalences and Predicate calculus.			
5. Assignment 2: Equivalence Relations and Lattices			
6. Assignment 3: Recurrence Relations			
Text Book 1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill,s 8th Edition,2019. 2. Harary – Graph Theory, Addison-Wesley Publishing Company.			
References: 1. Arthur Gill, "Applied Algebra for Computer Science", Prentice Hall. 2. K.D. Joshi, "Discrete Mathematics", Wiley Eastern Ltd. 3. Ralph. P. Grimaldi., "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition,			

Pearson Education Asia.

E-resources/ Web links:

17. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_54588
18. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_375
19. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html
20. https://www.scu.edu.au/study-at-scu/units/math1005/2022/
21.

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.

Course Code: **CAI2501**	**Course Title: Machine Learning Lab** **Type of Course: 1] Program Core** **2] Laboratory**	0	0	4	2
Version No.	1.0				
Course Pre-requisites	CSE1500				
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 cover both the theoretical foundations as well as the essential algorithms for the various learning methods. Lab sessions complement the lectures and enable the students to develop intelligent systems for real life 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: Apply advanced supervised machine learning methods for predictive modeling. [Apply] CO2: Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection [Apply] CO3: Build machine learning models with better predictive performance using Ensemble learning algorithms [Apply] CO4: Build predictive models using Perceptron learning algorithms [Apply]

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, Word Cloud

Experiment No. 3: Regression learning
Level 1: Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the model's 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 based classification model.
Level 2: Given data sets from UCI repository, implement a non-linear SVM based classification model.

Experiment No. 7: Unsupervised Learning
Level 1: K–means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhouette Coefficient. Compare the inertia of both as k increases. Tuning the hyperparameter 'k' using GridSearchCV.
Level 2: Using clustering for Image segmentation and Preprocessing. Kmeans++

Experiment No. 8: Density Based Clustering
Level 1: Implement DBSCAN – clustering using the local density estimation.

Level 2: Perform hard and soft clustering for new instances.

Experiment No. 9: Ensemble Learning using Subset of Instances
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. 10: Ensemble Learning using Subset of Features
Level 1: Apply ensemble learning techniques such as AdaBoost and Gradient Boosting **Level 2:** Apply ensemble learning techniques such as Stacking

Experiment No. 11: Perceptron Learning
Level 1: Implement the Perceptron Classifier
Level 2: – An Image Classifier Using the Sequential API of Keras

Experiment No. 12: Outlier Detection
Level 1 Outlier Detection using Isolation Forest
Level 2: Outlier Detection using 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:
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.
Textbook s 2. Aurélien Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Oreilly, Second Edition, 2019. 3. 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 1. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017

Course Code: CAI2504	**Course Title: Natural Language Processing** **Type of Course: Program Core - Theory**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE1700					
Anti-requisites	NIL					
Course Description	This course introduces the basics of Natural Language Processing methods with specific emphasis on modern applications. The course will teach students different concepts of natural language processing, such as word representations, text representations, part-of-speech tagging, word sense disambiguation, parsing, etc.					

	Topics: Word representations, Part-of-Speech tagging, chunking, parsing, text classification, sentiment analysis, named entity recognition, and machine translation.
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 19. Define different problems related to natural language processing. [Understand] 20. Discuss using NLP techniques for different applications. [Apply] 21. Propose solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply] 22. Learn to use different NLP tools and packages. [Apply]

Course Content:

Module 1	**Introduction to Natural Language Processing**	**Assignment**	**Case Study on Text Classification**	**No. of sessions: 08**
Definition of Natural Language Processing; Overview of various NLP tasks; Sentence and word boundary detection; Introduction to word representation, PoS tagging, Chunking and Parsing, and text classification; Applications of NLP (Sentiment Analysis, Named Entity Recognition, Machine Translation).				
Module 2	**Word and Text Representation**	**Hands-on coding**	**Implementing and Comparing Word Embeddings**	**No. of sessions: 08**
Introduction to Word Embeddings; Creation of word embeddings using Skipgram; Using word embeddings like GloVe / fastText; Cross-lingual word embeddings (e.g., MUSE); Pre-trained monolingual and multilingual language models; Text representations using BoW, feature-based, kernel, and embedding-based representations;				
Module 3	**Part-of-Speech Tagging, Chunking and Parsing**	**Hands-on coding**	**Implementing PoS Tagging and Parsing**	**No. of sessions: 08**
Sequence Labeling and Hidden Markov Model; Viterbi Algorithm; Part-of-Speech Tagging; Using NLTK and Spacy for PoS Tagging; Building a PoS Tagger; Chunking and Constituency Parsing; Using Parser from NLTK; Introduction to Transformer Models (Basic concept of BERT and its applications in NLP).				
Module 4	**NLP**	**Assignment**	**NLP Applications**	**No. of**

	Applications and Ethical AI		**and Ethical AI**	**Sessions : 06**

Lexical Resource Creation – Creation and evaluation. Agreement metrics; Sentiment Analysis – Definitions, Challenges (Sarcasm, Thwarting, etc.); Named-Entity Recognition – Definition, Relationship between NER and PoS tagging; Machine Translation – Definition, Challenges, Approaches and Paradigms, Evaluation Techniques. Ethical NLP & Bias in AI.

Targeted Application & Tools that can be used:

11. Execution of the NLP task will be done using the Google's cloud service namely "Colab", available at https://colab.research.google.com/, Anaconda Navigator.
12. Laboratory tasks will be implemented using the libraries available in Python such as NLTK, Gensim, Spacy and Huggingface Transformers.

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

2. Group project on some NLP Task like text classification (Creating a Simple Text Classifier: Use Scikit-learn to classify positive vs. negative reviews from a dataset), sentiment analysis, etc.

Textbook(s):

5. Daniel Jurafsky, James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech, Pearson Publication, 2024 (3rd Edition Draft).
6. Aditya Joshi, Pushpak Bhattacharyya. "Natural Language Processing", Wiley Publication, 2023 (1st Edition).

References:

R1. Chris Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", 1st Edition, MIT Press. 1999.
R2. Pawan Goyal. "Natural Language Processing". 1st Edition, 2016.

Weblinks

W1. E-Book link or R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBgAvLd1WscI0RqC/view
W2. Web Resource for T1: https://web.stanford.edu/~jurafsky/slp3/ - VERY VERY IMPORTANT!!!
W3. NPTEL Courses: https://nptel.ac.in/courses/106106211 CMI), https://nptel.ac.in/courses/106105158 (IIT Kgp), https://nptel.ac.in/courses/106101007 (IITB), https://nptel.ac.in/courses/106105572 (IIT Kgp - NEW)

Course Code:	**Course Title: Cryptography and Network**	**L- T-P- C**	3	0		3

CSE2502	**Security** **Type of Course: Program Core & Theory only**				0	
Version No.		1				
Course Pre-requisites		CSE2251 – Data Communications and Computer Networks				
Anti-requisites		**NIL**				
Course Description	The Course covers the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet. **Topics**: The cryptographic tools such as shared key encryption, public key encryption, key exchange, and digital signature are explored. The use and utilization of the internet protocols and applications such as SSL/ TLS, IPSEC, Kerberos, PGP, and S/ MIME, SET are reviewed. System security issues such as viruses, intrusion and firewalls are also explored.					
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: **CO1:** Identifies the basic concept of Cryptography **(Knowledge)** **CO2:** Express the different types of Cryptographic Algorithms. **(Comprehension)** **CO3:** Recognize the Public key Cryptographic Techniques for various applications. **(Comprehension)** **CO4:** Apply the network security concepts during their implementation of network security application developments. **(Application)**					
Course Content:						
Module 1	**Introduction to Cryptography**	Assignment	Identify the Concepts		08 Sessions	
Topics: Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: active attacks, passive attacks, services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution Ciphers : Caesar, Mono alphabetic, Polyalphabetic, Play-fair and Hill Cipher, Introduction to Block Cipher and Stream Cipher, Festal Structure.						
Module 2	**Private Key Cryptography and Number Theory**	Assignment	Analysis of requirement of complexity in cryptography		13 Sessions	
Topics:						

Symmetric Encryption Algorithms : Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, brief about primality testing and factorization, Discrete Logarithmic Problem, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese Remainder Theorem				
Module 3	**Public Key Cryptography and its Applications**	Assignment	Recognize the importance of various security concepts to achieve sufficient solutions	10 Sessions
	Topics: Overview of Public Key Cryptography, RSA, Diffie - Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Discussion on real time practices of Cryptography.			
Module 4	**Network Security**	Assignment	Implement the advanced network security algorithms in recent applications.	07 Sessions
Topics: Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IP Sec architecture, Network Security applications: Web Security.				
Targeted Application & Tools that can be used: Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.				
Assignment:				
Assignment 1: Solve the problems of basic encryption techniques. **Assignment 2:** Solve and analyze the problems on symmetric and asymmetric encryption.				
Textbooks: 1.William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall, 8th Edition, 2019. 2. Wade Trappe and Lawrence C Washington, "Introduction to Cryptography with Coding Theory", Pearson, 2020. **Reference Books:** 1.Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, third edition, 2010. 2. R.Rajaram, "Network Security and Cryptography" SciTech Publication.3rd Edition, 2014. 3. AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2nd Edition, 2019. 4. BruceSchneier, "Applied Cryptography", John Wiley and Sons Inc. Second Edition, 2015.				
Web references:				

1.https://onlinecourses.nptel.ac.in/noc22_cs90/preview 2.e-pgpathshala UGC lecture series : E-Series and Self learning Materials. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ== 3. http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=10133&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security 4.http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5875&query_desc=kw%2Cwrdl%3A%20Cryptography%20and%20Network%20Security.
Topics relevant to "Skill Development": Symmetric and Asymmetric Encryption Algorithms and its problems.

Course Code: **CSE1500**	**Course Title: Computational Thinking Using Python** **Type of Course: Integrated**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces students to the essential skills of **computational thinking** and their practical application through the **Python programming language**. By combining problem-solving strategies with coding, students will learn to decompose complex challenges, identify patterns, abstract general principles, and design algorithms to build functional programs					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computational Thinking and use the Computational Thinking Principles to solve the computational Problems using Python Language					
Course Outcomes	Upon successful completion of this course, students will be able to: • Explain and apply the core principles of **computational thinking**: o Decomposition o Pattern Recognition o Abstraction o Algorithm Design • Use **Python** to implement solutions to real-world problems.					

	• Write and debug Python code using functions, loops and conditions • Design simple programs and algorithms to automate repetitive or complex tasks. • Collaborate effectively and communicate problem-solving approaches using pseudocode and Python.			
Course Content:				
Module 1	**Pillars of Computational Thinking**	Comprehension		**9 Sessions**
What is computational thinking? Why is it important? Pillars of computational thinking: decomposition; pattern recognition; data representation and abstraction; algorithms Applying computational thinking to case studies				
Module 2	**Algorithm Design & Problem-Solving Strategies**	Application		**9 Sessions**
Introduction to Algorithms, Introduction to Problem Solving techniques: Brute Force, Divide and conquer, Common algorithms: find-max, linear search, binary search and other simple Algorithms				
Module 3	**Applied Computational Thinking using Python**	Application		**12 Sessions**
Introduction to Python, Data representation: variables, lists, Conditionals, Loops and Iteration Basic Example programs to illustrate the programming constructs				
Targeted Application & Tools that can be used: **Google Colab, Python**				
Text Book 1. "Computational Thinking for the Modern Problem Solver" – David D. Riley & Kenny A. Hunt 2. "Mastering Python 3 Programming: Ultimate Guide to Learn Python Coding Fundamentals and Real-World Applications" Subburaj Ramaswamy, BPB publications				

References

1. **Sweigart, Al.**
Automate the Boring Stuff with Python: Practical Programming for Total Beginners.
No Starch Press, 2015.
https://automatetheboringstuff.com

Severance, Charles.
Python for Everybody: Exploring Data Using Python 3.
CreateSpace Independent Publishing, 2016.
https://www.py4e.com

Wing, Jeannette M.
"Computational Thinking." *Communications of the ACM*, vol. 49, no. 3, 2006, pp. 33–35.
https://doi.org/10.1145/1118178.1118215

Downey, Allen B.
Think Python: How to Think Like a Computer Scientist.
Green Tea Press, 2015.
http://greenteapress.com/wp/think-python-2e/

.

E-Resources

https://edu.google.com/resources/programs/exploring-computational-thinking

Topics relevant to "SKILL DEVELOPMENT": Decomposition, Abstraction, Pattern recognition, Data Representation ,Algorithms

Course Code:	Course Title: Operating Systems Lab	L-T- P- C	0	0	2	1

CSE2270	**Type of Course: Lab**					
Version No.	1.0					
Course Pre-requisites	CSE2501					
Anti-requisites	**NIL**					
Course Description	This laboratory course provides hands-on experience with the core concepts of operating systems through practical assignments, simulations, and case studies. It covers foundational aspects such as system calls, process and thread management, inter-process communication, synchronization, deadlocks, memory management, and file systems. Students will implement and simulate real-time OS components and scheduling algorithms, fostering deeper understanding of OS architecture and design. The lab also introduces modern OS tools, programming interfaces, and the basics of open-source OS environments.					
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] Demonstrate system-level programming using system calls and OS structures. [**Apply**] 2] Simulate process scheduling and multithreading techniques. [**Apply**] 3] Apply various tools to handle synchronization problems using semaphores and shared memory. [**Apply**] 4] Demonstrate memory management and file system concepts using simulation or scripting. **[Apply]**					
Course Content:						
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:

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.

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.

List of Laboratory Tasks:

Lab sheet -1

L1: Write a program to demonstrate the use of fork() and exec() system calls in process creation.

L2: A system has limited memory and high-priority real-time processes. Design a scheduling algorithm that ensures responsiveness while preventing starvation.

Lab sheet -2

L1: Implement First-Come-First-Serve (FCFS) process scheduling using C or Python.

L2: You are designing a server that handles thousands of client connections. Compare multithreading and multiprocessing for this task and implement a basic server model.

Lab sheet -3

L1: Implement Round Robin Scheduling with a fixed time quantum.

L2: In a banking system, concurrent access to accounts leads to data corruption. Design a synchronization solution to avoid race conditions.

Lab sheet -4

L1: Write a program to create threads using Pthreads or Python's threading module.

L2: You're tasked with building a file access tracker in an OS. Implement a system to log file access patterns and identify frequent accesses.

Lab sheet -5

L1: Demonstrate inter-process communication (IPC) using pipes.

L2: A simulation tool needs to emulate process suspension and resumption. Design and implement such a mechanism using signals or condition variables.

Lab sheet -6

L1: Simulate the Producer-Consumer problem using semaphores.
L2: You're developing a system where sensor devices (producers) generate temperature readings, and data processors (consumers) store and process these readings. To prevent race conditions and ensure buffer safety, implement a synchronization mechanism using semaphores.

Lab sheet -7

L1: Implement Dining Philosophers Problem using threads and synchronization.
L2: In a multi-threaded cafeteria simulation, five philosophers sit around a circular table, each alternating between thinking and eating. To eat, a philosopher must hold two forks (represented by shared resources). Your task is to avoid deadlock and ensure no philosopher starves using thread synchronization techniques.

Lab sheet -8

L1: Write a program to simulate First Fit, Best Fit, and Worst Fit memory allocation strategies.
L2: A system with limited memory blocks needs to allocate memory to processes arriving with various size requests. Your task is to implement three classic memory allocation strategies—First Fit, Best Fit, and Worst Fit—to allocate memory to each process efficiently. Simulate and compare how memory gets allocated in each strateg

Lab sheet -9

L1: Demonstrate paging using a simple page table simulation.
L2: A program has a logical address space divided into pages. The system's memory is divided into equal-sized frames. When a program executes, its pages are loaded into available frames in main memory. Simulate the address translation process using a page table and demonstrate how a logical address is converted to a physical address.

Lab sheet -10

L1: Write a program to simulate page replacement algorithms like FIFO and LRU.
L2: In a virtual memory system, a process accesses pages in a specific order. The memory can only hold a limited number of pages (frames). When a page is needed and the memory is full, a page replacement algorithm is used to decide which page to evict. Simulate and compare FIFO and LRU algorithms for a given page reference string.

Lab sheet -11

L1: Simulate file directory structure (single level/two level).
L2: A university campus computer lab has limited memory space available for each student login session. When students open files or run programs, memory pages are

loaded into available memory frames. Due to the limited number of frames, some pages must be replaced when new ones are needed. The lab system uses page replacement algorithms to decide which pages to evict when memory is full..

Lab sheet -12

L1: Write a shell script to demonstrate file handling commands in Linux.
L2: Design a command-line mini shell that can run background and foreground processes and handle basic built-in commands like cd, pwd, exit.

Project work/Assignment

Demonstrate process concepts in LINUX OS.

Simulation of CPU scheduling algorithms.

Develop program to demonstrate use of Semaphores in threads.

Develop program to demonstrate use of deadlock avoidance algorithms.

Develop program to demonstrate use of page replacement algorithms.

Simulation of memory allocation strategies [first fit, best fit and worst fit].

Text Book

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

References

Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 10th edition Wiley, 2018.

William Stallings, “Operating Systems”,Ninth Edition, By Pearson Paperback ,1 March 2018.

Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, “ Cracking the Operating System skills”, Dreamtech, paperback, 2020

Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , “Operating Systems: Three Easy Pieces, Amazon digital Services”, September 2018.

E-resources/Weblinks

https://www.os-book.com/OS9/

https://pages.cs.wisc.edu/~remzi/OSTEP/

https://codex.cs.yale.edu/avi/os-book/OS10/index.html

Course Code: CSE3412	**Course Title:** Data Mining **Type of Course: Discipline** Elective/ Theory Only Course	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**Students are expected to be familiar with the basics of Linear Algebra, Probability and Statistics and should have a knowledge on DBMS.**					
Anti-requisites	**NIL**					
Course Description	Introduction, Applications, issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, different approaches for classification, clustering, outlier detection. Recent trends in data mining.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data Mining** and attain **Employability** through **Problem Solving** Methodologies			
Course Out Comes	**On successful completion of the course the students shall be able to:** • Apply the various pre-processing techniques needed for a data mining task. • Understand the functionality of the various data mining algorithms. • Appreciate the strengths and limitations of various data mining models. • Understand the advances in data mining for real life applications.			
Course Content:				
Module 1	**Introduction to Data Mining**	Assignment	Data Collection	**5 Sessions**
Topics: Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Merits and Demerits.				
Module 2	**Data preprocessing**	Quiz	Problem Solving	**9 Sessions**
Topics: Types of data – Pre Processing steps – Data Preprocessing Techniques – Similarity and Dissimilarity measures.				
Module 3	**Data Mining – Frequent Patterns**	Assignment	Problem Solving	**7 Sessions**
Topics: Market Basket Analysis, item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FPGrowth.				
Module 4	**Classification and clustering**	Assignment	Problem Solving	**11 Sessions**
Classification and Clustering Decision tree Induction – Bayesian classification –Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods – Density based method				
Module 5	**Outlier detection & Data mining trends**	Assignment	Problem Solving	**5 Sessions**
Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining- Demonstration of Weka tool.				
Project work/Assignment:				
Assignments 1. From the dataset given, find the Entropy, Gain value of the attributes and also draw the decision tree using entropy for the given dataset. 2. Transactional Data Base, D given below which contains set of items find the frequent item set using the Apriori Algorithm and generate the Association Rules. Minimum Support count is 2%.				

Minimum confidence is 60%.

T_{id}	Items
10	1, 3, 4
20	2, 3, 5
30	1, 2, 3, 5
40	2, 5

Text Book

T1 T1. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining" ,Pearson Education, 2016.

References

R1 *Han J & Kamber M, "Data Mining: Concepts and Techniques", Elsevier, Second Edition, 2006*

R2 *G K Gupta, "Introduction to Data Mining with Case Studies", PHI, Third Edition, 2014.*

R3 *Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill*

Additional web-based resources

W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012.

W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk

3. https://nptel.ac.in/courses/105105157

Topics relevant to "EMPLOYABILITY SKILLS": Data Mining Techniques, FP Growth for developing **Employability Skills** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: COM3405	**Course Title:** **Bioinformatics** **Type of Course:** **General** CSE Basket, **Theory based**	**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	NIL					
Course Description	This course is designed to provide the knowledge of the concepts related to bioinformatics. The course is aimed at understanding the					

	DNA and Protein sequences and databases. It also deals with Pairwise comparison and calculating the scoring matrix. Further, it focuses on Sequence Alignment techniques, discovering the Motifs in the sequence. Students will also learn the overview of Structural Bioinformatics and Genome sequencing.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Introduction to Bioinformatics** and attain **Employability** through **Participative Learning** techniques.			
Course Outcomes	**C.O.1:** Understand the DNA Protein sequence and structures. (Bloom's Level: **Knowledge)** **C.O.2:** Explain the file formats and sequence alignments of DNA sequence. (Bloom's Level: **Comprehension)** **C.O.3:** Apply the techniques of the motifs discovery for the analysis of Protein Sequence. (Bloom's Level: **Application)**			
Course Content:				
Module 1	**Fundamentals of Bioinformatics**	Quiz	Comprehension based Quizzes and assignments;	**9 Classes**
Topics: **Introduction to Bioinformatics**: Introduction to molecular biology, Cell, DNA, RNA, Transcription, Translation, Folding, Gene Structure, Introduction to Bioinformatics, Components and fields of bioinformatics, Omics, basic principles of structural/functional analysis of biological molecules, Biological Data Acquisition, Types of DNA sequences,Genomic DNA,Mitochondrial DNA,DNA Sequencing tools, Protein sequencing and structure determination methods, Finding Reverse complement of a sequence.				
Module 2	**Genome databases and Sequence Similarity**	Quizzes and assignments	Comprehension based Quizzes and assignments	**8 Classes**
Topics: Types and classification of genome databases, DNA sequence retrieval system, various DNA and protein sequence file formats, Common sequence file formats; Files for multiple sequence alignment; Files for structural data, Frequent words and k-mers in Text, String Reconstruction problem, Sequence Similarity searching, Sequence Similarity searching tools, NCBI BLAST, PSI BLAST, Significance of sequence alignments, Alignment scores and gap penalties.				
Module 3	**DNA sequence analysis and applications**	Quizzes and assignments	Comprehension based Quizzes and assignments	**10 Classes**
Sequence similarity searches and alignment tools, Finding alignment using Needleman-Wunsch and Smith-Waterman algorithm, Heuristic Methods of sequence alignment, Pair-wise and multiple sequence alignments, DNA sequence analysis, Motif in protein sequence ,Motif discovery using Gibbs sampling,Motif finding, Gene Prediction models: Hidden Markov model(HMM), Generalized Hidden Markov model(GHMM), Bayesian method.				

Targeted Application & Tools that can be used: BLAST, FastA, , ClustalW, MEGA
Project work/Assignment:
Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments
Textbook(s): 1. Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2004. 2. Introduction to Bioinformatics, Arthur Lesk, Fifth Edition, Oxford University Press, 2019
References 1. Bioinformatics Methods and Applications, S. C. Rastogi, N.Mendiratta, P.Rastogi, Fourth Edition, Prentice Hall India. 2.Bioinformatics Algorithms- An Active Learning Approach, Phillip Compeau & Pavel Pevzner, 2nd Edition, Vol. I & II, Active Learning Publishers, 2015 E-References 1. https://puniversity.informaticsglobal.com:2229/login.aspx
Topics related to development of "Employability skills": Batch wise presentations on selected topics 1. String Reconstruction problem 2. Sequence Similarity searching 3. Alignment scores and gap penalties 4. Protein sequencing 5. Gene Prediction models: Hidden Markov model(HMM) 6. Finding similarities by performing pairwise and multiple sequence alignment, 7. Evaluating phylogenetic trees. for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: **PPS3026**	Course Title: Industry Readiness Program	L- T - P- C	2	0	0	0
Version No.	1.0					

Course Pre-requisites	--
Anti-requisites	NIL
Course Description	This course is designed to develop to train future Design engineers and managers to be corporate ready. The modules are set to improve self-confidence, Communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in making impactful Portfolio and resumes, prepare for lively, meaningful and productive group discussions and crack interviews.
Course Objective	**The objective of the course is to familiarize the learners with the concepts of "Industry Readiness for Young Professionals" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: Prepare professional Portfolio and Resumes . CO2: Present Portfolio effectively CO3: Apply skills and knowledge learnt for active and effective Group Discussions. CO4: Show Interview Readiness
Course Content	

Module 1	**Portfolio and Resume Building**	Classroom activities	**10 Hours**

Topics: Preparing Portfolio, Presenting their work, Sharing formats of resumes, keywords to be discussed, tips on making smart video resumes. Creating impressions through resumes, Customization, list of common mistakes, Cover letter. **Activity:** Resume building exercise			
Module 2	**Group Discussion**	Group Activity	**10 Hours**
Topics: Group discussion as a placement process, GD techniques like Keyword. SPELT & POV of affected parties. Do & Don't of GD, Case-lets and topics for GD, practice session and evaluation **Activity:** Student group activity to build confidence			
Module 3	**Personal Interview**	Mock Interview	**10 Hours**
Topics: Role Play in interviews and constructive feedback, Stress Interviews, guesstimation. Do's and Don'ts'. Grooming as an integral part. Telephonic Interview and Virtual Interview, Mind Calming Interview Techniques. **Activity:** Mock interview and virtual interview			
Faculty : L&D			
Targeted Application & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Activities			
Assignment proposed for this course Assignment 1: Physical resume submission Assignment 2: Team formation for GD			
Continuous Individual Assessment Module 1: Submit physical resume Module 2: Mock GD assessment Module 3: Individual PI Assessment			

The topics related to skill development:

Art Of Presentation and Group Discussion for Skill Development through Participative Learning Techniques. This is attained through assessment Component mentioned in course handout.

Course Code: CSE2257	**Course Title: Computer Organization and Architecture**	**L - T - - P - C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	CSE2015					
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 Code: CAI3411	**Course Title:** Generative AI **Type of Course:** Theory	**L-T-P-C**	**2**	**0**	**2**	**3**
Version No.	1.0					
Course Pre-requisites	CSE2264					

Anti-requisites		NIL
Course Description		This course builds the foundational insight of understanding generative AI models and to explore various architectures, algorithms and practices of Gen AI skills to accelerate strategic decision making with data and deliver cutting-edge products faster with GenAI-augmented software development and leverage Gen AI tools to optimize workflows.
Course Objective		The objective of the course is to familiarize the learners to explore the competence in benchmarking and comprehend the potential generative AI models and techniques to revolutionize industries and create prominent Gen AI tools to attain **Employability Skills** through **Experiential Learning** techniques.
Course Out Comes		**On successful completion of the course the students shall be able to:** CO 1: Infer the concepts of generative AI models and prompt engineering in tailoring customized outputs [Understand]. CO 2: Demonstrate attention mechanism and transformers architecture with practical Applications. [Apply]. CO 3: Practice advanced generative AI techniques using Langchain Python framework [Apply]. CO 4: Solve real-time applications using multi-modal generative AI models [Apply].
Course Content:		

Module 1	Introduction to Generative AI	Participative Learning		Brainstorming session/Quiz	**No. of classes L-6 P-8**
	Topics: Introduction to Generative models: Historical perspective and evolution, Applications, Types of Generative models for different data modalities, Large Language Models (LLMs) – Introduction, evolution, Generative pre-trained transformers (GPT) and its variants, Google DeepMind's, PaLM2, LLaMa and its series of models by Meta AI, Claud and its variants by Anthropic, Prompt Engineering-basic prompting.				
Module 2	Text-based Generative models	Participative Learning		Fish bowl, Think-pair & share	**No. of classes L-8 P-6**
	Topics: Text-based Generative models: State-of-the Art models, RNN, LSTM, Transformer Architecture, Transformer based Generative models: BERT, GPT, Training and Fine tuning LLMs for Generative task, Open AI's Pre-trained transformers for Text Generation: ChatGPTs, Limitations of LLMs: Lack of context and Hallucination risks, Techniques to mitigate these limitations: chaining and retrieval augmentation, Workflow of an LLM application.				
Module 3	Introduction to Lang Chain	Experiential Learning		Implementation of Gen AI models using Langchain Framework	**No. of classes L-8 P-8**
	Topics: Introduction to Lang chain: Types, Components, Information retrieval using agents and tools in Lang chain, Retrieval Augmented Language Models (RaLM): Understanding Retrieval and vectors: Embeddings, Vector storage, Vector indexing, Vector Libraries, Vector Databases, Chatbot using memory and conversation buffer.				
Module 4	Generative models for other Data modalities	Project-based Learning		Multi-Modal Gen AI models for Realtime Applications	**No. of classes L-8 P-8**
	Topics: Generative Adversarial Networks (GAN): GAN Architecture, GAN variants, Neural Style				

	transfer with GAN, Training GANs and common challenges, GAN applications in image and text generation, Variational Auto Encoders (VAEs) and its variants, Image generation models: Dall-E, MidJourney and stable diffusion: Architecture and components of stable diffusion, Text-to-image Generation, Parameter tuning, Image-to-image generation, Training custom models, In-Painting: Exchanging classes, Multi-modal generative models using Whisper for Audio: Speech-to-Text generation.
	Project work/Assignment:
	1. Certification course in Generative AI through Google 2. Mini Project on (Module 3 and Module 4)
	Targeted Application & Tools that can be used Open AI Generative AI models: GPT 3.5 Turbo, GPT 4.0 vision model, Dall-E 3.0, Lang Chain Framework in Python, Python IDE, Stable Diffusion, Gemini, Hugging Face,
	Text Books: **T1:** Generative AI with LangChain, Ist Edition by Ben Auffarth, Packt. Inc. ISBN: 978-1-83508-346-8, Decemeber 2023. **T2**: Generative Deep Learning, 2nd Edition by David Foster, O'Reilly Media, Inc. ISBN: 9781098134181, May 2023. **T3:** Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, O'Reilly Media, Inc., ISBN:9781098153373, July 2024.
	Reference Books: R1. Bandi, A., Adapa, P. V. S. R., & Kuchi, Y. E. V. P. K. (2023). The power of Generative AI: a review of requirements, models, Input–Output formats, evaluation metrics, and challenges. Future Internet, 15(8), 260. https://doi.org/10.3390/fi15080260 R2. Barachini, F., & Stary, C. (2022). From digital twins to digital selves and beyond. In Springer eBooks. https://doi.org/10.1007/978-3-030-96412-2 R3. Hadi, M. U., Tashi, Q. A., Qureshi, R., Shah, A., Muneer, A., Irfan, M., Zafar, A., Shaikh, M. B., Akhtar, N., Wu, J., & Mirjalili, R4. S. (2023). Large Language Models: A Comprehensive Survey of its Applications, Challenges, Limitations, and Future Prospects. https://doi.org/10.36227/techrxiv.23589741.v4 R4. Hai-Jew, S. (n.d.). Generative AI in Teaching and Learning. IGI Global. R5. Salvaris, M., Dean, D., & Tok, W. H. (2018). Generative adversarial networks. In Apress eBooks (pp. 187–208). https://doi.org/10.1007/978-1-4842-3679-6_8
	MOOC's/Swayam Courses/Online Courses: h https://onlinecourses.swayam2.ac.in/imb24_mg116/preview **Certification Course by Google :** 1. https://www.cloudskillsboost.google a. Introduction to Generative AI (Beginner) b. Gemini for Google Cloud (Intermediate) c. Generative AI for Developers (Advanced) 2. https://www.credly.com/badges/90e3eae0-87f3-44e3-af82-658e837aad3d/public_url 3. https://www.coursera.org/learn/generative-ai-with-llms 4. https://www.coursera.org/specializations/prompt-engineering **ONLINE RESOURCES:** W1. https://openai.com

	W2: https://python.langchain.com/v0.2/docs/introduction/ W3: https://www.udemy.com/course/master-ai-image-generation-using-stable- diffusion/?kw=Image+generation+using&src=sac&couponCode=LETSLEARNNOWPP W4: https://huggingface.co/google-t5/t5-base W5: https://dominguezdaniel.medium.com/exploring-image-generative-ai-models-9359705b15d3 W6: https://cloud.google.com/use-cases/retrieval-augmented-generation?hl=en# W7: https://ig.ft.com/generative-ai/ W8: https://medium.com/@samia.khalid/bert-explained-a-complete-guide-with-theory-and-tutorial-3ac9ebc8fa7c
	Topics relevant to "EMPLOYABILITY SKILLS": Topics of all four modules will help in developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: FIN1002	**Course Title:** **Managerial Economics and Financial Accounting & Analysis**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	--					
Anti-requisites	**Nil**					
Course Description	The Course is conceptual and quantitative in nature, the economics concepts will help the students to gain insight about the basic aspects of economics such as Lw, Supply, Demand, Cost. The Financial Account portion will introduce the students to basic concepts of accounting.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the Basic concepts of Managerial Economics CO2: Recognize the type of production function and cost analysis CO3: Outline the principles of Accounting					

	CO4: Illustrate the Analysis of Financial statements			
Course objective	The objective of the course is to familiarize the learners with the concepts of Managerial Economics and attain Skill Development through Participative Learning techniques.			
Course Content:				
Module 1	**Introduction to Managerial Economics**	**Class presentation**	**Class presentation**	**10 Sessions**
Topics: Definition, Nature and Scope of Managerial Economics, factors influencing managerial decision making process. Demand Analysis – Definition, types, Significance of Elasticity of Demand. Law of Supply, Elasticity of Supply, Equilibrium between Demand and Supply.				
Module 2	**Theory of Production and Cost Analysis**	**Class presentation**	**Class presentation**	**11 Sessions**
Topics: Production function – Isoquants and Iso costs, MRTS, Least cost combination of inputs, Law of variable proportion, Cobb – Douglas Production function, Laws of Returns, Internal and External economies of scale. Cost Analysis – Types of Cost, Concept of revenue, Total, average and marginal revenue, determination of breakeven point (simple numerical problem, Managerial significance and limitation of BEA.				
Module 3	**Introduction to Financial Accounting**	**Numerical**	**Numerical**	**10 Sessions**
Topics: Accounting principles, concepts and conventions, double entry book keeping, journal, ledger, Trial balance.				
Module 4	**Preparation and Analysis of Financial statements**	**Numerical**	**Numerical**	**10 Sessions**
Topics: Final Accounts, Trading Account, Profit and Loss Account, Balance sheet with simple adjustments, Financial Statement Analysis (Comparative and Common size statements) – Ratio Analysis (Liquidity Ratio, Activity Ratios, Solvency and Profitability ratios)				
Targeted Application & Tools that can be used: PPT, Videos and board & Chalk Method				
Reference **Text book** 1. C.B.Gupta, Management Theory & Practice - Sultan Chand & Sons -NewDelhi 2. L.M.Prasad, Principles & Practice of Management - Sultan Chand & Sons – New				
Reference Dr. S.Shankaran, Managerial Economics - Margram Publication -Chennai P.L Metha, Managerial Economics - Sultan Chand Publications -NewDelhi **PU library link** https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/eb039157/full/html **NPTEL Course** https://onlinecourses.nptel.ac.in/noc22_mg43/preview				
Topics relevant to development of "SKILL DEVELOPMENT": **Break Even Analysis** for **Skill Development through Participative Learning Techniques.** This is attained through assessment component mentioned in course handout.				

Course Code: PPS 1001	**Course Title: Introduction to Soft Skills** **Type of Course: Practical Only Course**	L- P- C	0	2	1
Version No.	1.0				
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.				
Anti-requisites	NIL				
Course Description	This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.				
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.**				
Course Out Comes	**On successful completion of this course the students shall be able to:** CO1: **Recognize** significance of soft skills CO2: **Illustrate** effective communication while introducing oneself and others CO3: **List** techniques of forming healthy habits CO4: **Apply** SMART technique to achieve goals and increase productivity				
Course Content:					
Module 1	INTRODUCTION TO SOFT SKILLS	**Classroom activity**		**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- FRL1002	**Course Title:** Basic French **Type of Course:** HSMC – Open Elective	**L- T-P- C**	1	0	2	2
Version No.	4.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This Course is for beginners and gives an introduction of the French Language (basic grammar, conjugation, daily used vocabulary words, and basic conversations) and French culture. This Course is designed to build up all of the basic skills of French listening, reading, speaking, and writing introduced in the lessons. Besides, this Course offers an access to the French world, helping students to break cultural boundaries and raise cultural					

	literacy.			
Course Objective	This course is designed to improve the learners Employability skills by using participative learning techniques to develop students' language proficiency and cross-cultural competence by active and participatory teaching methods.			
Course Outcomes	**On successful completion of the course the students shall be able to:** 1) Identify the basics of French Grammar, vocabulary and Conjugation 2) Apply the basics strategies of listening, reading, speaking and writing skills 3) Use of French on everyday topics such as greetings, personal information, time and schedule 4) Practice conversations in French language with peer speakers in different situations			
Course Content:	Learning of Basic French skills			
Module 1	**Greetings and Introducing yourself**		[Remember]	**6 Periods**
Chapter 1. Greetings Objectives: Greetings, introducing yourself, how to welcome someone, Grammar: Construction of a sentence, the days of the weeks and the months Chapter 2. Introducing yourself Objectives: Introduce oneself / ask for someone's personal information. Grammar: Mas or Fem noun, adjectives, present tense of the 1st group Usage of audio visual files				
Module 2	**Expressing likes/dislikes and introducing someone**		[Apply]	**6 Periods**
Chapter 3. Expressing likes and dislikes Objectives: How to expressing what you like and dislike. Grammar: Negative form, singular and plural. Culture: The polite way to address people in French Assignment Chapter 4. Introducing someone Objectives: How to describe someone, Grammar: Vocabulary of the family, Demonstrative adjectives, Present tense of verbs of the 2nd and 3rd group				
Module 3	**Inviting someone and asking questions**		[Apply]	**9 Periods**

Chapter 5. Inviting someone Objectives: How to invite someone, accept or refuse the invitation, Read the time, Grammar: Future tense, Interrogation. Culture: The art of accepting and declining an invitation politely in French Internal Chapter 6. Asking for information, Objectives: How to ask for information, giving information				
Module 4	**Making a reservation and giving directions**		[Apply]	**9 Periods**
Chapter 7: Making a Reservation Objectives: How to make a reservation, future tense Chapter 8 : Giving directions Objectives: How to ask for directions, Imperative tense Group discussions				
Targeted Application & Tools that can be used				
Project work /Assignments 1) Assignment (Essay writing / presentation) 2) Internal 3) Group work / Group discussions				
Text Book L'Atelier 1 - - Méthode de Français--- Niveau A1 (Didier – 2019) Festival 1- - Méthode de Français--- Niveau A1 (CLE International – 2005)				
References Learning materials designed by the instructor				
Topics relevant to development of 'Employability Skills' through participative learning techniques: Foreign language proficiency and cross-cultural competence by active and participatory teaching methods.				

Course Code: **PPS 1012**	**Course Title: Enhancing Personality through 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					

<table>
<tr><td>Course Description</td><td colspan="3">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.</td></tr>
<tr><td>Course Objective</td><td colspan="3">The objective of the course is to familiarize the learners with the concepts of “Personality Development through Soft Skills” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="3">On successful completion of this course the students shall be able to:
CO 1 Identify the stages of team formation (Remember)
CO 2 Demonstrate effective presentation skills (Apply)
CO3 Prepare professional social media profile (Apply)</td></tr>
<tr><td>Course Content:</td><td colspan="3"></td></tr>
<tr><td>Module 1</td><td>Team Building</td><td>Classroom and outbound team building activities.</td><td>6 Hours</td></tr>
<tr><td colspan="4">Topics: Importance of team, stages of Team Formation, Trust and collaboration, Virtual Team.
Activity: Team Building outbound activity</td></tr>
<tr><td>Module 2</td><td>Art of Questioning</td><td>Role plays</td><td>4 Sessions</td></tr>
<tr><td colspan="4">Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions</td></tr>
<tr><td>Module 3</td><td>Presentation Skills</td><td>Practice and evaluation of individual / group presentation</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges.
Activity: Individual presentations and team presentation</td></tr>
<tr><td>Module 4</td><td>Professional Brand Building</td><td>Brand Framework Activity</td><td>4 Sessions</td></tr>
<tr><td colspan="4">Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies.</td></tr>
</table>

Activity: Create a basic online profile

Module 5	Recap / Revision /Feedback Session		1 Session

Targeted Application & Tools that can be used:

1. TED Talks
2. You Tube Links
3. Activities

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

3) Presentation Evaluation

Targeted Application & Tools that can be used:

1. TED Talks
2. YouTube Links
3. Videos by L&D Team shared on Edhitch/YouTube.com
4. LMS

Assignments proposed for this course

1. Evaluation on Presentation
2. Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z__jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

1. "Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8
2. "The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014
3. "The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006
4. "Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

1. https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/
2. https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to development of "SKILL": Art of Presentation, Team building, Art of questioning and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CHE1018	**Course Title:** Environmental Science **Type of Course:** MAC- Theory and Lab	**L- T- P- C**	**1**	**0**	**2**	**0**
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education. **This course is designed to cater to Environment and Sustainability**					
Course Objective	The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.**					
Course Outcomes	On successful completion of this course the students shall be able to: 6) Appreciate the historical context of human interactions with the environment and the need for eco-balance. 7) Describe basic knowledge about global climate change with particular reference to the Indian context. 8) Understand biodiversity and its conservation 9) Develop an understanding on types of pollution and ways to protect the environment 10) 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

16. Determination of total alkalinity of a water sample (knowledge)
17. Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
18. Estimation of copper from industrial effluents by colorimetric method (Comprehensive)
19. Estimation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)
20. Estimation of nickel from industrial effluents by titrimetric method (Comprehensive)
21. Estimation of chloride in drinking water by titrimetric method (Comprehensive)
22. Estimation of fluoride in ground water by colorimetric method (Comprehensive)
23. Determination of calcium in aqueous solution (Comprehensive)
24. Determination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
25. Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
26. Biological oxygen demand of waste water sample (Comprehensive)
27. Determination of dissolved oxygen of an industrial effluent (Comprehensive)
28. Quality monitoring analysis of a soil sample (knowledge)
29. Flame photometric estimation of Sodium and potassium (Application)
30. 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

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

Reference Books

7. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
8. William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.
9. Sinha N., (2020) Wild and Wilful. Harper Collins, India.
10. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/
11. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
12. 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: LAW1007	**Course Title: Indian Constitution and Professional Ethics for Engineers** **Type of Course: Theory**	**L-T- P-C**	1	**0**	**0**	1
Version No.						
Course Prerequisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce the students to the theory, concepts and practice of Constitution of India which is the law of the land. Further, the course aims at acquainting the students with basic approaches and methodologies to analyse and decide on the ethical dilemma in the field of engineering. The course is both conceptual and analytical. The course develops critical thinking skills by augmenting the student's ability to comprehend the conceptual and legal framework of Constitution of India. Ethics and values are very beautifully weaved into the tapestry of the Indian Constitution. Therefore, the course provides an introduction to the essential theoretical basis of engineering ethics and its application such engineers through a range of industry relevant topics as responsibility for safety and risks, responsibility of employers, rights of engineers etc.					
Course Objective	1. To introduce the students to the conceptual framework of Constitution of India and engineering ethics. 2. To enhance the practical knowledge on responsibility of engineering professionals as citizens of India. 3. To acquaint the student with the relevant contemporary issues surrounding constitutional values and professional ethics. 4. To orient the students about the ethical concepts and frameworks enabling them to identify the codes and moral values relevant to the professional world.					
Course Outcomes	**On successful completion of this course the students shall be able:** 1. To understand foundational Indian constitutional law concepts and values.					

	2. To identify the different pillars of democracy and their functions. 3. To analyse the role of the engineers' responsibility in ensuring safety of the society and the employer.

Module 1	**Introduction to the Indian Constitution**	Knowledge	Quiz	**5 Classes**
Course Content:				

Meaning of Constitution, Constitutional Law and Constitutionalism, India before and after adoption of Constitution, Preamble, Salient Features, Concept and Relevance of Fundamental Rights, Fundamental Duties and Directive Principles of State Policy in brief.				
Module 2	**Pillars of Democracy: Legislature Executive and Judiciary**	Knowledge	Short Essay	**5 Classes**
Federalism, Union and State Executive, Parliament and State Legislature, Union and State Judiciary, Amendment of the Constitution				
Module 3	**Engineering Ethics**	Analysis	Presentation on conceptual understanding and problem based scenarios	**5 Classes**
Scope & Aims of Engineering & Professional Ethics, Code of Ethics as defined in the website of Institution of Engineers (India), Profession, Professionalism, and Professional Responsibility, Conflicts of Interest, Engineering Standards, the impediments to Responsibility, IPRs (Intellectual Property Rights), Necessity of responsible experimentation ,Case Studies on Challenger, Chernobyl, and Boeing.				
Project work/Assignment: Quiz on Fundamental Rights, Short Essay on Judicial Activism in India, Problem based assignments of engineering ethics.				
Resources: 1. M.P. Jain, Indian Constitutional Law, 8th Edition, Lexis Nexis, 2022. 2. M.W. Martin and R. Schinzinger, Ethics in Engineering, 4thEdition, McGraw Hill Education, 2015.				

References:

1. Durga Das Basu, Commentary on the Constitution of India, 9th Edition, Lexis Nexis, 2019.
2. Rowan, John, and Zinaich Jr., Ethics for the Professions, Wadsworth, 2003.
3. R.C. Sekhar, Ethical Choices in Business, Response Books, Sage Publications, 1997.

Course Code: **ECE2010**	**Course Title: Innovative Projects using Arduino** **Type of Course: ESC**	**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**	Hands-on	Interfacing Task and	**4 Session**		

	of Arduino		Analysis	**s**
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: COM2500	**Course Title: Computer Vision and LLMs** **Type of Course: Program Core - Theory**	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	CSE3157					
Anti-requisites	NIL					
Course Description	This course combines computer vision with large language models. It provides an introduction to computer vision, deep learning techniques for computer vision, followed by large language models, and finally multimodality in the form of text and vision. Topics: Convolution, Convolutional Neural Networks, Image Representation, Softmax Function, Attention, Transformers, Multimodality					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 23. **Summarize** the concepts of digital image processing (Understand). 24. **Describe** the various Image formation techniques and its difficulties (Understand). 25. **Apply** the linear filter to images (Apply). 26. **Use** EM Algorithm for identifying the segments in an image (Apply).					

Course Content:				
Module 1	**Introduction to Computer Vision**	**Adversarial Quiz Tests**	**Module Tests**	**No. of Sessions: 09**
Basic Image Processing Operations – Sampling and quantization, Image Resizing, Aliasing and image enhancement, Spatial domain filtering. **Advanced Image processing Operations** – Color Image Processing, Image Restoration and reconstruction, Image Compression, Image Segmentation. **Image Formation –** Sources, Shadows and Shading. **Image Models** – Geometric Image Features, Analytical Image Features				
Module 2	**Deep Learning for Computer Vision**	**Adversarial Quiz Tests**	**Module Tests**	**No. of sessions: 06**

Feedforward Neural Networks, Gradient Descent, Regularization. Convolutional Neural Networks for Image Classification. Advanced CNN Architectures – VGG, ResNet. CNNs for Object Detection and Segmentation.

Module 3	**Deep Generative Models**	**Adversarial Quiz Tests**	**Module Tests**	**No. of sessions: 09**

Attention and Transformers. Soft and Hard Attention – Image Captioning. Vision Transformers. Generative Adversarial Networks. Autoencoders and Variational Autoencoders. Diffusion Models. Applications beyond Image Captioning – Visual QA and Visual Dialogs.

Module 4	**Vision Language Models**	**Adversarial Quiz Tests**	**Module Tests**	**No. of Sessions: 06**

Diffusion Models. Classifier and Classifier-Free Diffusion Guidance. Text-conditioned Diffusion Models. Sampling, Prediction Space, Noise Schedules, Architectures of Diffusion Models. Self-Supervised Learning – SimCLR. Contrastive Learning. Vision Language Models. Examples of Vision Language Models – Dall-E, Imagen, StyleGAN.

Targeted Application & Tools that can be used:

13. Google Colab
14. Python IDEs like PyCharm

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

3. Group project on a Computer Vision task like image captioning, sentiment analysis, etc.

Textbook(s):

7. Ian Goodfellow, Yoshua Bengio, Aaron Courville. *Deep Learning*, (1st Edition). The MIT Press, 2016.
8. David Forsyth, Jean Ponce. *Computer Vision: A Modern Approach* (2nd Edition). Pearson Education India, 2015.
9. David Foster. *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play* (2nd Edition). O'Reilly, 2023.

References:

R1. Vineeth Balasubramaniam. *Deep Learning for Computer Vision* (1st Edition). NPTEL. 2020.

Weblinks

W1. NPTEL Course: https://nptel.ac.in/courses/106106224

Course Code: **COM2501**	**Course Title: Computer Vision and LLMs Lab** **Type of Course: Program Core - Laboratory**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CAI2500					
Anti-requisites	NIL					
Course Description	This course combines computer vision with large language models. It provides an introduction to computer vision, deep learning techniques for computer vision, followed by large language models, and finally multimodality in the form of text and vision. Topics: Convolution, Convolutional Neural Networks, Image Representation, Softmax Function, Attention, Transformers, Multimodality					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 27. **Summarize** the concepts of digital image processing (Understand). 28. **Describe** the various Image formation techniques and its difficulties (Understand). 29. **Apply** the linear filter to images (Apply). 30. **Use** EM Algorithm for identifying the segments in an image (Apply).					

Course Content:
No. of Sessions: 15 (30 hours)

Experiment No. 1: Image File Handling
Level 1: Read image files using Python.
Level 2: Save image files using Python.

Experiment No. 2: Introduction to Digital Image Processing
Level 1: Perform image enhancement operations
Level 2: Perform filtering with morphological operators

Experiment No. 3: Image Denoising
Level 1: Perform image denoising operation.
Level 2: Noise removal using a Weiner filter.

Experiment No. 4: Image Segmentation
Level 1: Perform edge-based and region-based image segmentation
Level 2: Perform image labelling.

Experiment No. 5 & 6: Image Classification
Level 1: Perform image classification using Logistic Regression and Support Vector Machine
Level 2: Perform image classification using Multilayer Perceptron and CNN.

Experiment No. 7 & 8: Object Detection
Level 1: Detect objects in a scene using HOG
Level 2: Detect objects in a scene using CNN

Experiment No. 9 & 10: Optical Character Recognition
Level 1: Implement a CNN to detect printed characters in various fonts.
Level 2: Implement a CNN to detect and decipher handwritten characters.

Experiment No. 11: Image Generation Using DALL-E
Level 1: Using GPT Vision model for text to image generation
Level 2: Creating an image by first creating a prompt and then an image.

Experiment No. 12: Generative Adversarial Network
Level 1: Implement a GAN for neural style transfer.
Level 2: Use a GAN to generate a Ghiblified image of an event.

Experiment No. 13: Image to Image Generation
Level 1: Develop a Hidden Markov Model (HMM) for NLP tasks such as PoS tagging.
Level 2: Evaluate the performance of the HMM on a specific NLP task (e.g., Named Entity Recognition or Chunking).

Experiment No. 14 & 15: Subtitle Generation
Level 1: Generate subtitles for a video in English.
Level 2: Generate ***English*** subtitles for an anime (Japanese animated) video. NOTE: The audio here will be in Japanese!

Targeted Application & Tools that can be used:

15. Google Colab
16. Python IDEs like PyCharm

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

Students will perform a shared task in the semester.

Textbook(s):

7. Ian Goodfellow, Yoshua Bengio, Aaron Courville. *Deep Learning*, (1st Edition). The MIT Press, 2016.
8. David Forsyth, Jean Ponce. *Computer Vision: A Modern Approach* (2nd Edition). Pearson Education India, 2015.
9. David Foster. *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play* (2nd Edition). O'Reilly, 2023.

References:

R1. Vineeth Balasubramaniam. *Deep Learning for Computer Vision* (1st Edition). NPTEL. 2020.

Weblinks

W1. NPTEL Course: https://nptel.ac.in/courses/106106224

Course Code: CSE3400	**Course Title: Intelligent Systems with Machine Learning** **Type of Course: Lab**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE1700					
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 : 2. 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. 3. 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 4. 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. 3. Aurélien Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Oreilly, Second Edition, 2019. 4. Andreas C Muller, Sarah Guido, "Introduction to Machine Learning with Python :A Guide for Data Scientists", Oreilly, First Edition, 2018 4. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.
	References In references apart from the books and web links, mention a few standards &Hand books relevant to the Laboratory tasks used by the professionals. 1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining*"**,** Pearson Education, 2016. 2. **https://towardsdatascience.com/machine-learning/home** 3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/ 4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Course Code: CSE3401	**Course Title: Advanced Deep Learning Techniques** **Type of Course: Theory**	**L- T-P- C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	CSE1700					
Anti-requisites	NIL					

Course Description	This course introduces students to the concepts of deep neural networks and state of the art approaches to develop deep learning models. In this course students will be given an exposure to the details of neural networks as well as deep learning architectures and to develop end-to-end models for such tasks. It will help to design and develop an application-specific deep learning models and also provide the practical knowledge handling and analyzing end user realistic applications. Topics include Fundamental concepts of deep neural networks, Convolutional Neural Networks, Recurrent Network structures, Deep Unsupervised Learning, Generative Adversarial Networks and applications in various problem domains.
Course Objective	This course is designed to improve the learners EMPLOYABILITY SKILLS by using EXPERIENTIAL LEARNING techniques.
Course Outcomes	On successful completion of this course the students shall be able to: 4. Learn the Fundamental Principles of Deep Learning. (Remember). 5. Identify the Deep Learning Algorithms for learning tasks in various related domains (Apply). 6. To understand and apply deep generative models. (Understand). 7. Apply deep learning architectures to image and audio data. (Apply)

Course Content:

Module 1	**Introduction to Deep Learning and Neural Networks**	Assignment		**13[7L+6P] Sessions**

Topics:

Fundamentals of Deep Learning, Perceptron, Multilayer Perceptron, Optimizing Perceptions using Activation Functions, Loss Functions, Gradient Descent.

Feedforward Neural Network, Training Neural Network with Back-propagation, Hyper parameters, Regularization, Dropouts, Batch Normalization, Practical Issues in Neural Network Training -The Problem of Overfitting, The Vanishing and Exploding Gradient Problems

Module 2	**Common Deep Learning Architectures:**	Assignment		**18[8L+10P] Sessions**

Topics:

Convolutional Neural Network, Transfer learning Techniques, Variants of CNN: DenseNet, ResNet

Sequence Modelling: Recurrent Neural Network and its variants - Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU)

Module 3	**Deep Generative Models**	Assignment		**16[8L+8P] Sessions**
Topics: Generative Adversarial Networks, Kohonen Networks, Autoencoders, Boltzmann Machine, Restricted Boltzmann Machine, Deep Belief Network				
Module-4	**Advanced Deep Learning Architectures**	Assignment		**13[7L+6P] Sessions**
Topics: Hopfield Network, Probabilistic Neural Network, Deep Reinforcement Learning - The Basic Framework of Reinforcement Learning Deep Learning applications: Image segmentation, Object detection,Speech Recognition, Video Analytics				
Project work/Assignment:				
3. Assignment 1 on (Module 1 and Module 2) **4. Assignment 2 on (Module 3 and Module 4)**				
List of Laboratory Tasks: **Lab 1: Working with Deep Learning Frameworks** Objective: Explore various Deep Learning Frameworks Tasks: Identify deep learning frameworks (Keras, Tensorflow, Matplotlib, etc) Activity: Practice with various methods available in DL Frameworks to develop a Model. **Lab 2: Build a Basic Artificial Neural Network** Objective: Create a ANN with DL frameworks. Task: Identify suitable ANN Layers using Keras and Tensorflow. Activity: Design a basic Artificial Neural Networks using Keras with TensorFlow (pima-indians-diabetes) **Lab 3 and Lab 4: Build a MultiLayer Perceptron** Objective: Create a MLP for classification task.				

Task: Identify suitable model for house price prediction.

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

Lab 5: Build a Convolutional Neural Network

Objective: Create a CNN model.

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

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

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

Objective: Create a RNN and LSTM Model

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

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

Lab 8: Build a Gated Recurrent Unit architecture.

Objective: Create a Time Series Model.

Task: Build GRU Architecture for predicting time series data.

Activity: Implement a GRU architecture for language translations.

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

Objective: Create a Seq2Seq Model

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

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

Lab 11: Build an Auto-Encoder model

Objective: Create an Unsupervised Deep Learning Model.

Task: Create AutoEncoder network Output Translations.

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

Lab 12: Build Generative Adversarial Networks.

Objective: Create an Unsupervised Deep Learning Model.

Task: Design GAN Architecture for Image generations. Activity: Design a Age Prediction model by Applying Generative Adversarial
REFERENCE MATERIALS: TEXTBOOKS 3. François Chollet, “Deep Learning with Python”, 2nd Edition, Manning Publications, 2022 4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017. REFERENCES 4. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra , “Deep Learning”, Pearson Publication, 2021. 5. David Foster, “Generative Deep Learning” O’Reilly Publishers, 2020. 6. John D Kellehar, “Deep Learning”, MIT Press, 2020. **JOURNALS/MAGAZINES** 1. IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385 2. IEEE Transactions on Pattern Analysis and Machine Intelligence https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf 3. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x SWAYAM/NPTEL/MOOCs: 4. Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview 5. Coursera – Neural Networks and Deep Learning Andrew Ng 6. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Code: CSE3402	**Course Title: Computational Optimization for Intelligent Systems** **Type of Course: Theory (Discipline Elective)**	**L-T--P- C**	3	0	0	3
Version No.		1.0				

Course Pre-requisites		CSE1700
Anti-requisites		**NIL**
Course Description		This course introduces a range of machine learning models and optimization tools that are used to apply these models in practice. Course will introduce what lies behind the optimization tools often used as a black box as well as an understanding of the trade-offs of numerical accuracy and theoretical and empirical complexity. For the students with some optimization background this course will introduce a variety of applications arising in machine learning and statistics as well as novel optimization methods targeting these applications.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Optimization Techniques for Machine Learning** and attain **Skill Development** through **Participative Learning** techniques.
Course Outcomes		On successful completion of this course the students shall be able to: 7. **Demonstrate** simple examples to illustrate how Machine Learning is applied in real-world scenarios. [**Understand].** 8. **Implement** Machine Learning models (e.g., decision trees, linear regression, neural networks) using tools or programming languages. **[Apply].** 9. **Determine** the suitability of convex optimization in solving problems like portfolio optimization, machine learning, or network design. **[Apply].** 10. **Solve** convex optimization problems with real or simulated data, such as minimizing a cost function or optimizing resource allocation. **[Apply].**
Course Content:		

Module 1:	**Fundamentals of Machine learning**	**Quiz**		Knowledge based Quiz	**10 Sessions**
	Topics: Machine Learning Paradigm, Empirical Risk Minimization, Structural Risk Minimization, Learning Guarantees, Introduction of VC-Dimension, Dimensionality Reduction Techniques.				
Module 2:	**Machine learning models**	**Quiz**		Comprehension based Quiz	**12 Sessions**
	Topics: Logistic Regression, Support Vector Machines, Sparse Regression, Low Dimensional Embedding, Low Rank Matrix Factorization, Sparse PCA, Multiple Kernel Learning, Loss Functions, Entropy, Cross-Entropy Loss				

Module 3	**Convex optimization models**	**Assignment**		Batch-wise Assignments	**13 Sessions**
	Topics: Linear Optimization, Convex Quadratic Optimization, Second Order Cone Optimization, Semi-definite Optimization, Convex Composite Optimization.				
Module 4:	**Methods for convex optimization**	Assignment and Presentation		Batch-wise Assignment and Presentations	**10 Sessions**
	Topics: gradient descent, Newton method, interior point methods, active set, prox methods, accelerated gradient methods, coordinate descent, cutting plances, stochastic gradient.				
	Targeted Application & Tools that can be used: Use of Google Colab				
	Project work/Assignment: **Survey on Methods for convex optimization** **Survey on Machine learning models related to optimization**				
	Text Book T1. Charu C. Aggarwal, "*Linear Algebra and Optimization for Machine Learning*", Springer, 2020. T2. Sra Suvrit, Nowozin Sebastian, and Wright Stephen J, "*Optimization for Machine Learning*", The MIT Press,2012.				
	References R1.Guanghui Lan, "*First-order and Stochastic Optimization Methods for Machine Learning*", Springer Cham, 2020. **Web References** W1. https://sm-nitk.vlabs.ac.in/ W2. https://nptel.ac.in/courses/				
	Topics relevant to SKILL DEVELOPMENT: Concepts of Convex optimization models and Methods for convex optimization f**or Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.**				

Course Code: **CSE3403**	**Course Title: Reinforcement Learning for AI Systems** **Type of Course: Theory Only**		**L-T-P-C**	2	0	2	3
Version No.		1.0				
Course Pre-requisites	•	CSE1700				
Anti-requisites		NIL				
Course Description		The goal of this class is to provide an introduction to reinforcement learning, a very active research sub-field of machine learning. Reinforcement learning is concerned with building programs that learn how to predict and act in a stochastic environment, based on past experience. Applications of reinforcement learning range from classical control problems, such as power plant optimization or dynamical system control, to game playing, inventory control, and many other fields. Notably, reinforcement learning has also produced very compelling models of animal and human learning. During this course, we will study theoretical properties and practical applications of reinforcement learning. We will follow the second edition of the classic textbook by Sutton & Barto (available online for free, or from MIT Press), and supplement it as needed with papers and other materials.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Reinforcement Learning** and attain **Skill Development** through **Problem Solving** Methodologies.				
Course Out Comes		On successful completion of the course the students shall be able to: 1. Knowledge of basic and advanced reinforcement learning techniques. 2. Identification of suitable learning tasks to which these learning techniques can be applied. 3. Appreciation of some of the current limitations of reinforcement learning techniques. 4. Formulation of decision problems, set up and run computational experiments, evaluation of results from experiments.				
Course Content:						
Module 1	Introduction		Assignment		Programming	**No. of Classes:10**
	Topics: Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. **Probability Primer** Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions.					

	Correlation and independence.				
Module 2	Markov Decision Process	Assignment		Programming	**No. of Classes:10**
	Topics: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.				
Module 3	Prediction and Control by Dynamic Programing	Assignment		Programming	**No. of Classes:10**
	Topics: Overview of dynamic programing for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions **Monte Carlo Methods for Model Free Prediction and Control** Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.				
Module 4	TD Methods and Policy Gradients	Assignment		Programming	**No. of Classes:10**
	Topics: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants. Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods.				
	Targeted Application & Tools that can be used: While Convolution Neural Network (CNN) and Recurrent Neural Network (RNN) are becoming more important for businesses due to their applications in Computer Vision (CV) and Natural Language Processing (NLP), Reinforcement Learning (RL) as a framework for computational neuroscience to model decision making process seems to be undervalued. Besides, there seems to be very little resources detailing how RL is applied in different industries. Despite the criticisms about RL's weaknesses, RL should never be neglected in the space of corporate research given its huge potentials in assisting decision making. **Tools**: Torch, Google Colaboratory, Spider, Jupiter Notebook				
	Project work/Assignment:				

This part is written for general readers. At the same time, it will be of greater value for readers with some knowledge about RL.

- **Resources management in computer clusters**

Designing algorithms to allocate limited resources to different tasks is challenging and requires human-generated heuristics. The paper “Resource Management with Deep Reinforcement Learning” [2] showed how to use RL to automatically learn to allocate and schedule computer resources to waiting jobs, with the objective to minimize the average job slowdown.

State space was formulated as the current resources allocation and the resources profile of jobs. For action space, they used a trick to allow the agent to choose more than one action at each time step. Reward was the sum of (-1/duration of the job) over all the jobs in the system. Then they combined REINFORCE algorithm and baseline value to calculate the policy gradients and find the best policy parameters that give the probability distribution of actions to minimize the objective.

- **Traffic Light Control**

Researchers tried to design a traffic light controller to solve the congestion problem. Tested only on simulated environment though, their methods showed superior results than traditional methods and shed a light on the potential uses of multi-agent RL in designing traffic system.

Five agents were put in the five-intersection traffic network, with a RL agent at the central intersection to control traffic signalling. The state was defined as eight-dimensional vector with each element representing the relative traffic flow of each lane. Eight choices were available to the agent, each representing a phase combination, and the reward function was defined as reduction in delay compared with previous time step. The authors used DQN to learn the Q value of the {state, action} pairs.

- **Robotics**

There are tremendous works on applying RL in Robotics. Readers are referred to for a survey of RL in Robotics. In particular, trained a robot to learn policies to map raw video images to robot’s actions. The RGB images were fed to a CNN and outputs were the motor torques. The RL component was the guided policy search to generate training data that came from its own state distribution.

- **Web System Configuration**

There are more than 100 configurable parameters in a web system and the process of tuning the parameters requires a skilled operator and numerous trail-and-error tests. The paper “A Reinforcement Learning Approach to Online Web System Auto-configuration” showed the first attempt in the domain on how to do autonomic reconfiguration of parameters in multi-tier web systems in VM-based dynamic environments.

The reconfiguration process can be formulated as a finite MDP. The state space was the system configuration, action space was {increase, decrease, keep} for each parameter, and reward was defined as the difference between the given targeted response time and measured response time. The authors used the model-free Q-learning algorithm to do the task.

Text Book

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition
2. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia
3. "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy

	References 1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019. 2. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018). 3. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012):
	E-Resources NPTEL course – https://onlinecourses.nptel.ac.in/noc19_cs55/preview https://archive.nptel.ac.in/courses/106/106/106106143/ https://www.digimat.in/nptel/courses/video/106106143/L35.html
	Topics relevant to "SKILL DEVELOPMENT": Real time Data Analysis using Reinforcement learning **for Skill Development through Problem Solving techniques. This is attained through assessment component mentioned in course handout.**

Course Code: **CSE3404**	**Course Title: Computational Linguistics and Natural Language Processing** **Type of Course: Theory Only**	**L- T-P- C**	3	0	0	3
Version No.		1.0				
Course Pre-requisites		CSE1700				
Anti-requisites		NIL				
Course Description		The purpose of this course is to introduce students to the science of natural language processing (NLP). NLP is the science of extracting information from unstructured text. It is basically how we can teach machines to understand human languages and extract meaning from text. In addition to regular theory, the course also involves: 1. Programming Assignments 2. Regular Quiz Tests (once a week and once after every module)				
Course Objective		The objective of the course is to familiarize the learners with the concepts of Fundamentals of Natural language Processing and attain **Skill Development** through **Participative Learning** techniques.				
Course Out Comes		**On successful completion of the course the students shall be able to:** • **Understand** the fundamental concepts of Natural Language Processing. [Knowledge] • **Read** corpora and **train** models for different NLP tasks. [Application]				

		• **Use** word embeddings for solving an NLP Application. [Application] • **Understand** sequence to sequence modeling as used in machine translation. [Application]			
Course Content:					
Module 1	**Introduction**	Quizzes			**7 Sessions**
	Topics: Introduction. History. Text Analytics. Various tasks in NLP. Sentence boundary Detection. Edit distance. Introduction to word embeddings, PoS tagging, chunking, parsing, machine translation.				
Module 2	**Word and Text Representations**	Quizzes		Assignments	**8 Sessions**
	Topics: Logistic Regression and Naïve Bayes classification. Vector semantics and embeddings. Neural Networks and Neural Language Models. Text representations and classification. Deep learning architectures for sequence processing (CNN and LSTM).				
Module 3	**PoS Tagging, NER Tagging and Parsing**	Quizzes		Assignments	**12 Sessions**
	Topics: Part-of-Speech Tagging – using NLTK and spacy. Building a PoS Tagger using existing data and Hidden Markov Model. Named Entity Recognition. Relationship between NER tagging and PoS tagging. Constituency Parsing.				
Module 4	**NLP Applications**	Quizzes			**9 Sessions**
	Topics: Lexical Resource Creation. Sentiment Analysis. Machine Translation. Word Sense Disambiguation and WordNet. Question Answering.				
	Targeted Application & Tools that can be used: 1. **Python Libraries (Eg. NLTK, Spacy, etc.)** 2. **Java (Stanford CoreNLP)** 3. **Google Colab**				
	Project work/Assignment:				
	Assignment: Students will have to do group assignments for Modules 2 & 3. As a part of their assignments, they will have to implement the solution to particular problems.				
	Text Book				

	T1Daniel Jurafsky, and James Martin."*Speech and Language Processing*" (3rd edition draft, 2022)
	References **R1**Chris Manning and HinrichSchutze, "*Foundations of Statistical Natural Language Processing*", 1st Edition, MIT Press. 1999. **R2**PawanGoyal, "*Natural Language Processing*". NPTEL. **E-Book Link for R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBgAvLd1WscI0RqC/view** **Web resources:https://web.stanford.edu/~jurafsky/slp3/** **NPTEL Course: https://onlinecourses.nptel.ac.in/noc22_cs98/course**
	Topics relevant to "SKILL DEVELOPMENT": Assignment implementations in software, batch wise presentations for developing Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3405	**Course Title: Synergistic Neural Fuzzy Computing** **Type of Course: Theory** **(Discipline Elective in AI & ML Basket**)	**L-T-P-C**	2	0	2	3
Version No.		1.0				
Course Pre-requisites		CSE1700 – Essentials of AI				
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:** 2. Define the concept of Neural Networks. [Knowledge] 3. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge] 4. Discuss the concepts of Fuzzy Sets and Relations. [Comprehension] 5. 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: 2. Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.)				

	3. 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): 2. 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 3. 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: 2. Shivanandam, Deepa S, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html 3. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374 4. 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 5. 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 presentationsare usedforSkill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3409	**Course Title:** Emerging Technologies in Big Data **Type of Course:** **Lab Integrated**	L-T-P- C	2 -0	2	3
Version No.	1.0				
Course Pre-requisites	CSE3156-Database Management System,				
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: **CSE3410**	**Course Title: Statistical Techniques for Data Science** **Type of Course: Theory**	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	MATXXXX					
Anti-requisites	NIL					
Course Description	This course provides an in-depth introduction to statistics and machine learning theory, methods, and algorithms for data science. Topics include multiple regression, kernel learning, sparse regression, generalized linear models, supervised and unsupervised learning, deep learning, covariance learning, factor models, principal component analysis, and more. The course emphasizes the applicability and limitations of these methods using mathematical statistics and real-world data sets.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Statistical Foundations for Data Science** and attain **Employability** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 4) Understand the rise and significance of Big Data in various fields such as Biological Sciences, Health Sciences, Computer and Information Sciences, Economics and Finance, Business and Program Evaluation, Earth Sciences, and Astronomy. 4) Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem. 4) Apply linear regression with random design and partial linear regression. 4) Apply the power method and learn about factor models and					

	structured covariance learning.			
Course Content:				
Module 1	Introduction	Assignment	Programming	**No. of Classes:10**
Topics: Introduction to bigdata, Rise of Big Data and Dimensionality in -Biological Sciences ,Health Sciences , Computer and Information Sciences , Economics and Finance, Business and Program Evaluation, Earth Sciences and Astronomy - Impact of Big Data - Impact of Dimensionality , Computation of Noise Accumulation , Spurious Correlation , Statistical theory - Aim of High-dimensional Statistical Learning.				
Module 2	Multiple Linear Regression	Assignment	Programming	**No. of Classes:12**
Topics: Multiple Linear Regression, The Gauss-Markov Theorem , Statistical Tests - Weighted Least-Squares , Box-Cox Transformation , Model Building and Basis Expansions, Polynomial Regression - Spline Regression , Multiple Covariates , Ridge Regression - Bias-Variance Tradeoff - Penalized Least Squares - Bayesian Interpretation - Ridge Regression Solution Path - Kernel Ridge Regression , Exponential family 231 5.1.2 Elements of generalized linear models , Maximum likelihood , Computing MLE: Iteratively reweighed least squares , Deviance and Analysis of Deviance, Regularization parameters, Refitted Cross-validation, Extensions to Nonparametric Modeling.				
Module 3	Inference in linear regression	Assignment	Programming	**No. of Classes:14**
Topics:				

Inference in linear regression - Debias of regularized regression estimators , Choices of weights , Inference for the noise level , Inference in generalized linear models , Desparsified Lasso , Decorrelated score estimator - Test of linear hypotheses , Numerical comparison - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression , Gaussian graphical models - Inference via penalized least squares , Sample size in regression and graphical models , General solutions , Local semi-LD decomposition , Data swap , Gradient approximation

Module 4	Principal Component Analysis	Assignment	Programming	**No. of Classes:9**

Topics:

Principal Component Analysis -Introduction to PCA , Power Method , Factor Models and Structured Covariance Learning , Factor model and high-dimensional PCA-Cluster Analysis - K-means clustering , Hierarchical clustering , Model-based clustering , Spectral clustering , Data-driven choices of the number of clusters , Variable Selection in Clustering , Sparse K-means clustering , Sparse model-based clustering , Sparse Mixture of Experts Model, Correlation Screening, Generalized and Rank Correlation Screening, Nonparametric Screening, Sure Screening and False Selection.

Targeted Application & Tools that can be used:

Tools: Torch, Google Colaboratory, Spider, Jupiter Notebook

Project work/Assignment:

Text Book

TextBook(s):

T1 Fan, J., Li, R., Zhang, C.-H., and Zou, H. (2020). Statistical Foundations of Data Science. CRC Press.

T2 Wainwright, M. J. (2019). *High-dimensional statistics: A non-asymptotic viewpoint.* Cambridge University Press.

References

R1. James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An*

Introduction to Statistical Learning with Applications in R . Springer, New York.

R2. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

R3. Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

Book link

R1: Fan, J., Li, R., Zhang, C.-H., and Zou , Statistical Foundations of Data Science. CRC Press.

E book link

R2: W. N. Venables, D. M. Smith and the R Core Team, https://cran.r-roject.org/doc/manuals /R-intro.pdf, October,2022

Web resources:

W1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP

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

Topics relevant to "EMPLOYABILITY SKILLS": - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout..**

<table>
<tr><td>Course Code:

CSE3411</td><td colspan="3">Course Title: Predictive Analytics and Applications

Type of Course: Program Core</td><td>L-T- P- C</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">MATXXXX</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">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 analyzing and synthesizing data sets for decision making in the firms.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is skill development of student by using Learning techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
• CO 1: Define the nature of analytics and its applications. (Remember)
• CO 2: Summarize the concepts of predictive analytics and data mining. (Understand)
• CO 3: Construct the analytical tools in business scenarios to achieve competitive advantage.(Apply)
• CO 4: Build the real-world insights in decision trees and time series analysis methods in dynamic business environment.(Apply)</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td>Introduction to Predictive Analytics</td><td>Self-Learning</td><td colspan="5">Applications of analytics</td><td>7 Sessions</td></tr>
<tr><td colspan="9">Topics:Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics; Popularity in Analytics; Predictive analytics in business Scenarios- case studies</td></tr>
</table>

Module 2	**Principles and Techniques**	Case analysis		**8 Sessions**
Topics: Predictive modeling: Propensity models, cluster models, collaborative filtering, applications and limitations - Statistical analysis: Univariate Statistical analysis, Multivariate Statistical analysis				
Module 3	**Model Selection**	Participative Learning & Case Analysis		**7 Sessions**
Preparing to model the data: supervised versus unsupervised methods, statistical and data mining methodology, cross-validation, overfitting, bias-variance trade-off, balancing the training dataset, establishing baseline performance. Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models				
Module 4	**Time Series Analysis**	Discussion & Presentation		8 Sessions
Time series Model: ARMA, ARIMA, ARFIMA - Temporal mining - Box Jenkinson method, temporal reasoning, temporal constraint networks				
Text Book				

1.Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015

2.Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

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

2. **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

3. **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

4. **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

Course Code: **CSE3412**	**Course Title: Data Mining** **Type of Course: Discipline Elective/ Theory Only**			**L- T-P-C**	3	0	0	3
Version No.		2.0						
Course Pre-requisites		MAT1003						
Anti-requisites		**NIL**						
Course Description		Introduction, Applications, issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, different approaches for classification, clustering, outlier detection. Recent trends in data mining.						
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Data Mining** and attain **Employability** through **Problem Solving** Methodologies						
Course Out Comes		**On successful completion of the course the students shall be able to:** • Apply the various pre-processing techniques needed for a data mining task. • Understand the functionality of the various data mining algorithms. • Appreciate the strengths and limitations of various data mining models. • Understand the advances in data mining for real life applications.						
Course Content:								
Module 1	**Introduction to Data Mining**		Assignment		Data Collection		**5 Sessions**	

	Topics: Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Merits and Demerits.				
Module 2	**Data preprocessing**	Quiz		Problem Solving	**9 Sessions**
	Topics: Types of data – Pre Processing steps – Data Preprocessing Techniques – Similarity and Dissimilarity measures.				
Module 3	**Data Mining – Frequent Patterns**	Assignment		Problem Solving	**7 Sessions**
	Topics: Market Basket Analysis, item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FPGrowth.				
Module 4	**Classification and clustering**	Assignment		Problem Solving	**11 Sessions**
	Classification and Clustering Decision tree Induction – Bayesian classification –Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods – Density based method				
Module 5	**Outlier detection & Data mining trends**	Assignment		Problem Solving	**5 Sessions**
	Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining- Demonstration of Weka tool.				
	Project work/Assignment:				

Assignments

2. From the dataset given, find the Entropy, Gain value of the attributes and also draw the decision tree using entropy for the given dataset.

3. Transactional Data Base, D given below which contains set of items find the frequent item set using the Apriori Algorithm and generate the Association Rules. Minimum Support count is 2%. Minimum confidence is 60%.

T_{id}	Items
10	1, 3, 4
20	2, 3, 5
30	1, 2, 3, 5
40	2, 5

	Text Book **T1** T1. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining" ,Pearson Education, 2016.
	References **R1** *Han J & Kamber M, "Data Mining: Concepts and Techniques", Elsevier, Second Edition, 2006* **R2** *G K Gupta, "Introduction to Data Mining with Case Studies", PHI, Third Edition, 2014.* **R3** *Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill* **Additional web-based resources** W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/previewText book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012. W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk 4. https://nptel.ac.in/courses/105105157
	Topics relevant to "EMPLOYABILITY SKILLS": Data Mining Techniques, FP Growth for developing **Employability Skills** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3413	**Course Title: No SQL Data Management** **Type of Course: Lab Integrated**	**L-T-P-C**	2	0	2	3
Version No.		1.0				
Course Pre-requisites		CSE1510				
Anti-requisites		NIL				
Course Description		The **NoSQL Data Management** course provides a comprehensive understanding of non-relational database systems, emphasizing their emergence as scalable and flexible alternatives to traditional relational databases. It covers various NoSQL data models, including key-value, document, column-family, and graph databases, exploring their structure, use cases, and design principles. Students will learn about the challenges of data persistence, concurrency, and integration, and how aggregate-oriented models address these issues. The course delves into distribution				

		models such as sharding and replication, the implications of the CAP theorem, and consistency trade-offs. Additionally, it introduces Map-Reduce for large-scale data processing and guides students in modeling data for access efficiency. Practical applications and limitations of each NoSQL type are discussed, preparing students to design robust, scalable data solutions for real-world applications.
Course Objectives		The objective of the course is to introduce students to the principles, models, and practical applications of NoSQL databases. It aims to equip students with the knowledge and skills necessary to understand the advantages of NoSQL over traditional relational databases, comprehend various data models (key-value, document, column-family, and graph), explore distribution models for scalability and availability, and apply Map-Reduce and other techniques for data processing.
Course Out Comes		1. Understand the limitations of relational databases and explain the motivation behind the emergence of NoSQL databases. 2. Differentiate between various NoSQL data models such as key-value, document, column-family, and graph databases based on structure, use cases, and performance. 3. Analyze and apply appropriate distribution strategies including sharding, replication, and consistency models in distributed NoSQL systems. 4. Design and implement data access patterns using aggregate-oriented modeling and schema-less approaches for scalable NoSQL applications. 5. Utilize Map-Reduce and other data processing techniques to handle large-scale data operations efficiently in NoSQL environments.
Course Content:		

Module 1	**Introduction to NoSQL and Aggregate-Oriented Data Models**	**Quiz**		**Knowledge based quiz**	**No. of sessions:8**
	Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing AggregateOriented Databases. More Details on Data Models; Relationships, Graph Databases, Schema less Databases, Materialized Views, Modelling for Data Access.				
Module 2	**Distributed Data Systems and Consistency Models**	**Assignment**		**Data Visualization**	**No. of sessions:10**
	Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums. Version Stamps, Business and System				

	Transactions, Version Stamps on Multiple Nodes					
Module 3	**Key-Value Stores and Map-Reduce Framework**	**Design an algorithm using Example**		**Random Forest**	**No. of sessions:10**	
	Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multi operation Transactions, Query by Data, Operations by Sets.					
Module 4	**Document-Oriented Databases and Use Cases**	**Case Study**		**Conduct a case study on how data sets can be gathered and implemented in real time application.**	**No. of sessions:10**	
	Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure					
Module 5	**Graph Databases and Connected Data Solutions**	**Case Study**			**No. of sessions:10**	
	Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.					
	TEXTBOOKS: 1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012 REFERENCE BOOKS: 1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN- 13: 978-9332557338) 2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022) 3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694) VIDEO LINKS: 1. https://www.geeksforgeeks.org/introduction-to-nosql/ (and related links in the page) 2. https://www.youtube.com/watch?v=0buKQHokLK8 (How do NoSQL databases work? Simply					

	explained)

Course Code: CSE3414	**Course Title: Applied Data Intelligence** **Type of Course: Program Core**	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	The aim of the course is to give complete overview of Python's data analytics tools and techniques. Learning python is a crucial skill for many data science roles, and this course helps to understand and develop feature engineering. With a blended learning approach, Python for data science along with concepts like data wrangling, mathematical computing, and more can be learnt.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **Applied Data Science** and attain **Employability** through E**xperiential Learning** techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 1. Understand Numpy and Matrix Operations [Knowledge] 2. Analyze the need for data preprocessing and visualization techniques. [Comprehensive] 3. Demonstrate the performance of different supervised learning algorithms like decision Tree, Random Forest, Linear Regression, Logistic Regression etc. [Application] 4. Apply unsupervised learning algorithms like K-Means, K-Medoids etc for grouping the given data. [Applicaion]					
Course Content:						

Module 1	**Introduction to Data Science, Python Data Structures, Python Numpy Package**	**Quiz**		**Knowledge based quiz**	**No. of sessions:8**
	Data Science - Need, Applications, Difference between data analysis and data analytics. Python-Variables, data types, control structures, Operators, Simple operations, Array and its operations, Numpy operations, Matrix and its operations				
Module 2	**Data preparation and preprocessing using Pandas dataframe,**	**Assignment**		**Data Visualization**	**No. of sessions:10**

	Exploratory Data Analysis, Data Visualization				
	Dealing missing values, Normalization, statistical description about the data, Accessing the data, Summary of the data, Relationship between the data, Data Visualization using matplotlib				
Module 3	**Supervised Learning Algorithms**	**Design an algorithm using Example**		**Random Forest**	**No. of sessions:10**
	Decision Tree Algorithm, ID3 Classifier, Random Forest, Classifier Accuracy, Linear Prediction, Logistic Regression – Case study				
Module 4	**Unsupervised Learning Algorithms**	**Case Study**		**Conduct a case study on how data sets can be gathered and implemented in real time application.**	**No. of sessions:10**
	Various distance Function, Dissimilarity between the mixed types of data, K-Means Algorithm, K-Medoids Algorithm -Case Study				
	List of Laboratory Tasks: 1. Introduction to R tool for data analytics science 2. Basic Statistics and Visualization in R 3. K-means Clustering 4. Association Rules 5. Linear Regression 6. Logistic Regression 7. Naive Bayesian Classifier 8. Decision Trees 9. Simulate Principal component analysis 10. Simulate Singular Value Decomposition				
	Targeted Application & Tools that can be used: • IBM SPSS • Julia and Jupyter Notebook • Matplotlib				
	Project work/Assignment:				
	1. Design forest fire and wildfire prediction system. 2. Driver Drowsiness Detection System with OpenCV & Keras 3. Credit Card Fraud Detection using Python.				
	Textbook(s): 1. Applied Data Science with Python and Jupyter-Alex Galea,Packt Publishing,October2018 2. Data Visualization in Python with Pandas and Matplotlib Paperback –DavidLandup, June 16, 2021				

	References: 1.Data Science with Python and Dask- Jesse Daniel,1st Edition,July30,2019 **Weblinks:** • Udemy: https://www.udemy.com/course/applied-data-science-with-python-specialization-mhm/ • NPTEL online course : https://nptel.ac.in/courses/106106179 • https://presiuniv.knimbus.com/user#/home
	Topics relevant to "EMPLOYABILITY SKILLS": Data Science, Decision Tree Algorithm **for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSE3415	Course Title: Cloud Data Engineering Type of Course : Theory	L-T- P-C	2	0	2	3

Version No.		1.0
Course Pre-requisites		CSE2506
Anti-requisites		nil
Course Description		This Course is designed to introduce the concepts of Cloud Computing as a new computing paradigm. Cloud Computing has emerged in recent years as a new paradigm for hosting and delivering services over the Internet. The students can explore various Cloud Computing terminology, principles and applications. Understanding different views of the Cloud Computing such as theoretical, technical and commercial aspects. **Topics include:** Evolution of cloud computing and its services available today, Introduction, Architecture of cloud computing, Infrastructure, platform, software, Types of cloud, Business models, cloud services, Collaborating using cloud services, Virtualization for cloud, Security, Standards and Applications.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Could computing and Virtualization** and attain **Employability** through **Participative Learning** techniques.
Course Out Comes		**On successful completion of the course the students shall be able to:** • Describe fundamentals of cloud computing, virtualization and cloud computing services. • Discuss high-throughput and data-intensive computing. • Explain security and standards in cloud computing. • Demonstrate the installation and configuration of virtual machine.
Course Content:		

Module 1		**10 Sessions**
	Introduction to Cloud and Virtualization Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Virtualization, Characteristics of Virtualized Environments Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Technology Examples, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Economics of Cloud	

Module 2		**10 Sessions**
	High Throughput and Data Intensive Computing: Task computing, MPI applications, Task based programming, Introduction to DIC, Technologies for DIC, Aneka Map Reduce Programming	

Module 3		**09 Sessions**
	Cloud Security and Standards : Cloud Security Challenges, Software-as-a-Service Security, Application standards, Client standards, Infrastructure and Service standards.	

Module 4		09 Sessions
	Cloud Platforms, Advances in cloud: introduction to **Amazon Web Services**: Introduction to **Google App Engine,** Introduction to **Microsoft Azure.** **Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Cloud**	
	Text Book 1. John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press. 2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education.	
	References 1. David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press. 2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw-Hill. **Web resources:** https://presiuniv.knimbus.com/user#/home	
	Topics relevant to "EMPLOYABILITY SKILLS": Aws, Azure, APIs, Aneka Cloud Platform, EC2, Installation of VM Workstation, Infrastructure Security Challenges for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component mentioned in course handout..	

Course Code: **CSE3416**	**Course Title:** Federated Learning **Type of Course: Theory**	**L- T-P- C**	2	0	2	3

Version No.		1
Course Pre-requisites		CSE2506
Anti-requisites		
Course Description		Federated Learning can improve the performance of models by leveraging the diversity of the data across different devices. In this course, students will learn basics of Federated Learning and will be able to apply the real-time updates of the model in various practical scenarios.
Course Objective		The objective of the course is to get exposure to need for distributed model updates and understand the importance of privacy and security in machine learning techniques.
Course Out Comes		**On successful completion of the course the students shall be able to:** • Describe the key concepts and architecture of Federated Learning. (Knowledge) • Apply different methods to develop federated learning systems. (Comprehension) • Apply optimization techniques in Federated Learning (Application) • Construct and scale a simple federated system (Application) • Evaluate privacy and security concerns in Federated Learning and implement privacy-preserving techniques (Application)
Course Content:		

Module 1	**Introduction to Federated Learning:**	Assignment		Data Collection/Interpretation	**10 Sessions**
	Topics: Introduction to Federated Learning – Overview of Federated Learning: Definition, History, and Applications – Concepts and Terminology – Federated Learning Architecture -Machine Learning Perspective - Security & Privacy in Federated Learning – Federated Learning vs Centralized Learning: Comparison and Contrast.				
Module 2	**Horizontal and Vertical Federated Learning**	Case studies / Case let		Case studies / Case let	**13 Sessions**
	Topics: Horizontal Federated Learning (HFL) -Definition and Architecture of Horizontal Federated Learning – Federated Averaging (FedAvg) Algorithm – Improvements on the FedAvg Algorithm. Vertical Federated Learning (VFL) – Definition and Architecture of Vertical Federated Learning – VFL Algorithms: Secure Federated Linear Regression, Secure Federated Tree Boosting. Federated Learning with Non-IID Data – Heterogeneity in Federated Learning -Stratification and Local Updated Rules – Advanced Optimization Techniques in Federated Learning -Adaptive Learning Rate - Momentum and Weight Decay				
Module 3	**Federated Transfer**	Case studies /		Case studies / Case let	**14 Sessions**

	Learning and Security	Case let			
	Topics: Federated Transfer Learning (FTL) – Framework of Federated Transfer Learning – Homomorphic Encryption in FTL – FTL Training Process -FTL Prediction Process – Security Analysis of FTL – Secret Sharing based FTL Security in Federated Learning – Protecting Against Data Leakage in FL -Private Parameter Aggregation for FL – Data Leakage in FL Advanced Security Issues -Dealing with Byzantine Threats to Neural Networks in FL.				
	Targeted Application & Tools that can be used: Building and simulating federated learning systems using tensorFlowFederated (TFF), PySyft, Google Colab / Jupyter Notebook. Simulating and deploying FL across nodes using Cloud Platforms (AWS, GCP, Azure) It can help small, medium and large businesses in any sector keep information assets secure.				
	Project work/Assignment:				
	Assignment: Practical Applications and Case Studies -Real-world Applications of Federated Learning				
	Text Book **T1** Federated learning comprehensive overview of methods and applications Springer Nature Switzerland AG; 1st ed. 2022 edition By Heiko Ludwig (Editor), Nathalie Baracaldo **T2** Federated Learning (Synthesis Lectures on Artificial Intelligence and Machine Learning) , by Ronald J. Brachman, Francessa Rossi, and Peter Stone, Series Editors, Released 30 December 2019. Publisher(s): Morgan & Claypool Publishers. .				
	References **R1 Federated Learning with Python by Kiyoshi Nakayama PhD, George Jeno, O'Reilly Media, Inc. Pub.** **R2 What-is-federated learning? By Emily Glanz, Nova Fallen, O'Reilly Media, Inc. Pub.** **E book link R1:** http://www.iso.org/iso/home/standards/management- standards/iso27001.html **E book link R2:** https://www.oreilly.com/library/view/what-is-federated/9781098107253/ch03.html				
	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: **CSE3417**	**Course Title: Edge Computing** **Type of Course: Theory Only (Discipline Elective)**		**L-T-P-C**	**2**	**0**	**2**	**3**
Version No.		1.0					
Course Pre-requisites		CSE2506					
Anti-requisites		**Nil**					
Course Description		In this course, we will study significant tools and applications that comprise today's cloud computing platform, with a special focus on using the cloud for big data applications. The course covers various topics such as the evolution of computing industry, cloud computing basics and edge computing. The course provides information on the different types of edge compute deployments, different types of edge compute services (such as CDN Edge, IOT Edge, and Multi-access Edge (MEC)). The course also educates the students on the different vendor platforms, software services, standard bodies and open source communities available for edge computing. Students will also create a research project of their choosing.					
Course Objective		The objective of the course is to familiarize the learners with the concepts of Edge Computing and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes		On successful completion of the course the students shall be able to: CO1 Understand the principles, architectures of edge computing (Knowledge) CO2 Describe IoT Architecture and Core IoT Modules (Comprehension) CO3 Summarize edge to Cloud Protocols (Comprehension) CO4 Describe Edge computing with RaspberryPi (Comprehension)					
Course Content:							
Module 1	IoT and Edge Computing Definition and Use Cases	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity			**9 Sessions**	
	Topics: Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.						
Module 2	IoT Architecture and Core IoT Modules	Term paper/Assignment/**Case Study**	Programming/Simulation/Data Collection/any other such associated activity			**9 Sessions**	

	Topics: A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.			
Module 3	RaspberryPi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**10 Sessions**
	Topics: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.			
Module 4	Edge to Cloud Protocols	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	**7 Sessions**
	Topics: Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols-Protocols,MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions,MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.			
Module 5	Edge computing with RaspberryPi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**7 Sessions**
	Topics: Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.			
	Targeted Application & Tools that can be used: 1. **Application** : Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking. 2. **Tools** :Eclipse ioFog : An integrated development environment built by the Eclipse Foundation, backed by IBM. Eclipse ioFog is the organization's open-source edge computing platform.			
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
	Exploring topics such as developing scalable architectures, moving from closed systems to open systems, and ethical issues rising from data sensing, addresses both the challenges and opportunities of Edge computing presents. Students can harness federating Edge resources, middleware design issues, data management and predictive analysis, smart transportation and surveillance applications, and more. A coordinated and integrated solutions can be provided by thorough knowledge of the foundations, applications, and issues that are central to Edge computing.			
	Text Book ● IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806			

	2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.
	Topics relevant to "EMPLOYABILITY SKILLS": Implementation of Microcomputer RaspberryPi and device Interfacing for developing **Employability Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSE3418	Course Title: Network Security and Firewall Management Type of Course: Lab Integrated	L-T- P- C	2	0	2	3
Version No.	1					
Course Pre-requisites	CSE2503					
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: **CSE3419**	**Course Title:** Information Security and Management **Type of Course: Theory Only**		**L- T-P- C**	3	0	0	3

Version No.		1
Course Pre-requisites		CSE2503
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 WEBLINKS: 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: CSE3420	Course Title: Network Intrusion Detection and Prevention Type of Course:1] PCC 2] Theory Only	L- T-P- C	3	0	0	3

Version No.		1.0
Course Pre-requisites		CSE2503
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: CSE3421	Course Title: Principles and Practices of Web Security Type of Course: Lab Integrated	L- T-P- C	2	0	2	3
Version No.	1					
Course Pre-requisites	CSE2503					
Anti-requisites	Nil					
Course Description	The purpose of this course this course is to introduce you to the field of web security by understanding web functionality and various security validations. The web is our gateway to many critical services and is quickly evolving as a platform to connect all our devices. Web vulnerabilities are growing on a year-to-year basis and designing secure web applications is challenging. The course covers fundamental concepts of web security principles, web vulnerability and exploitation, various attacks on web applications, and a few basic topics on web encryption.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Web Security** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** • Define the fundamentals of web applications and validation [Knowledge] • Recognize the significance of password and authentication in web applications[Comprehension] • Explain the importance of session management in web [Comprehension] • Apply web attack techniques to find vulnerabilities in web applications [Application]					
Course Content:						

Module 1	**Introduction**	Quiz		Comprehension based Quiz on web fundamentals	**10 Sessions**
	Topics: Web Functionality, Encoding Schemes, Mapping the Application - Enumerating the Content and Functionality, Analyzing the Application Bypassing, Client-Side Controls: Transmitting Data Via the Client, Capturing User Data, Handling Client-Side Data Securely - Input Validation, Blacklist Validation - Whitelist Validation - The Defense in-Depth Approach - Attack Surface Reduction, Rules of Thumb, Classifying and Prioritizing Threats.				
Module 2	**Web Application Authentication**	Assignment		Comprehensive based assignment on Web authentication	**11 Sessions**
	Topics: Authentication Fundamentals- Two Factor and Three Factor Authentication, Web Application Authentication- Password Based, Built-in, HTTP, Single Sign-on, Custom Authentication, Validating credentials - Secured Password Based Authentication: Attacks against Password, Importance of Password Complexity - Design Flaws in Authentication Mechanisms - Implementation Flaws in Authentication Mechanisms - Securing Authentication.				
Module 3	**Session Management**	Quiz		Comprehension based Quiz on	**11 Sessions**

	&Web Security Principles			web security techniques.	
	Topics: Need for Session Management, Weaknesses in Session Token Generation, Weaknesses in Session Token Handling, Securing Session Management; Access Control: Access Control Overview, Common Vulnerabilities, Attacking Access Controls, Securing Access Control. Origin Policy, Exceptions, Browser security Principles-Cross Site Scripting and Cross Site Request Forgery, File Security Principles: Source Code Security, Forceful Browsing, Directory Traversals.				
Module 4	**Web Application Vulnerability**	Assignment		Comprehension based assignment on web vulnerabilities	**10 Sessions**
	Topics: Attacking data-stores and backend components- Injecting into Interpreted Contexts, injecting into SQL, NoSQL, XPath, LDAP, Injecting OS Commands, Manipulating File Paths, Injecting into XML Interpreters, Injecting into Back-end HTTP Requests, Injecting into Mail Services, Attacking application logic-real world logic flaws, Attacking users-Cross site scripting-varieties of XSS,XSS attacks in action, finding and exploiting XSS vulnerabilities, preventing XSS attacks, Other techniques-cookie based Attacks, HTTP Header Injection				
	List of Laboratory Tasks: **Task 01:** Practical knowledge of known vulnerabilities in CGI, LAMP stacks, REST APIs cross-site scripting **Task 02:** HTTP and setting up stacks, the various types of databases Access Controls, Vulnerabilities **Task 03:** SQL injection and prevention **Task 04:** Study of web authoring tools **Task 05:** Testing web applications **Task 06:** Cross site request forgery attack lab **Task 07:** Web tracking				
	Targeted Application & Tools that can be used 1. Wordpress tool can be used for building websites with possible vulnerabilities. 2. Tools such as Nmap and Nessus can be used for web attack demonstration**.**				
	Project work/Assignment:				
	Assignment: Group assignment to identify and write different web exploits to demonstrate vulnerabilities in web applications.				
	Text Book **T1**Dafydd Stuttard, Marcus Pinto, “The Web Application Hacker’s Handbook”, Willey Publishing Inc.				
	References **R1** B. Sullivan, V. Liu, and M. Howard, “Web Application Security”, A B Guide. New York: McGraw-				

	HillEducation, 2011**R2**Web Application Security: Exploitation and Countermeasure for Modern Web Applications, by AndrewHoffman **E book link R1:** https://presiuniv.knimbus.com/user#/home **E book link R2 :** https://presiuniv.knimbus.com/user#/home R3 **Web resources:** NPTEL / Swayam Link: Introduction to Information Security I, IIT Madras https://nptel.ac.in/courses/106106129 PU Library Link :https://puniversity.informaticsglobal.com/login
	Topics relevant to "EMPLOYABILITY SKILLS": Session Management &Web Security Principles and Web Application vulnerability for **Skill Development** through **Experiential Learning Techniques.** This is attained through the assessment component mentioned in the course handout.

Course Code: CSE3422	**Course Title: Penetration Testing and Risk Assessment** **Type of Course: Theory**	**L-T- P- C**	3	0	0	3

Version No.		1.0
Course Pre-requisites		CSE2503
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**	Quiz		Theory	**11 Sessions**

	analysis				
	Topics: Types of Mobile Application Key challenges in Mobile Application and Mobile application penetration testing methodology, Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention -Handheld Exploitation, WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless – WLAN Penetration Test Methodology.				
Module 4	**Exploits**	Quiz		Theory	**8 Sessions**
	Topics: Architecture and Environment- Leveraging Metasploit on Penetration Tests, Understanding - Metasploit Channels, Metasploit Framework and Advanced Environment configurations – Understanding the Soft Architecture, Configuration and Locking, Advanced payloads and add on modules Global datastore, module datastore, saved environment Meterpreter.				
	Targeted Application & Tools that can be used: This course helps the students to understand the threats and vulnerabilities using NMAP.				
	Project work/Assignment:				
	Project Assignment:				
	Text Book 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: CSE3423	Course Title: Go Programming Type of Course: Theory Only	L- T-P- C	3	0	0	3

Version No.		1.0
Course Pre-requisites		CSE1502
Anti-requisites		NIL
Course Description		Go is an open source programming language created by Google. Go is expressive, concise, clean, and efficient. Its concurrency mechanisms make it easy to write programs that get the most out of multicore and networked machines. Go compiles quickly to machine code yet has the convenience of garbage collection and the power of run-time reflection. It's a fast, statically typed, compiled language that feels like a dynamically typed, interpreted language. It is gaining popularity and it is continuing to grow rapidly in industries such as Dropbox, Uber etc. This course will provide an introduction to the Go programming essentials to students of Engineering through lecture hours with demonstrations. Topics: Topics covered in this course are go program structure; data types and control statements; Composite Types – arrays, slices, strings, runes, bytes, hash maps; functions; methods; garbage collection essentials – pointers, structs, interfaces; error handling; Concurrency – go routines and channels, Packages – import and create custom packages and applications of Go
Course Objective		The objective of the course is to familiarize the learners with the concepts of **GO Programming** and attain Employability Skills through Problem Solving techniques.
Course Out Comes		**On successful completion of the course the students shall be able to:** CO1: Identify primitive programming constructs in GO. (**Knowledge**) CO2: Discuss composite data types with concepts of modular programming. (**Comprehension**) CO3: Implement garbage collection using pointers, structs, interfaces and modules. (**Application**) CO4: Apply concurrent programming and test routines with applications. **(Application)**
Course Content:		

Module 1	**Introduction to Go Programming Language**	Assignment	Data Collection/Interpretation		**10 Sessions**

Topics: **[Knowledge]**

Feature of Go language, Installing and Configuring the development environment- Go tools and playground. Structure of Go program; Basic types-numbers, boolean, strings, runes. Variables- declaration, zero values, naming, rules, conversions, constants, multiple variables. Introduction to packages, functions from other packages, println, reading input, Control Structures - if, switch, for, programming exercises using control

	statements.					
Module 2	**Composite types and functions**	Assignment	Data Collection/Interpretation		**9 Sessions**	
	Topics: **[Comprehension]** Composite types - arrays, slices, slices with overlapping storage, Structs. Functions-declaring, parameters, returning multiple values, variadic functions; Programming exercises					
Module 3	**Pointers, Structs, Interfaces and modules**	Quiz	Case studies / Case let		**9 Sessions**	
	Topics: **[Application]** Pointers: *and & operator, types, pointers with functions, garbage collector – history, Methods and Interfaces, Modules,packages – importing and creating custom packages; Programming exercises.					
Module 4	**Concurrency and Applications**	Quiz	Case studies / Case let		**7 Sessions**	
	Topics: **[Application]** Concurrency using Go routines, multiple go routines, channels – channel operations, Testing- writing test, Go test command, Core Packages for – strings, containers and lists, Writing Web Applications, Basic Statistical Computations, histogram plotting, encryption and decryption.					
	Targeted Application & Tools that can be used: 1. https://go.dev/play/ ● https://go.dev/doc/install					
	Project work/Assignment:					
	Text Book **T1** 1. John Badner,"Learning Go: An Idiomatic Approach to Real World Go Programming", Oreilly, California,2021.					
	References **R1.** 1. Alan A.A. Donovan and Brian W. Kernighan, "The Go Programming Language", Pearson Education, India,2016. **R2**. Tsoukalos M. Mastering Go: Create Golang production applications using network libraries, concurrency, machine learning, and advanced data structures. Packt Publishing Ltd; 2019 Aug 29. **Web resources:** https://www.golangprograms.com/go-language.html EBSCO database of Presidency University:https://puniversity.informaticsglobal.com/login W3. GO document: https://go.dev/doc/ **Online tool for program execution:** ● GO Play Ground - https://go.dev/play/ ● Download and install: https://go.dev/doc/install					

	Topics relevant to development of "Employability": Go Programming basics for developing **Employability Skills** through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: **CSE3424**	**Course Title: Advanced DBMS** **Type of Course:** **Lab Integrated**	**L-T-P-C**	2	0	2	3
Version No.	**1.0**					
Course Pre-requisites	**CSE1510**					
Anti-requisites	**NIL**					
Course Description	**The purpose of this course is to make the students revisit RDBMS transactions first. Then introduce them with Distributed, Parallel, and NoSQL database concepts. They include the main characteristics, advantages, and disadvantages of each one of them. Importance and differences among them are noted. Need to transit from RBMS to NoSQL is discussed. The striking features of distributed, parallel and NoSQL are considered and studied.** **The associated laboratory provides a chance to have hands-on concepts learned during this course.**					
Course Objective	**This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by learning the working on Database using MySQL.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** (1) Recall the transactions in RDMS **(2)** Explain advanced features of distributed, parallel, and NoSQL databases. **(3)** Illustrate the features in Distributed database **(4)** Employ Parallel database concepts in real life applications.					
Course Content:						
Module 1	**Transactions in RDBMS**	Quiz	Comprehension based Quizzes and assignments.		**06Classes**	
Topics: RDBMS -Transaction control state diagram, ACID properties of transaction, Schedules in transactions - Serial, Non-Serial and Serializable, Serializability-Conflict and View, Conflict Serializability check by Precedency Graph, Concurrency Control – Lock Based and Time Stamp Based.						

Module 2	**NoSQL Databases**	Programming and Mini Project	Laboratory experiments and Mini Projects on NoSQL Topics using MongoDB/ Casandra.	**06Classes**

Topics:

NoSQL Introduction – Scale Out, Commodity Hardware, Brief History, Features – Non-Relational, Schema Free, Simple API, and Distributed. NoSQL Architectures/Data Models - Document, Columnar, Key-Value, and Graph. Transaction in NoSQL- BASE for reliable database transactions, Achieving Horizontal Scalability with Database Sharding, CAP theorem.

Case Study: MongoDB/Casandra/ AWS/ HBase

Module 3	**Distributed Databases**	Assignment	Assignment on main topics of Distributed Databases	**06Classes**

Topics:

Loosely Coupled, Characteristics of Distributed Databases, Local and Global view of applications, Distributed Processing, Types – Homogeneous and Heterogeneous, Distributed Data Storage – Replication and Fragmentation, Fragmentation – Horizontal and Vertical Type, Difference between Centralized and Distributed Databases.

Module 4	Parallel Databases	Assignment	Assignment on main topics of Parallel Databases	**06 Classes**

Topics:

Tightly Coupled, Features of parallel databases, Shared Memory, Shared Disk, Shared Nothing Systems. Advantages of each of these schemes, Advantages and Disadvantages of Parallel Databases, Differences between Parallel and Distributed Databases.

Install MONGODB

https://www.javatpoint.com/mongodb-create-database

Create any one of the following databases.

Employee, Student, University, Banking, or Online Shopping

Drop database

Create Collection: In MongoDB db.createCollection(name,option) is used to create collection.

Drop Collection

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

Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on 'Student' Database.

Level 2: Do MongoDB text search on 'Employee' Database.

Experiment No. 2: Try experiments on MongoDB Operators

Level 1: Perform queries involving MongoDB Query and Projection Operators using 'Student' Database.

Level 2: Do queries involving MongoDB update operator on 'Employee' Database.

Experiment No. 3:Explore different query modifiers.

Level 1: Perform different query modifiers on 'Student' Database.

Level 2: Try various query modifiers on 'Employee' Database.

Experiment No. 4:Explore Aggregation commands.

Level 1: Implement different aggregation commands on 'Student' Database.

Level2: Perform various aggregation commands on 'Employee' Database.

Experiment No. 5:Explore Authentication commands.

Level 1: Try authentication commands on 'Student' Database.

Level 2: NA

Experiment No. 6:Explore Replication Commands

Level 1: Try all replication commands on 'Student' Database.

Level2: Implement replication commands on 'Employee' Database.

Experiment No.7:Try Sharding Commands.

Level1: Explore Sharding Commands on 'Student' Database.

Level 2: Implement Sharding Commands on 'Employee' Database.

Targeted Application & Tools that can be used:

MongoDB is to be installed and used.

Project work/Assignment:

Each batch of students (self-selected batch mates) will identify projects, such as, Library, Banking, and Reservation etc.,and do it. Concepts of NoSQL, like, CRUD operations, supporting ad hoc queries, indexing flexibility, assisting replication, creating capped collections, and Retrieving data from multiple documents.

Sample Mini Projects:

1. Content Management System

Clubbing the content assets like text and HTML into a single database helps provide a better user experience. MongoDB has an excellent toolset not only for storing and indexing but also for controlling the structure of a content management system. You can easily design a web-based CMS by using the model proposed by "Metadata and Asset Management" in MongoDB. Additionally, you can use "Storing Comments" to model user comments on blog posts.

2. Gaming Project

Data is an essential part of making video games work. Some typical examples of gaming data include player profiles, matchmaking, telemetry, and leaderboards.

The common thread between all games is that they all have a specific goal. And you have to achieve multiple objectives or pay your way out to reach the end goal. This may involve steps like watering your plants, growing vegetables, serving food in a restaurant, and so on.

Textbook(s):

1. **Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2019(Wiley Publications).**
2. **Stefano Ceri, Giuseppe Pelagatti , Distributed Databases: Principles and Systems,, 2017(McGraw Hill Education).**

References

1. **Elmasri R and Navathe S B, "Fundamentals of Database System",7th Edition, 2017(Pearson Publication).**
2. **Pivert. *NoSQL Data Models: Trends and Challenges*, 1st edition(Wiley).**

Topics related to development of "FOUNDATION":Transaction, CRUD Operations, Replication, and Sharding

Topics related to development of "EMPLOYABILITY": Project implementations in software, batch wise presentations

Topics related to development of "HUMAN VALUES AND PROFESSIONAL ETHICS": Team Dynamics during Mini Project Development.

Course Code: CSE3425	**Course Title:** Programming in C# and .NET **Type of Course:** Theory Integrated Lab	**L-T-P-C**	1	0	4	3
Version No.	**1.0**					
Course Pre-requisites	**CSE 1504**					
Anti-requisites	**NIL**					
Course Description	.NET is a software framework which is designed and developed by Microsoft. It is used to develop Form-based applications, Web-based applications, and Web services. There is a variety of programming languages available on the .Net platform, VB.Net, C# etc. C# is one of the most popular languages of .NET framework. It is used to build applications for Windows, phone, web etc. It provides a lot of functionalities and also supports industry standards. This course intends to provide the basic concepts of .NET framework and various components of the .NET framework architecture. This course also provides the features of C# programming language to design and implement console, desktop-based applications and web based applications.					
Course Objective	**This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by learning the working on Database using MySQL.**					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand the fundamental concepts and benefits of .NET framework and its components.[Comprehension] 2. Illustrate the Object-Oriented paradigm using C# Language.[Knowledge] 3. Develop different types of applications by applying the C# programming concepts and database connectivity.[Application] 4. Demonstrate the use of event handling mechanism[Application]					
Course Content:						
Module 1	Concepts of .NET Technology, Implementation of .NET, Components of .NET framework	Quiz	Demonstration of Assembly, Introduction to IDE		**Th + Pr 4+ 1(6)**	
Topics: Understand the motivation behind the .NET platform, Common Language Infrastructure (CLI). Know the role of the Common Type System (CTS), the Common Language Specification (CLS) and the Common Language Runtime (CLR), Understand the assembly, metadata, namespace, type distinction, Contrast single-file and multi-file assemblies, Know the role of the Common Intermediate Language (CIL),Introduction to .NET Core						
Module 2	C# Programming constructs, OOPS concepts	Lab Based Assignme	Hands on Session for the		**3+6(15)**	

		nts,	Concepts, Creating a Console application	

Topics: Program structures, Types and Variables, Expressions, Statements, Structs, Class, Objects Name Spaces - Constructor and Destructors, Function Overloading & Inheritance, Operator Overloading, Array, Interfaces, Modifiers -, Working with Console input & Output, Property and Indexers , Enum ,Interfaces

Module 3	Event handling, Data base Connectivity	Lab based Assignments	Practice Exercises using Visual Studio.NET	**3+3(9)**

Topics:
Delegates and events, Exception handling, Advantage of ADO.NET, ADO.NET Architecture, .NET Providers, Connection, Command, Data Set, Data Reader. Working with Connection Oriented and Connection less approach, Programming Window Forms Applications: The notifies - subscribers paradigm for handling
events. .NET framework for handling GUI events

Module 4	ASP.NET	Lab based Assignments	Practice Exercises using Visual Studio.NET	**2+2(6)**

Topics:
Introduction to Web Forms, Basic working of WebForms, Introduction to Web Forms, Connectivity with the database , validation Controls

List of Practical Tasks:

Experiment 1:[Module 1]

Level 1: Demonstrate the .NET framework and Visual studio IDE for writing C# code.

Level 2: Demonstrate the .NET framework and inside of Assembly using ildasm tool.

Experiment 2: [Module 2]

Level 1: University wants to gift for those date of birth falls on February 29th . Create a C# program that will accept the employee's birth year. Check the leap year and issue them with surprise gift.

Level 2: A developer wants to check the given input is in Fibonacci series or not.

Experiment 3: [Module 2]

Level 1 : A teacher is asked to create mark list of her class students. The class consists of 10 students and they have 5 different subjects. Store the student's name and five subject marks also. Calculate the total of all subject marks and display them.

Level 2: A class teacher is storing the students 'name and Roll number. Write a program to help to sort out the roll number using different sorting techniques.

Experiment 4: [Module 2]

Level 1: Design a class to represent a bank account. Include the following members: Data Members: - Name of the depositor, Account Number, Type of Account, Balance amount in the account and methods : To assign initial values, To deposit an amount, To withdraw an amount after checking balance, To display name and the balance. Write a C# program to demonstrate the working of the various class members.

Level 2: Define a class 'Person' with data members name and age. Also include following: Default Constructor and parameterized constructor, Input method which takes values from user and assigns to data members, Output method to display all data . Create 5 objects of 'Person' class using array of objects and call all the methods of a class.

Experiment 5: [Module 2]

Level 1: Write a C# program to show single and multilevel inheritance.

Level 2: Create a class 'Emp' by extending Person class with additional data member empno, position with following features:

a. Default constructor

b. Parameterized constructor

c. Input method which takes values from user and assigns to data members and calls input method of Person

d. Output method to display all data and calls output method of Person

Define a class Manager by extending Emp with data member bonus. Provide necessary constructors and override input and output methods. Create objects of manager in main.

Experiment 6: [Module 2]

Level 1: Calculate the area of different shapes using method overloading.

Level 2: Class teacher created different groups in a class and store the data in that. In order to make common announcements and activities, teacher merged all data into a single group. Write a code to merge two groups into one.

Experiment 7: [Module 2]

Level 1: Class Teacher stores students marks in an array. Teacher is searching for highest and lowest marks of the class and number of students scored those marks. Write a program to help teacher to do the same.

Level 2: Create an application for currency converter.

Experiment 8: [Module 3]

Level 1: EC is updating their database of new voters. If the user's age is less than 18, application should raise the exception.

Level 2: Develop a desktop based application for displaying employees salary and leave balance.

Experiment 9: [Module 3]

Level 1: Create a login screen and prompts for the user name and Password. If the user exists in the database , show welcome message to the user when the button is clicked.

Level 2: Company wants to create a calculator application using C#.

Experiment 10: [Module 3]

Level 1: University stores the CSE students' data in the database and display the student details whenever required. Administrator allows to insert, update and modify the data. Implement this.

Level 2: University decides to conduct online quiz for CSE students. Create a windows-based application to implement this.

Experiment 11: [Module 4]

Level 1: University is organizing a cultural festival and organizing teams wants to collect registration for various events with the help of web page. Design a registration form for collecting the participant details.

Level 2: University is decided to display all information about the various departments in their website.

Design a web site to show the above mentioned.

Experiment 12: [Module 4]

Level 1: XYZ corporation wants to review their product. So company is creating a feedback form and validating the data with the help of validation controls. Design a feedback form with validation controls.

Level 2: XYZ corporation wants to review their product. So company is creating a feedback form and validating the data with the help of validation controls. Design a feedback form with validation controls and display the comparison chart of various months.

Targeted Application & Tools that can be used:

Microsoft Visual studio.NET 2022, Visual Studio Code.

Project work/Assignment:

Problem Solving: Design of Algorithms and implementation of programs.

Programming: Implementation of given scenario using .NET.

Textbook(s):

1. Herbert Schildt , "C# 4.0 The Complete Reference", Fourth Edition, TMH

2. 2. Matthew Macdonald,"ASP.NET: The Complete Reference", McGraw Hill Education

References:

1. Joseph Albahari and Ben Albhari, "C# 3.0/4.0 in NUTSHELL", O'REILLY.

2. Andrew Troelsen, "C# and the .NET Platform" 1st edition Apress

3. Matthew Macdonald,"Beginning ASP.NET 4.5 in C#", Wiley India

Online References

1.C# Tutorial (C Sharp) (w3schools.com)

2. https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/tutorials/

3.https://docs.microsoft.com/en-us/aspnet/tutorials

Topics relevant to development of "Employability": Web Application developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3426	**Course Title: Front-end Full Stack Development** **Course Type : Lab Integrated**	**L- T-P- C**	2	0	2	3

Version No.		1.0
Course Pre-requisites		CSE1504
Anti-requisites		**NIL**
Course Description		This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.
Course Objectives		The objective of the course is to familiarize the learners with the concepts Front end Full Stack Development and attain Employability through experiential Learning techniques.
Course Outcomes		**On successful completion of the course the students shall be able to:** **1] Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension]** **2] Illustrate a basic web design using HTML, CSS, Javascript. [Application]** **3] Illustrate development of a responsive web. [Application]** **4] Apply concepts of Angular.js to develop a web front-end. [Application]**
Course Content:		

Module 1	Fundamentals of DevOps	Project		Programming	**04 Sessions**
	Topics: Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control.				
Module 2	Web Design & Development	Project		Programming	**03 Sessions**
	Topics: HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform; **Assignment:** Develop a website for managing HR policies of a department.				

Module 3	Responsive web design	Project		Programming	**08 Sessions**
	Topics: BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction **Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society.				
Module 4	Fundamentals of Angular.js	Project		Programming	**15 Sessions**
	Topics: Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Overview of React.js **Assignment:** Develop a software tool to do inventory management in a warehouse.				
	Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.** **Professionally Used Software: GCC compiler.**				
	Text Book: T1. Fender, Young, "*Front-end Fundamentals*", Leanpub, 2015 T2. Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*", APress, 2018				
	References: R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020. R2. Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials"*, Packt Publishing, 2016				

	R3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development."*; Wiley; 2014. R4. Web Reference: https://www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2 R5. Web Reference: https://www.freecodecamp.org/news/frontend-web-developer-bootcamp/ https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live https://nptel.ac.in/courses/106102064
	Topics relevant to development of "Employability": DevOps Tools Overview – Jenkins, Docker, Kubernetes for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE3427	**Course Title: Java Full Stack Development** **Course Type: Lab Integrated**	**L- T-P- C**	2	0	2	3

Version No.		1.0
Course Pre-requisites		**CSE1514**
Anti-requisites		
Course Description		This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.
Course Outcomes		**On successful completion of the course the students shall be able to:** **1] Practice the use of Java for full stack development [Application]** **2] Show web applications using Java EE. [Application]** **3] Solve simple applications using Java Persistence and Hibernate [Application]** **4] Apply concepts of Spring to develop a Full Stack application. [Application]** **5] Employ automation tools like Maven, Selenium for Full Stack development. [Application]**
Course Content:		

Module 1	Introduction	Project		Programming	**03 Sessions**
	Topics: Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools.				
Module 2	Java EE Web Applications	Project		Programming	**05 Sessions**
	Topics:				

	Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App **Assignment:** Develop an application for managing HR policies of a department.				
Module 3	Java Persistence using JPA and Hibernate	Project		Programming	**06 Sessions**
	Topics: Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA) **Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society.				
Module 4	Spring Core	Project		Programming	**10 Sessions**
	Topics: Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development **Assignment:** Develop a software tool to do inventory management in a warehouse.				
Module 5	Automation tools	Project		Programming	**06 Sessions**
	Topics: Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands **Assignment:** Illustrate the use of automation tools in the development of a small software project.				
	Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**				

	Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.
	Project work/Assignment:
	Problem Solving: Design of Algorithms and implementation of programs. **Programming: Implementation of given scenario using Java.**
	Text Book: T1. Fender, Young, "*Front-end Fundamentals*", Leanpub, 2015
	References R1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017. R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."* , Apress, 2015

Course Code: **CSE3428**	**Course Title: .NET Full Stack Development** Course Type: Lab Integrated		**L- T-P- C**	2	0	2	3
Version No.		1.0					
Course Pre-requisites		CSE1504					
Anti-requisites		**CSE3427**					
Course Description		This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course.					
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.					
Course Outcomes		**On successful completion of the course the students shall be able to:** **1] Practice the use of C# for developing a small application [Application]** **2] Show web applications using Entity Framework. [Application]** **3]Solve simple web applications that use SQL and ASP.NET [Application]** **4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]**					
Course Content:							
Module 1	C# Programming for Full Stack Development	Project		Programming		**10 Sessions**	
	Topics: .NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework						

	Assignment: Develop a small application for managing library using C#.				
Module 2	Entity Framework Core 2.0	Project		Programming	**06 Sessions**
	Topics: Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET **Assignment:** Develop an application for managing HR policies of a department.				
Module 3	ASP.NET	Project		Programming	**06 Sessions**
	Topics: ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts; **Assignment:** Develop a web application to mark entry/exit of guests in a building.				
Module 4	ASP.NET	Project		Programming	**08 Sessions**
	Topics: Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application **Assignment:** Develop a software tool to do inventory management in a warehouse.				
	Targeted Application & Tools that can be used: **Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.** **Professionally Used Software: Visual Studio**				
	Project work/Assignment:				
	Problem Solving: Design of Algorithms and implementation of programs. **Programming: Implementation of given scenario using .NET.**				

	Text Book: T1. Fender, Young, "*Front-end Fundamentals*", Leanpub, 2015 T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021.
	References R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021. R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017. R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018. R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017.

Course Code: CSE2263	**Course Title:** **Analysis of Algorithms Lab** **Type of Course: Lab**	**L- T-P- C**	0	0	2	1
Version No.	1					
Course Pre-requisites	CSE2054					
Anti-requisites	NIL					
Course Description	This course introduces techniques for the design and analysis of efficient algorithms and methods of applications. This course discusses the classic approaches for algorithm design such as Divide and Conquer, Dynamic Programming, Greedy method. This course also describes other basic strategies searching solution space. The core concepts of analyzing algorithms and classifying them into various complexity classes is covered in the end.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Analysis of Algorithms** and attain **Skill Development** through **Experiential Learning** Methodologies.					
Course Out Comes	**On successful completion of the course the students shall be able to:** 1. Compute efficiency of a given algorithm. [Applying] 2. Apply divide and conquer technique for searching and sorting Problems. [Applying] 3. Apply the Dynamic Programming technique for a given problem. [Applying] 4. Apply greedy technique for solving a Problem.[Applying] 5. Demonstrate Back tracking technique and limitations of Algorithms.[Applying]					
Course Content						

Module 1	**Introduction**	**3 Sessions**
Measuring running time of an algorithm, Compare running time of algorithms, Implement sorting algorithms such as bubble sort, selection sort		
Module 2	**Divide-and-conquer**	**3 Sessions**
Compare searching algorithms: Linear Search, Binary Search; Compare Sorting algorithms: Insertion Sort, Merge Sort, QuickSort.		
Module 3	**Dynamic programming**	**3 Sessions**
Introduction and memorization: Factorial; Coin Change Problem ; Floyd-Warshall's Algorithm.		
Module 4	**Greedy technique**	**3 Sessions**
Fractional Knapsack Problem; Minimal Spanning Tree Algorithms-Prim's Algorithm, Kruskal's algorithm		
Module 5	**Complexity Classes**	**3 Sessions**
Branch and Bound: Knapsack problem; Backtracking, - N-Queens problem.		
	List of Laboratory Tasks: **1. Measuring running time of an algorithm** **Objective: To experimentally determine the running time of basic algorithms for input size n=10, 100, 1000, etc. by taking difference of starting time and ending time.** **2. Compare running time of algorithms** **Objective: To execute two algorithms to solve the same problem, and to comparatively evaluate the better algorithm for large values of N.** **3. Implement sorting algorithms such as bubble sort, selection sort** **Objective: To implement comparison based sorting strategies.** **4. Compare searching algorithms** **Objective: To implement two searching strategies and compare their performance.** **5. Compare Sorting algorithms** **Objective: To implement searching strategies that follow top down design approach(Insertion sort, merge sort).** **6. Quick Sort** **Objective: To demonstrate Quick sort and its variants, and their impact on running time.** **7. Dynamic Programming** **Objective: To demonstrate Dynamic Programming approach with the help of Factorial algorithm.** **8. Coin Change Problem** **Objective: To implement an efficient algorithm for the Coin Change problem.** **9. Floyd-Warshall's Algorithm**	

	Objective: To demonstrate how dynamic programming is used with the help of Floyd-Warshall's algorithm. **10. Fractional Knapsack Problem** **Objective: To demonstrate how greedy method can be used to solve the Fractional Knapsack Problem.** **11. Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategy to solve the Minimal Spanning Tree problem using Prim's Algorithm.** **12. Kruskal's Minimal Spanning Tree Algorithm** **Objective: To implement greedy strategies to solve the Minimal Spanning Tree problem using Kruskal's Algorithm.** **13. Knapsack Problem** **Objective: To implement Knapsack problem using branch and bound technique.** **14. N-Queen's Problem** **Objective: To demonstrate backtracking method with the help of N-Queen's problem.** **15. Case Study** **Objective: To demonstrate how various techniques can be used to solve the same problem with the help of Knapsack problem.**
	Targeted Application & Tools that can be used 1. PyTorch/Jupyter Notebook – For Python programming
	Text Book **T1** Anany Levitin, "*Introduction to the Design and Analysis of Algorithms*", 3rd edition, Pearson Education, 2018. **T2** Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "*Introduction to Algorithms*", 4th edition, MIT Press, 2022.
	References R1. J. Kleinberg and E. Tardos, "*Algorithm Design*", Addison-Wesley, 2005. R2. Tim Roughgarden, "*Algorithms Illuminated"* (books 1 through 3), "Operating Systems Design and Implementation", Soundlikeyourself Publishing, 2017-2019. R3. AV Aho, J Hopcroft, JD Ullman, "*The Design and Analysis of Algorithms"*, Addison-Wesley, 1974. R4. Donald E. Knuth, "*The Art of Computer Programming"*, Volumes 1and 3 Pearson. Web Based Resources and E-books: W1. NPTEL: https://onlinecourses.nptel.ac.in/noc19_cs47/preview W2. Coursera: Analysis of Algorithms by Princeton University W3. Algorithms Specialization in Coursera by Stanford University(Group of 4 courses). W4. Algorithms Coding Contest Links maintained by Prof Gerth Stølting Brodal of Aarhus University

	Topics relevant to "EMPLOYABILITY SKILLS": The lab experiments and assessments enable the student to acquire Skill Development through Experiential Learning techniques

Course Code: **PPS1012**	**Course Title: Enhancing Personality through Soft Skills** Type of Course: Practical Only Course	L- T - P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	--					
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 "Personality Development through 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:** CO 1 **Identify the stages of** team formation (Remember) CO 2 **Demonstrate** effective presentation skills (Apply) CO3 **Prepare** professional social media profile (Apply)					
Course Content:						
Module 1	Team Building	Classroom and outbound team building activities.	6 Hours			
Topics: Importance of team, stages of Team Formation, Trust and collaboration, Virtual Team. **Activity: Team Building outbound activity**						

Module 2	Art of Questioning	Role plays	**4 Sessions**
Topics: Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions			
Module 3	Presentation Skills	Practice and evaluation of individual / group presentation	**10 Sessions**
Topics: Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges. **Activity:** Individual presentations and team presentation			
Module 4	Professional Brand Building	Brand Framework Activity	4 Sessions
Topics: Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies. **Activity:** Create a basic online profile			
Module 5	Recap / Revision /Feedback Session		1 Session
Targeted Application & Tools that can be used: TED Talks You Tube Links Activities			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
Presentation Evaluation			
Targeted Application & Tools that can be used: TED Talks YouTube Links Videos by L&D Team shared on Edhitch/YouTube.com LMS			

Assignments proposed for this course

Evaluation on Presentation
Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z__jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

"Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8

"The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014

"The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006

"Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills
https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/

https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to development of "SKILL": Art of Presentation, Team building, Art of questioning and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 7100	**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: **CSE2502**	**Course Title:** Cryptography and Network Security **Type of Course: PCC**		**L- T- P- C**	3	**0**	0	**3**
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	The Course deals with the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Cryptography and Network Security above and attain Skill Development through Problem Solving methodologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Describe the basic concept of Cryptography 2. Classify different types of Cryptographic Algorithms 3. Solve Mathematical problems required for Cryptography 4. Illustrate Network Security concepts					
Course Content:						
Module 1	Introduction to Cryptography	Assignment	Recognize the techniques	**7 Sessions**		
Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: active attacks, passive attacks, services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution Ciphers : Play-fair and Hill Cipher, Vigenere cipher, Introduction to Block Cipher and Stream Cipher, Feistel Structure, ECB modes of block cipher.						
Module 2	Symmetric Encryption Algorithm	Assignment	Analysis of solutions	9 Sessions		
Overview of Public Key Cryptography, RSA, Diffie-Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Ei-gamal Encryption, Elliptic curve cryptography overview.						
Module 3	Public Key Cryptography	Assignments	Analysis of solutions	9 Sessions		
Overview of Public Key Cryptography, RSA, Diffie-Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Ei-gamal Encryption, Elliptic curve cryptography overview						
Module 4	Network Security	Assignment	Analysis of solutions	05 Sessions		
Topics: Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IPSec architecture, Network Security applications: DNS Security.						
Targeted Application & Tools that can be used: Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages.						
Text Book(s): T1 William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson publication, ISBN: 978-93-325-8522-5, 2017						

Reference(s): R1 Bruice Schneier, “Applied Cryptography – Protocols, Algorithms and Source code in C”, Second Edition, Wiley Publication, ISBN: 978-81-265-1368-0, 2017 R2 Cryptography and Network Security, Express Learning, ITL Education Solution Limited. R3 e-pg pathshala UGC lecture series Web references: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site =ehost-live https://nptel.ac.in/courses/106105031.
Topics relevant to “Skill Development”: Topics relevant to “Skill Development”: 1. Play-fair and Hill Cipher 2. Euclidean and Extended Euclidean Algorithm 3. Secure Hash Algorithm 4. Diffie-Helman Key exchange 5. Totient Function. 6. Fermat’s little theorem

Course Code: COM2502	**Course Title: Applied Machine Learning** **Type of Course: Program Core - Theory**	**L-T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	CAI2500					
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	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.
Course Out Comes	On successful completion of this course the students shall be able to: 31. **Apply** advanced supervised machine learning methods for predictive modeling. [Apply] 32. **Produce** machine learning models with better predictive performance using meta learning algorithms [Apply] 33. **Create** predictive models using Perceptron learning algorithms [Apply] 34. **Employ** advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection [Apply] 35. **Implement** machine learning based intelligent models using Python libraries. [Apply]

Course Content:

Module 1	**Supervised Learning**	**Assignment**	**Module Tests**	**No. of Sessions: 08**

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. Evaluation Methodologies – Testing Dataset, Train-Validation-Testing, N-Fold Cross Validation.

Module 2	**Ensemble Learning**	**Assignment**	**Module Tests**	**No. of Sessions: 06**

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**	**Module Tests**	**No. of Sessions: 07**

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**	**Module Tests**	**No. of Sessions: 09**

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). Association Rule Mining. Collaborative Filtering.

Targeted Application & Tools that can be used:

17. Google Colab
18. Python IDEs like PyCharm

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

4. 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.

Textbook(s):

10. Aurélien Géron. *Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow*, Oreilly, 3rd Edition, 2022.

References:

R1. Andreas C Muller, and Sarah Guido. *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'Reilly, 1st Edition, 2016.

Weblinks

W1. NPTEL Courses: https://nptel.ac.in/courses/106106139 (IIT M), https://nptel.ac.in/courses/106105152 (IIT Kgp)

Course Code: COM2501	**Course Title:** **Computer Vision and LLMs Lab** **Type of Course:** **Program Core - Laboratory**	**L-T-P-C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	CAI2500					
Anti-requisites	NIL					
Course Description	This course combines computer vision with large language models. It provides an introduction to computer vision, deep learning techniques for computer vision, followed by large language models, and finally multimodality in the form of text and vision. Topics: Convolution, Convolutional Neural Networks, Image Representation, Softmax Function, Attention, Transformers, Multimodality					
Course Objectives	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: 36. **Summarize** the concepts of digital image processing (Understand). 37. **Describe** the various Image formation techniques and its difficulties (Understand). 38. **Apply** the linear filter to images (Apply).					

	39. **Use** EM Algorithm for identifying the segments in an image (Apply).

Course Content:
No. of Sessions: 15 (30 hours)

Experiment No. 1: Image File Handling
Level 1: Read image files using Python.
Level 2: Save image files using Python.

Experiment No. 2: Introduction to Digital Image Processing
Level 1: Perform image enhancement operations
Level 2: Perform filtering with morphological operators

Experiment No. 3: Image Denoising
Level 1: Perform image denoising operation.
Level 2: Noise removal using a Weiner filter.

Experiment No. 4: Image Segmentation
Level 1: Perform edge-based and region-based image segmentation
Level 2: Perform image labelling.

Experiment No. 5 & 6: Image Classification
Level 1: Perform image classification using Logistic Regression and Support Vector Machine
Level 2: Perform image classification using Multilayer Perceptron and CNN.

Experiment No. 7 & 8: Object Detection
Level 1: Detect objects in a scene using HOG
Level 2: Detect objects in a scene using CNN

Experiment No. 9 & 10: Optical Character Recognition
Level 1: Implement a CNN to detect printed characters in various fonts.
Level 2: Implement a CNN to detect and decipher handwritten characters.

Experiment No. 11: Image Generation Using DALL-E
Level 1: Using GPT Vision model for text to image generation
Level 2: Creating an image by first creating a prompt and then an image.

Experiment No. 12: Generative Adversarial Network
Level 1: Implement a GAN for neural style transfer.
Level 2: Use a GAN to generate a Ghiblified image of an event.

Experiment No. 13: Image to Image Generation
Level 1: Develop a Hidden Markov Model (HMM) for NLP tasks such as PoS tagging.
Level 2: Evaluate the performance of the HMM on a specific NLP task (e.g., Named Entity Recognition or Chunking).

Experiment No. 14 & 15: Subtitle Generation
Level 1: Generate subtitles for a video in English.
Level 2: Generate ***English*** subtitles for an anime (Japanese animated) video. NOTE: The audio here will be in Japanese!

Targeted Application & Tools that can be used:

19. Google Colab
20. Python IDEs like PyCharm

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

Students will perform a shared task in the semester.

Textbook(s):

10. Ian Goodfellow, Yoshua Bengio, Aaron Courville. *Deep Learning*, (1st Edition). The MIT Press, 2016.

11. David Forsyth, Jean Ponce. *Computer Vision: A Modern Approach* (2nd Edition). Pearson Education India, 2015.

12. David Foster. *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play* (2nd Edition). O'Reilly, 2023.

References:

R1. Vineeth Balasubramaniam. *Deep Learning for Computer Vision* (1st Edition). NPTEL. 2020.

Weblinks

W1. NPTEL Course: https://nptel.ac.in/courses/106106224

Course Code: UG COURSE: CAI3429	**Course Title: Deep Learning for Computer Vision** **Type of Course: Discipline elective Theory with embedded lab**	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	MAT1003					
Anti-requisites	NIL					
Course Description	This course covers the fundamentals and advanced concepts of deep learning for computer vision applications. Students will explore convolutional neural networks (CNNs), object detection, image segmentation, and generative models. Hands-on lab experiments will reinforce theoretical concepts using frameworks like TensorFlow and PyTorch.					
Course Out Comes	**On successful completion of the course the students shall be able to:** **1. Understand the Fundamentals of Deep Learning for Vision** Explain the core concepts of neural networks and deep learning architectures for image processing. Implement and optimize convolutional neural networks (CNNs) for classification tasks. **2. Apply Object Detection and Image Segmentation Techniques** Implement and analyze state-of-the-art object detection algorithms such as YOLO, Faster R-CNN, and SSD. Develop and evaluate image segmentation models like U-Net and Mask R-CNN. **3. Explore Advanced Deep Learning Techniques for Vision** Utilize Vision Transformers (ViTs) and attention mechanisms					

	for image classification. Generate and manipulate images using Generative Adversarial Networks (GANs). 4. **Deploy and Optimize Deep Learning Models for Real-World Applications**			
Course Content:				
Module 1	**Fundamentals of Deep Learning for Vision**	Assignment	Practical	**No. of Classes: 8**
Introduction to Deep Learning & Neural Networks, Convolutional Neural Networks (CNNs) Architecture Backpropagation & Optimization in CNNs, Transfer Learning & Pretrained Models.				
Module 2	**Object Detection & Image Segmentation**	Assignment	Practical	**No. of Classes: 14**
Introduction to Object Detection (R-CNN, SSD, YOLO), Region Proposal Networks (Faster R-CNN) Semantic & Instance Segmentation (U-Net, Mask R-CNN), Real-time Object Detection Applications				
Module 3	**Advanced Topics in Vision**	Assignment	Practical	**No. of Classes: 8**
Attention Mechanisms & Vision Transformers (ViTs), Generative Adversarial Networks (GANs) for Image Generation, Self-supervised Learning for Vision, Multi-modal Learning (CLIP, DALL·E)				
Module 4	**Applications & Deployment**	Assignment	Practical	**No. of Classes: 8**
Edge AI & Mobile Deployment (TensorFlow Lite, ONNX), Adversarial Attacks & Robustness in Vision Models, Explainability & Interpretability of Vision Models, Case Studies & Industry Applications				

Lab Experiments are to be conducted on the following topics:-

Lab Sheet 1:

Keras Sequential API model

1. Read in the data and explore
2. Define a Sequential API model
3. Define the hyperparameters and optimizer
4. Train the model and visualize the history
5. Testing

Keras Functional API model:

1. Define a Functional API model
2. Train the model and visualize the history

Lab Sheet 2:

Softmax regression with Keras

1. Read in the data and prepare
2. Define a Sequential API model
3. Define the hyperparameters and optimizer
4. Train the model and visualize the history
5. Testing

Lab Sheet 3:

Convolutional Neural Network with Keras (grayscale images)

1. Read in the data:
2. Visualize the data:
3. Prepare the data:
4. Define a CNN model:
5. Define the hyperparameters and optimizer:
6. Train the model and visualize the history:
7. Testing:

Lab Sheet 4:

Convolutional Neural Network with Keras (color images):

1. Read in the data:
2. Visualize the data:
3. Prepare the data:
4. Define a CNN model:
5. Define the hyperparameters and optimizer:
6. Train the model and visualize the history:
7. Testing:

Lab Sheet 5:

Time series and prediction:

1. Read in the data and explore:
2. Apply the exponential smoothing method and predict

Recurrent neural network (RNN):

1. Pre-processing:
2. Do the necessary definitions: (Hyper parameters, Model,
3. Train the model:
4. Predict the future:

Lab Sheet 6:

Document classification with LSTM network:

1. Read in the data:
2. Explore the data:
3. Data preprocessing:

4. Define the model:
5. Define the optimizer and compile:
6. Train the model and visualize the history:
7. Testing:

Lab Sheet 7:

Document classification with LSTM network (Binary):

1. Read in the data:
2. Explore the data:
3. Data preprocessing:
4. Define the model:
5. Define the optimizer and compile:
6. Train the model and visualize the history:
7. Testing:

Lab Sheet 8:

Document classification with LSTM + CNN network (Binary):

1. Read in the data:
2. Explore the data:
3. Data preprocessing:
4. Define the model:
5. Define the optimizer and compile:
6. Train the model and visualize the history:
7. Testing:

Lab Sheet 9:

Softmax regression to recognize the handswritten digits:

1. Download the MNIST data:
2. Take a look at the dataset:
3. Do the necessary definitions:
4. Training and Testing:

Multi-layer neural network to recognize the handswritten digits:

1. Download the MNIST data:
2. Take a look at the dataset:
3. Do the necessary definitions:

Training and Testing:

Lab Sheet 10:

Object Detection using YOLOv5

Lab Sheet 11:

Image Segmentation using U-Net
Custom Object Detection using Faster R-CNN

Lab Sheet 12:

Implementing Vision Transformers for Image Classification
Generating Images using GANs (DCGAN, StyleGAN)

(Group Project)

8. Object Detection and Recognition:
    a. Haar cascade object detection (e.g., face detection or object

detection using pre-trained classifiers).
   b. Feature-based object detection using techniques like Speeded-Up Robust Features (SURF) or Scale-Invariant Feature Transform (SIFT).
   c. Deep learning-based object detection using Convolutional Neural Networks (CNNs) or You Only Look Once (YOLO) algorithm.
9. Optical Character Recognition (OCR):
   a. Preprocessing of text images (e.g., binarization, noise removal, or skew correction).
   b. Text localization using techniques like connected component analysis or Stroke Width Transform (SWT).
   c. Character recognition using machine learning algorithms like Support Vector Machines (SVM) or Convolutional Neural Networks (CNNs).
10. Gesture Recognition:
   a. Hand segmentation using techniques like background subtraction or skin color detection.
   b. Feature extraction from hand regions (e.g., finger counting, hand shape descriptors).
   c. Classification of gestures using machine learning algorithms (e.g., k-Nearest Neighbors or Support Vector Machines).

Tools/Software Required :

1. OpenCV 4
2. Python 3.7
3. MATLAB

Text Books

1. "Deep Learning for Computer Vision Image Classification, Object Detection and Face Recognition in Python" **Jason Brownlee (2019)**

2. "Deep Learning for Computer Vision with python" **Adrian Rosebrock (2017)**

References

3. **Goodfellow, I., Bengio, Y., & Courville, A. (2016).** *Deep Learning*. MIT Press.

   A foundational book covering deep learning principles, including CNNs, optimization, and generative models.

4. **Raschka, S., & Mirjalili, V. (2022).** *Machine Learning with PyTorch and Scikit-Learn.* Packt Publishing.

   Covers practical deep learning techniques using PyTorch, including CNNs and transfer learning.

5. **Geron, A. (2022).** *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd Edition)*. O'Reilly Media.

   Provides hands-on implementations of deep learning for computer vision using TensorFlow and Keras.

6. **Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2021).** *Dive into Deep Learning*. Available online (https://d2l.ai).

   Open-access book covering CNNs, object detection, and advanced vision techniques with PyTorch

and TensorFlow.

7. **Chollet, F. (2021).** *Deep Learning with Python (2nd Edition).* Manning Publications.

   Explains deep learning fundamentals and applications with Keras, including image classification and segmentation.

8. **Ballé, J., Laparra, V., & Simoncelli, E. P. (2017).** *Deep Learning for Computer Vision: A Brief Introduction.*

   A concise introduction to CNNs, object detection, and generative models.

Course Code: ECE3073	**Course Title: IoT: Architecture and Protocols** **Type of Course: PCC**	**L- T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	**The purpose of this course is to introduce the students to the Internet of Things (IoT) technologies and Industry 4.0 which is transforming the industry by integrating modern technology with the help of sensors, computational processes and communication technologies. The comprehensive nature of the course inculcates critical thinking skills among students to develop and design a complete IoT solution. The course emphasizes on programming and interfacing various hardware resources in order to provide wireless and/or wired smart IoT solutions which enhance students' abilities to become an efficient IoT Application Designer.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** i) Discuss various types of IoT architectures. ii) Explain various cloud architectures. iii) Summarize various communication protocols used in IoT applications.					

Course Content:				
Module 1	**IoT Architecture & Components**	Assignment/ Quiz	Memory Recall based Quizzes	**12 Sessions**
Topics: Basics of IoT, Design and Components, Future of Technology, Scope and Challenges, IoT enabled Areas, Market research, Sensors and actuators, M2M IoT standard Architecture, IoT world forum (IoTWF) standardized architecture. Architecture (2, 3 Layer), Physical device and control layer, Connectivity layer, Edge computing layer, Upper layers, IoT Reference Model. Simplified IoT architecture-A core of IoT functional Stack.				
Module 2	**Data Management**	Assignment/ Quiz	Real time Application Project	**12 Sessions**
Topics: Selection of IoT Platforms, Embedded Systems, Data management and computing stack - Edge computing, Fog computing, cloud computing, Cloud architecture, SaaS, PaaS, IaaS. Cloud service provider - Google Cloud, AWS etc.				
Module 3	**Communication in IoT**	Assignment/ Quiz	Memory Recall based Quizzes	**11 Sessions**
IoT Accessing technology- IEEE 802.15.1, networking layers, physical layer and topology. IPV4 and IPV6 - Addressing IoT nodes, IoT Edge, 6LOWPAN, ipv4/ipv6, MQTT, AMQP, COAP and MDNS. Web socket Application aware communication, Network and channel aware communication – Topologies and Hierarchy, IoT LAN and WAN connectivity, RFID, BLE, LPWAN, LORA. Real-time applications of IoT.				
Targeted Application & Tools that can be used: Important Applications range from civilian to defense sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IOT **Professionally Used Software:** Kiel, C and Python, Arduino boards and Raspberry Pi				
Project Work/Assignment:				
1.Case Studies: At the end of the course students will be given a 'real-world' application based circuits like Power Amplifier, Signal/Function Generator etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format. **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.** **4.Assignments:** **Assignment 1: Design a IOT based application for healthcare and agriculture and physically challenged peoples.** **Assignment 2: Write a brief report on Current IOT based systems available and identify their components, the Network they are using to communicate.** **Assignment 3: Design a IOT based application for** **a. Health care** **b. Agriculture** **c. Transport Management** **d. Stock Management** **e. COVID-19**				
Text Book(s):				

1. Sudip Misra, , Anandarup Mukherjee, Arijit Roy " Introduction to IOT ", Cambridge University Press, January 2021.
Reference(s): **Reference Book(s):** **R1 Arshdeep Bagha & Vijay Madisetti, " Internet of Things a Hands on Approach" .** **R2 Adrian McEwen & Hakim Cassimally "Designing the Internet of Things".** **R3** IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things By David Hanes, CCIE No. 3491 Gonzalo Salgueiro, CCIE No. 4541 **Online Resources (e-books, notes, ppts, video lectures etc.):** 1. https://nptel.ac.in/courses/117/103/117103063/ 2. https://nptel.ac.in/courses/108108179
Topics relevant to the: "FOUNDATION SKILLS", Introduction and background on IoT Technology, Introduction to IOT Technology, Cloud Computing Topics relevant to the:" EMPLOYABILITY", Industry 4.0 and IoT.

Course Code: CSE7100	**Course Title: Mini Project**	**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: Identify the engineering problems related to local, regional, national or global needs. (Understand)					

	Apply appropriate techniques or modern tools for solving the intended problem. (Apply) Design the experiments as per the standards and specifications. (Analyze) Interpret the events and results for meaningful conclusions. (Evaluate) Appraise project findings and communicate effectively through scholarly publications. (Create)

Course Code: PPS1001	**Course Title: Introduction to Soft Skills** **Type of Course: HSMC**	**L- T-P- C**	**0**	**0**	**2**	**1**
Version No.	1.0					
Course Pre-requisites	--					
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			
4) Individual Assessment 5) 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: **CSE2251**	**Course Title:** Data Communications and Computer Networks **Type of Course:** **Theory**	**L- T-P- C**	3	**0**	0	**3**
Version No.	1.0					
Course Pre-requisites	ECE2007					
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	The objective of the course is to familiarize the learners with the concepts of					

Objective	Data Communications and Computer Networks and attain Employability through Problem Solving Methodologies.			
Course Outcomes	On successful completion of the course, the students shall be able to: 1] Ilustrate 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	**7 Sessions**
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 Sessions**
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 –CO3	Assignment	Problem Solving	**10 Sessions**
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 Sessions**

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.

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

Problem Solving: Choose and appropriate devices and implement various network concepts.
Programming: Simulation of any network using NS2.

Text Book(s):

1. 1. Behrouz A. Forouzan, “Data Communications and Networking 5E”, 5 th Edition, Tata McGraw-Hill, 2017.
2. Andrew S Tanenbaum, Nick Feamster & David J Wetherall, “Computer Networks” Sixth Edition, Pearson Publication, 2022

Reference(s):

1.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

6. https://puniversity.informaticsglobal.com/login

Course Code: ECE3111	**Course Title:** Microprocessor and Microcontroller **Type of Course:** Theory (For CSE)	**L- T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**ECE2007**					
Course Description	**The purpose of this course is to enable the students to appreciate the fundamentals of microprocessor and microcontroller. The course is both conceptual and analytical which imparts knowledge of both hardware and software leading to a system design used in real-world applications. The course develops critical thinking skills by augmenting the student's quest to develop assembly language programs as well hardware interconnections for commonly used applications. The comprehensive nature of the course covers a number of quizzes, assembly language programming using simulation tools and various interfacing assignments, which enhances students' abilities to become an independent system designer.**					
Course Objective	**The objective of the course is SKILL DEVELOPMENT of the student by using PARTICIPATIVE LEARNING techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1) Discuss the architecture and working principles of 8086 microprocessor and 8051 microcontroller** **(2) Solve assembly language programming problems using coding and debugging skills.** **(3) Demonstrate methods to interface memories, input/output devices and programmable peripheral devices.** **(4) Illustrate various important features and associated terminologies of advanced microprocessors like 80286-80486 and Pentium.**					
Course Content:						
Module 1	Fundamentals of Microprocessors	Quiz	Memory Recall based Quizzes	**09 Sessions**		

Topics:

Overview of 8086 Microprocessor Architecture, 8086 – 80486 Programming Model, Pin Diagram, Signals, Min/Max Mode, Timing Diagram, Instruction cycle, Machine Cycle and T-states.

Addressing Modes: Register Addressing, Immediate Addressing, Direct Addressing, Register Indirect Addressing, Base-Plus-Index Addressing, Register Relative Addressing, Base Relative-Plus-Index Addressing, Memory Addressing Mode.

Module 2	8086 Instruction Sets and Assembly Language Programming	Assignment / Quiz	Programming and Simulation task	**12 Sessions**

Topics:

Instruction Sets: Data movement instructions, Program control instructions, Arithmetic and Logical Instructions, Stack Instructions, String Instructions. Assembly Language Programs.

Module 3	Introduction to Microcontroller	Assignment	Memory Interfacing Task and Analysis	**12 Sessions**

Topics:

Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions

Module 4	Bus Interfaces and Advanced Processors	Assignment	System Design Task and Analysis	**09 Sessions**

Topics:

8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication.

List of Laboratory Tasks

Targeted Application & Tools that can be used:

Application Area:

Microprocessor-based systems are found everywhere today and not just in computers and smartphones. They are used also in automatic testing of products, speed control of motors, traffic light control, communication equipment, television, satellite communication, home appliances, such as microwave oven, washing machine etc. This course will enable students to become a Firmware Engineer, Computer Hardware Engineer etc.

Professionally Used Software: MASM / emu8086 emulator / Keil development kits for programming and interfacing experiments.

Project work/Assignment:

1. Case Studies: At the end of the course students will be given a 'real-world' application based circuits like a Traffic Light System, A Chocolate Vending Machine, etc. as a case study. Students will be submitting a report which will include Circuit Diagrams, Design, Working Mechanism and Results etc. in appropriate format.

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.

4. Project Assignment: Carry out a system design on a chart paper for an application using the 8086 microprocessor and various devices including ROMs / RAMs, LEDs / Switches / Actuators and Peripheral Devices like 8255 / 8254 etc.

Assignment: 1] Interface 8086/ 8088 microprocessor with various types of memories and I/O devices.

Assignment 2: Identify the components of an automatic vending machine (chocolate / chips / soft-drinks) and list out various device connections. Indicate the working mechanisms by drawing a flow-chart.

Text Book(s):

1. **Brey B. B., "The Intel Microprocessors", Pearson**
2. **"The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.**

References

Reference Book(s)

1. **Hall Douglas V. and Rao S. S. S. P., "Microprocessor and Interfacing", McGraw Hill Education.**
2. **Das Lyla B., "The x86 Microprocessors", Pearson**
3. **Microprocessor Programming and Interfacing Laboratory Manual**
4. "The 8051 Microcontroller", Kenneth J. Ayala, 3rd Edition, Thomson/Cengage Learning.

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

1. The Intel Microprocessors: Architecture Programming and Interfacing book by Barry B. Brey, Eighth Edition <https://userpages.umbc.edu/~squire/intel_book.pdf>
2. Microprocessors Lectures adapted from slides and the textbook materials of Dr. Kip Irvine <https://www.philadelphia.edu.jo/academics/qhamarsheh/page.php?id=13>
3. Documentation for Emu8086 <https://www.philadelphia.edu.jo/academics/qhamarsheh/uploads/emu8086.pdf>
4. Microprocessors and Interfacing NPTEL Video Lectures <https://nptel.ac.in/courses/108/103/108103157/>
5. x86 Assembly Language Programming < https://cs.lmu.edu/~ray/notes/x86assembly/>
6. The 8085 Microcontroller and Embedded Systems by M. Mazidi (Ebook) http://irist.iust.ac.ir/files/ee/pages/az/mazidi.pdf
7. Embedded System Design with ARM By Prof. Indranil Sengupta, Prof. Kamalika Dutta | IIT Kharagpur (NPTEL) https://onlinecourses.nptel.ac.in/noc20_cs15/preview

E-content:

8. M. Unger, G. Fries, T. Steinecke, C. Waghmare and R. Ramaswamy, "Functional Safety Test Strategy for Automotive Microcontrollers During Electro-Magnetic Compatibility Characterization," 2019 12th International Workshop on the Electromagnetic Compatibility of Integrated Circuits (EMC Compo), 2019, pp. 49-51, https://ieeexplore.ieee.org/document/8919673
9. J. Yater et al., "Highly Optimized Nanocrystal-Based Split Gate Flash for High Performance and Low Power Microcontroller Applications," 2011 3rd IEEE International Memory Workshop (IMW), 2011, pp. 1-4 https://ieeexplore.ieee.org/document/5873213
10. C. Kuo et al., "A microcontroller with 100 K bytes embedded flash EEPROM," Proceedings of 4th International Conference on Solid-State and IC Technology, 1995, pp. 138-140 https://ieeexplore.ieee.org/document/499653

11. A. Wild et al., "A 0.9V Microcontroller for Portable Applications," ESSCIRC '96: Proceedings of the 22nd European Solid-State Circuits Conference, 1996, pp. 264-267. https://ieeexplore.ieee.org/document/5468642

Topics relevant to development of "FOUNDATION SKILLS": Assembly Language Programming using instruction set of 8051 for basic ALP programming and also Interfacing of Peripheral devices with a microcontroller. Assembly Language Programming concepts, Memory & I/O Interfacing, Interrupts and Programmable Peripheral ICs.

Topics relevant to development of "EMPLOYABILITY": Embedded C programming and Interfacing.

Topics relevant to "ENTREPRENEURSHIP": Building programming skills using Assembly instructions/C code which can be extended to build modern control systems in electronics domain. Example – car cruise control, antilock brake system, Traffic controlling etc.

Course Code: CSE2258	**Course Title: Web Technologies** **Type of Course: Program core Theory**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
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:						

Module 1	**Introduction to XHTML**	Quizzes and Assignments	Quizzes on various features of XHTML, simple applications		**20 Sessions**
	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, Demonstration of applications using XHTML for Responsive web pages.				
Module 2	**Advanced CSS**	Quizzes and assignments	Comprehension based Quizzes and assignments; Application of CSS in designing webpages		**20 Sessions**
	Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks				
XML: Basics, Demonstration of applications using XML with XSLT.					
Module 3	**PHP – Application Level**	Quizzes and assignments	Application of PHP in web designing		**20 Sessions**
PHP: Introduction to server-side Development with PHP, Arrays, Superglobal Arrays, $GET and $ POST, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object Oriented Design, Working with Databases, SQL, Database APIs, Managing a MySQL Database. Accessing MySQL in PHP, Applications.					
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: **CSE2273**	**Course Title:** Cloud computing Lab **Type of Course :** Lab	**L- T-P- C**	0	**0**	2	**1**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	This course is designed to give hands-on experience with cloud platforms, services, and deployment models. Students will learn to set up, configure, and manage cloud environments using platforms like AWS, Microsoft Azure, and Google Cloud. The course covers virtualization, containerization, serverless computing, cloud storage, security, and scalability. Through practical assignments, students will develop skills in deploying cloud applications, managing cloud resources, automating cloud workflows, and implementing cost-effective cloud solutions.					
Course Objective	The objective of the course is to Understand Cloud Infrastructure, deploy and manage virtual machines, implement cloud storage, develop and deploy cloud applications, optimize cost and performance.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1· Deploy and Manage Cloud Resources. CO2. Develop and Deploy Cloud-based Applications CO3. Optimize Performance and Cost in the Cloud CO4. Implement Security and Automation in Cloud Environments					
Course Content:						
Module 1	Introduction to Cloud and Virtualization	Assignment	Virtualization		**10 Sessions**	
Lab Assignment 1: Setting Up Virtual Machines on Cloud • Create a **Virtual Machine (VM)** on AWS/Azure/GCP						

Configure OS, storage, and network settings

- Connect to the VM using SSH/RDP

Install web server (Apache/Nginx) and deploy a static webpage

Lab Assignment 2: Containerization Using Docker

- Install **Docker** on a local or cloud VM
- Create and run a **Docker container**
- Build a **custom Docker image** with a simple Python/Node.js application
- Push the image to **Docker Hub** and deploy it on a new VM

Module 2	High Throughput and Data Intensive Computing	Assignment	Virtualization	**10 Sessions**

Lab Assignment 1: Setting Up a Distributed Computing Environment

- Launch a **Hadoop or Spark cluster** on AWS EMR / Azure HDInsight / Google Dataproc
- Configure **HDFS (Hadoop Distributed File System)** for big data storage
- Run a **basic MapReduce job** on sample data

Lab Assignment 2: Data Preprocessing with Cloud Storage

- Store large datasets in **Amazon S3 / Azure Blob Storage / Google Cloud Storage**
- Use **Apache Spark or Hadoop** to read, clean, and process data
- Convert datasets into **Parquet or Avro formats** for efficient storage

Lab Assignment 3: Batch Processing with Apache Spark

- Load large datasets (e.g., logs, tweets, transaction data) into **Spark DataFrame**
- Perform **ETL (Extract, Transform, Load) operations** on the data

- Use **SparkSQL** for querying large datasets

Lab Assignment 4: Real-Time Data Processing with Spark Streaming

- Set up **Kafka / AWS Kinesis / Google Pub/Sub** for real-time data ingestion
- Process streaming data using **Spark Streaming**
- Perform windowed aggregations and visualize real-time trends

Lab Assignment 5: Cloud-Based Machine Learning with Big Data

- Use **Google BigQuery ML / AWS SageMaker / Azure Machine Learning** for model training
- Train a **linear regression or classification model** on a large dataset
- Deploy the trained model as an API for real-time predictions

Lab Assignment 6: Running Parallel Machine Learning Workloads

- Implement **distributed ML training** using **Spark MLlib or TensorFlow on Cloud TPUs**
- Train models on a large dataset and optimize performance using distributed execution

Lab Assignment 7: Auto-Scaling and Load Balancing for Data Processing

- Deploy a **serverless Spark job** using **AWS Glue / Azure Synapse**
- Implement **auto-scaling for high-throughput jobs**
- Measure performance improvements using cloud monitoring tools

Lab Assignment 8: Cost Optimization for High-Throughput Data Processing

- Analyze **cloud cost reports** for data-intensive workloads
- Optimize cloud storage and compute resources for cost-efficiency
- Compare **on-demand vs. reserved vs. spot instances** for cost savings

Module 3	Cloud Security and Standards	Assignment	Virtualization	**9 Sessions**

Lab Assignment 9: Configuring Identity and Access Management (IAM)

- Set up **IAM roles and policies** in AWS / Azure / Google Cloud
- Create and assign users with **least privilege access**
- Implement **Multi-Factor Authentication (MFA)** for added security
- Audit IAM policies using **AWS IAM Access Analyzer / Azure Security Center**

Lab Assignment 10: Setting Up Single Sign-On (SSO) and Role-Based Access Control (RBAC)

- Configure **AWS Cognito / Azure Active Directory / Google IAM** for authentication
- Implement **Role-Based Access Control (RBAC)** for users and groups
- Integrate **OAuth 2.0 / OpenID Connect (OIDC) / SAML** for secure authentication

Lab Assignment 11: Encrypting Data at Rest and in Transit

- Encrypt **cloud storage (S3, Blob, Cloud Storage)** using **KMS (Key Management Service)**
- Set up **TLS/SSL certificates** for secure web traffic encryption
- Enable **database encryption (AWS RDS, Azure SQL, GCP Cloud SQL)**

Lab Assignment 12: Implementing Compliance & Governance in Cloud

- Enable **GDPR, HIPAA, ISO 27001 compliance tools** in cloud platforms
- Use **AWS Config / Azure Policy / GCP Security Command Center** to enforce compliance
- Conduct **security audits and generate compliance reports**

Lab Assignment 13: Implementing Cloud Monitoring & Threat Detection

- Configure **AWS CloudTrail / Azure Monitor / GCP Operations Suite** for activity logging

- Set up **intrusion detection systems (IDS) & anomaly detection**
- Analyze security logs using **Amazon GuardDuty / Azure Sentinel / Chronicle Security**

Lab Assignment 14: Automating Security Incident Response

- Deploy a **Serverless Lambda / Azure Logic App** to automatically respond to security incidents
- Implement **automated alerts** for suspicious activity
- Test a **denial-of-service (DDoS) simulation** and implement mitigation strategies

Module 4	Cloud Platforms	Assignment	Virtualization	**9 Sessions**

Lab Assignment 15: Getting Started with Cloud Platforms

- Create a **free-tier account** on AWS, Azure, or Google Cloud
- Navigate the **Cloud Console, CLI, and SDKs**
- Explore and configure **dashboard, billing, and IAM settings**

Lab Assignment 16: Launching a Virtual Machine (VM) on Cloud

- Deploy a **VM instance** using **AWS EC2, Azure Virtual Machines, or Google Compute Engine**

Configure **OS, storage, networking, and security groups**
Connect to the instance using **SSH (Linux) or RDP (Windows)**

Lab Assignment 17: Cloud Storage and File Management

- Create **Object Storage (AWS S3 / Azure Blob Storage / Google Cloud Storage)**

Upload, download, and set access permissions for files
Implement **Lifecycle Policies and Versioning**

Lab Assignment 18: Cloud Database Management

- Deploy a **Relational Database (AWS RDS / Azure SQL Database / Cloud SQL)**

Connect and query the database using **MySQL/PostgreSQL clients**
Set up database **backups and automatic scaling**

Lab Assignment 19: Configuring Virtual Networks in Cloud

- Set up a **Virtual Private Cloud (VPC) / Azure Virtual Network / GCP VPC**

Configure **subnets, firewalls, and security groups**

Test **network communication between two VMs**

Lab Assignment 20: Deploying a Web Application on Cloud

Deploy a Python/Node.js/Java web app using:

- **AWS Elastic Beanstalk**
- **Azure App Service**
- **Google App Engine**

Connect the app to Cloud Database (RDS, CosmosDB, Firestore)

Monitor application performance and logs

Targeted Application & Tools that can be used:

Text Book(s):

1. John Rittinghouse and James Ransome, “Cloud Computing, Implementation, Management and Security”, CRC Press.

2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education.

Reference(s):

1. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press.

2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill. Web resources: https://presiuniv.knimbus.com/user#/home

ECO1001	**Economics** **Type of Course: Open Elective**					
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 general basic concepts and principles in economics like demand for and supply of resources and products, consumer behaviour, economic aggregates like national income, unemployment, general price level and balance of payments, economic cycles, fiscal policy and monetary policy. The course also provides basic profile of Indian economy and its economic structures. The course builds a sense of economic use of resources and ability to understand economic scenario in general.					
Course Objective	The objective of the course is to familiarize the learners with the general basic concepts of economics and provide depiction of Indian economy with an aim to enhance their decision-making skills.					
Course Outcomes	**On successful completion of this course the students shall be able to:** CO.1 **Understand** the basic principles of demand, supply and market equilibrium CO.2 **Understand** the basic macroeconomic concepts, indicators, their interrelationships and the scope of fiscal and monetary policies CO.3 **Understand** the general profile of Indian economy					
Course Content:						
Module 1	**Demand and Supply**	Assignment 1: Write 5-page summary about production operation in any of the selected firm	Numerical calculation of various short run and long run costs	**15 Sessions**		
Introduction to economics: definitions of economics, microeconomics and macroeconomics; Theory of demand: The concept of demand, determinants of demand, law of demand - assumptions, demand curve; The concept of supply, determinants of supply, law of supply - assumptions, supply curve; Revealed preference hypothesis of consumer behaviour– assumptions, equilibrium of the consumer, derivation of demand curve; Market equilibrium; Production: rationale of firm's existence, factors of production, production function- methods of production, isoquants and its properties, laws of production; equilibrium of the firm- optimization of output; cost of production: short run cost curves, short run total cost, average cost, short run average fixed cost and variable cost, and marginal cost curves, long run cost curves: marginal cost, average cost and total cost curves, economies of scale and diseconomies of scale.						
Module 2	**Macroeconomic concepts, theories and Policies**	Assignment 2: Class room presentation of Macroeconomic profile of any selected country (Group activity)	-	**15 Sessions**		
Circular flow of income; National income/output: definitions of national income, concepts of national income/output at basic prices, producers prices and retail prices; Business cycles; phases of business cycles; unemployment- definition of unemployment, methods of measuring unemployment; General price levels – inflation and deflation, causes and effects of inflation and						

deflation; Balance of payments- current account, capital account and official settlements account, Balance of payment disequilibrium and fluctuations in foreign exchange rate; Monetary policy: central bank instruments of controlling money supply, effects of expansionary and contractionary monetary policy on overall economy; Fiscal policy: instruments of fiscal policy, effects of expansionary and contractionary fiscal policy on overall economy.

Module 3	**Indian Economy**	Class quiz on Indian economy (50 marks)	-	**15 Sessions**

Indian economy-basic statistics: sectoral contributions to national output – Profile and contribution to the total output by the agriculture sector, the industrial sector and service sector; India's Balance of payments sub-accounts and foreign exchange fluctuations in general price level in India; Unemployment situation in India; Reserve bank of India and General profile of monetary policy scenario in India; NITI Ayog – objectives; India union budget 2025-26; General profile of agriculture, industrial and service sector policies in India.

Targeted Application & Tools that can be used:

- Lecture and Solving Numerical Problems- Modules 1,2
- Familiarize with data bases on Indian economy

Assignment:

1. **Assignment 1:** Write 5-page summary about production operation in any of the selected firm
2. **Assignment 2**: Class room presentation of Macroeconomic profile of any selected country (Group activity)
3. **Class quiz** on Indian economy (50 marks)

Text Book(s):

- Koutsoyiannis, A. (1979). *Modern Microeconomics (Sec. Ed.).* New York: Macmillan press.
- Ahuja, H.L. (2015). Macroeconomics. New Delhi: S. Chand Publishing.
- Puri, V.K. et al., (2024). *Indian Economy (42 Ed.).* New Delhi: Himalayan Publishing.

Reference Book (s):

1. Mithani, D.M. (2010). *Macroeconomics*. Mumbai: Himalayan Publishing.
2. Mishkin, F.S. (2017). *Macroeconomics: Policy and Practice.* Noida: Pearson India Education.
3. Pindyck, R.S. and Rubinfeld, D. (2017). M*icroeconomics.* Noida: Pearson India.
4. Puri, V.K. and Misra, S.K. (2019). *Indian Economy: Its development experience*. Nagpur: Himalayan Publishing.
5. Verma, S. (2017). *Indian Economy*. New Delhi: Unique Publishers.

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

1. https://archive.org/details/a.-koutsoyiannis-auth.-modern-microeconomics-1979-macmillan-education-uk
2. https://blogmedia.testbook.com/kmat-kerala/wp-content/uploads/2023/06/indian-economy-by-sanjiv-verma-by-upscpdf.com_-58675b62.pdf
3. https://home.ufam.edu.br/andersonlfc/Macrol/Livro%20Macro.pdf
4. https://omeka.urbeuniversity.edu/files/original/c61471e9878ffe19597d640cb97f817bd7e678f6.pdf

Course Code: FIN1002	**Course Title: Essentials of Finance** **Type of Course: HSMC**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-	This course is designed to be accessible to all students, regardless of their					

requisites	prior financial knowledge.			
Anti-requisites				
Course Description	This course is designed to equip students with a **foundational understanding of key financial concepts and principles**. It will enable them to comprehend the **core functions of finance**, delve into the intricacies of **financial management within organizations**, and gain insights into the **fundamental aspects of taxation**. The course aims to develop students' abilities to **interpret financial statements, evaluate investment opportunities, understand capital structure decisions**, and navigate the **basics of tax implications**.			
Course Objective	Upon successful completion of this course, students will be able to: • **Understand the basic forms of business organization and their financial implications.** • **Understand the fundamental principles and concepts** that influence financial decision-making in various contexts. • **Analyse and interpret financial statements** to assess the financial health and performance of an organization. • **Identify income under various heads of income as per Income Tax Act, 1961 and determine the tax liability.**			
Course Outcomes	**List the course outcomes** **On successful completion of this course the students shall be able to:** CO.4 **Understand the basic concepts of finance and financial markets and organizations.** CO.5 **Apply and interpret financial information for business decision making.** CO.6 **Identify various heads of income and deduction under Income Tax Act, 1961.**			
Course Content:				
Module 1	**Introduction to Finance**	Assignment/ Quiz	Numerical solving Task	**10 Sessions**
Definition and Scope of Finance, Areas of Finance: Corporate Finance, Investments, Financial Institutions, International Finance; Types of Financial Markets: Money Markets vs. Capital Markets, Primary vs. Secondary Markets; Forms of Business Organization and Financial Goals: Shareholder Wealth Maximization vs. Profit Maximization; Understanding Financial Statements: Balance Sheet and Income Statement- Simple Numerical.				
Module 2	**Financial Management**	Assignment/ Quiz	Numerical solving Task	**18 Sessions**
Capital Budgeting Decisions: Payback Period, Net Present Value (NPV), Profitability Index (PI), Internal Rate of Return (IRR); Leverage- Basic Numerical; Capital Structure Decisions: Optimal Capital Structure, Trade-off Theory of Capital Structure; Cost of Capital: Equity, Debt, WACC; Dividend Policy: Factors influencing Dividend Policy.				
Module 3	**Taxation**	Assignment/ Quiz	Numerical solving Task	**17 Sessions**

Principles of a Good Tax System: Equity, Certainty, Convenience, Economy; Direct vs. Indirect Taxes; Residential Status of an Individual- Basic Problems; Heads of Income; Salary, House Property- Basic Numerical; Deductions under Chapter VI-A; Computation of Taxable Income and Tax Liability; E-Filing procedure.
Targeted Application & Tools that can be used: **Textbooks, PPT, Spreadsheet Software (e.g., Microsoft Excel), Official Website of Income Tax Department.**
Project Work/ Assignment:
1. 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. **2. Case Study**: - At the end of the course students will be given a 'real-world' cases like business models of successful companies or tax evasion by reputed companies on which they have to come up with detailed analysis and assessment.
Text Book(s): 1. **Dr. Vinod K. Singhania & Dr. Monica Singhania.** (Latest Assessment Year Edition). *Students' Guide to Income Tax including GST*. Taxmann Publications. **2. Pandey, I. M.** (2025). *Financial Management*. Vikas Publishing House.
Reference Book (s): 1. **Bhole, L.M., & Mahakud, J.** (Current Edition). *Financial Institutions and Markets: Structure, Growth and Innovations*. McGraw Hill Education India. 2. **Mehrotra, H.C., & Goyal, S.P.** (Latest Assessment Year Edition). *Income Tax Law & Practice*. Sahitya Bhawan Publications. 3. **Gordon, E., & Natarajan, K.** (Current Edition). *Financial Markets and Services*. Himalaya Publishing House. **Online Resources (e-books, notes, ppts, video lectures etc.):** 5. https://presidencyuniversity.linways.com 6. https://onlinecourses.nptel.ac.in/noc24_ec01/preview 7. https://www.incometax.gov.in/iec/foportal/
Topics relevant to "SKILL DEVELOPMENT": This course is designed to provide practical financial skills through participative learning techniques. Students will engage in performing suitable calculations to determine financial parameters (e.g., time value of money, investment returns, tax liabilities) and analysing financial statements to assess organizational performance and make informed decisions.

Course Code: CIV7601	Course Title: Universal Human Values and Ethics Type of Course: MAC course	L-T-P-C	-	-	-	0
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of the course is to develop a holistic perspective in students' life. The course adopts a self-reflective methodology of teaching and is designed to equip the students to explore their role in all aspects of living as a part of the society. It presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration. This self-exploration develops more confidence and commitment in students					

	enabling them to critically evaluate their pre-conditioning and present beliefs. As an outcome of the holistic approach, the students will be able to practice the ethical conduct in the social and professional life. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information. This course is designed to cater to Human Values and Professional Ethics.			
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'SELF LEARNING' techniques			
Course Outcomes	On successful completion of this course the students shall be able to: CO.1 Recognize the importance of Value Education through the process of self-exploration CO.2 Explain the human being as the co-existence of the self and the body in harmony. CO.3 Describe the role of foundational values in building harmonious relationships. CO.4 Summarize the importance of a holistic perspective in developing ethical professional behavior.			
Course Content:				
Module 1	Introduction to Value Education	Online Assessment	MCQ Quiz	5 Sessions
Topics: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.				
Module 2	Harmony in the Human Being	Online Assessment	MCQ Quiz	5 Sessions
Topics: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health				
Module 3	Harmony in the Family and Society	Online Assessment	MCQ Quiz	5 Sessions
Topics: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.				
Module 4	Implications of the Holistic Understanding – A Look at Professional Ethics	Online Assessment	MCQ Quiz	5 Sessions
Topics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Strategies for Transition towards Value-based Life and Profession				
Targeted Application & Tools that can be used: Application areas are Personal life, Education and Career, Workplace , Society and Environmental				

Responsibility
Tools: Online Tools – NPTEL and Swayam.

Project work/Assignment:

Assessment Type

- Online exams (MCQs) will be conducted by the Department of Civil Engineering through Linways.

Online Link*:

1) UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin
2) Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
3) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

Text Book

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019.
3. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

1. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
2. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
3. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
4. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
5. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A N Tripathy, 2003, Human Values, New Age International Publishers.
7. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
8. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
10. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.

Resources:

1. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
2. https://onlinecourses.nptel.ac.in/noc25_mg141/preview
3. https://onlinecourses.swayam2.ac.in/ini25_hs52/preview
4. https://onlinecourses.nptel.ac.in/noc25_hs219/preview
5. https://onlinecourses.swayam2.ac.in/cec25_mg14/preview
6. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
7. https://onlinecourses.swayam2.ac.in/imb25_mg196/preview

Topics relevant to Skill Development:

1. An attitude of enquiry.
2. Write reports

The topics related to Human values and Professional ethics:

All topics in are relevant to Human values and Professional ethics.

Course Code: MAT3041	Course Title: Statistical Reasoning & Data Analysis Type of Course: 1] Open Elective	L-T- P-C	3	0	0	3

Version No.		1.0
Course Pre-requisites		Nil
Anti-requisites		**NIL**
Course Description		This course introduces fundamental statistical methods and data analysis techniques with direct applications in engineering. Students will learn to collect, analyze, and interpret data to solve real-world engineering problems, such as process optimization, quality control, and system performance evaluation. Emphasis is placed on practical implementation using tools like Python (Pandas, SciPy), MATLAB, or Excel.
Course Objective		The goal of the course Statistical Reasoning & Data Analysis is to understand and summarize data using descriptive statistics. Apply basic probability concepts to solve problems. Perform statistical inference (estimation and hypothesis testing). Analyze relationships between variables using correlation and regression. Use statistical software (e.g., Excel, R, Python, or SPSS) for data analysis.
Course Out Comes		On successful completion of the course the students shall be able to: 1. Apply statistical methods to improve product quality (e.g., Six Sigma). 2. Analyze sensor/telemetry data for predictive maintenance. 3. Design experiments to optimize engineering systems. 4. Communicate data-driven insights effectively.
Course Content:		

Module 1	**Foundations of Statistical Thinking**		**12 Classes**
Definition of statistics, Types of data (qualitative vs. quantitative, discrete vs. continuous), The role of statistics in research/media/industry, Levels of measurement (nominal, ordinal, interval, ratio), Sampling methods and bias (e.g., surveys, experiments, observational studies), Measures of central tendency and dispersion (mean, variance, Standard Deviation, IQR), Data visualization tools - Histograms, box plots, scatter plots, Introduction to tools like Excel, Python (matplotlib), or R (ggplot2).			
Module 2	**Probability Foundations**	**Assignment**	**10 Classes**
Probability Rules – Independent Events, Conditional Probability & Bayes' Theorem - Intuition & Applications (Medical Testing, Spam Filtering). Bayes' theorem for fault diagnosis, Real-World applications – Risk Assessment, Quality Control			
Module 3	**Exploratory Data Analysis**		**10 Classes**
What is EDA? Importance in Data Science, Types of Data (Structured, Unstructured, Numerical, Categorical), Tools for EDA (Python: Pandas, NumPy, Matplotlib, Seaborn; R: ggplot2, dplyr), Data Sourcing (CSV, Excel, SQL, APIs, Web Scraping), Outlier detection, Feature relationships (correlation matrices), Hands-on case studies (COVID-19 data, financial trends)			
Module 4	**Regression & Predictive Models**	**Assignment**	**13 Classes**
What is Predictive Modeling? Use Cases (Business, Healthcare, Finance), Types of Predictive Models			

(Regression, Classification, Time Series), Model Workflow: Data → EDA → Preprocessing → Modeling → Evaluation, Tools: Python (scikit-learn, statsmodels) / R (caret, lm).
Simple Linear Regression, Model evaluation (R-squared, residuals), Ethics in predictive analytics (algorithmic bias)

Targeted Application & Tools that can be used:

- Bridges gap between theory and **real-world engineering decisions**.
- Foundational for advanced topics like **ML, AI, and IoT data analytics**.
- Aligns with **industry standards** (e.g., Six Sigma, ISO 9001).
- **Software**: Python (Pandas, NumPy, SciPy), MATLAB, or Excel.
- **Labs**: Hands-on projects with real engineering datasets (e.g., vibration sensor data, production line quality metrics).

Assignment:

60% quantitative problem-solving,
30% case studies/projects,
10% participation.
Assignment: 25%
Mid-Term : 25%
End Term : 50%

Text Book

1. Statistics for Engineers and Scientists, William Navidi
2. Statistics for Beginners, David Freedman
3. Introductory Statistics, OpenStax (free online)

References:

1. Naked Statistics" by Charles Wheelan (for intuitive understanding)
2. Python for Data Analysis (Wes McKinney)

E-resources/ Web links:
Free Online Courses (With Certificates)

- Coursera: Statistics for Data Science
  - Focuses on Python-based statistical analysis (University of Michigan).
- edX: Introduction to Statistics
  - Covers probability, hypothesis testing, and regression (UC Berkeley).
- Khan Academy: Statistics & Probability
  - Beginner-friendly, math-focused tutorials.
- MIT Open Course Ware: Statistics for Engineers - Covers SPC, DOE, and reliability analysis.
- Jeffrey Chasnov (HKUST): Probability for Engineers - Focuses on practical probability applications.
- Engineering-Specific Resources
  - NIST Engineering Statistics Handbook (Free eBook): https://www.itl.nist.gov/div898/handbook/ Covers SPC, DOE, and reliability testing.
- Six Sigma Basics: ASQ - Connects stats to quality engineering.

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of Basic Statistics & Data Analysis with reference to specific engineering problems.

- Learn descriptive statistics (mean, median, variance) to summarize data effectively.
- Master probability concepts (distributions, Bayes' theorem) for risk assessment.

• Practice hypothesis testing (t-tests, ANOVA) to validate engineering decisions. • Develop regression skills (linear, multivariate) to predict outcomes from data. • Use visualization tools (Matplotlib, Seaborn) to communicate insights clearly. • Apply statistical process control (SPC) to monitor quality in manufacturing. • Automate analyses with Python/R (Pandas, SciPy) for efficient data handling. • Work with real datasets (Kaggle, UCI) to build practical experience. • Complete a capstone project (e.g., optimizing a process using DOE) to solidify skills. • Stay updated with industry trends (Six Sigma, predictive maintenance).

Course Code: MAT3042	**Course Title: Actuarial Mathematics** **Type of Course: 1] Open Elective**	**L-T- P-C**	**3**	**0**	**0**	**3**

Version No.		1.0
Course Pre-requisites		Nil
Anti-requisites		**NIL**
Course Description		Actuarial Mathematics applies mathematical and statistical methods to assess risk in insurance, finance, and other industries. This course introduces fundamental concepts used by actuaries, including life contingencies, premium calculation, and reserving techniques.
Course Objective		The course objective of Actuarial Mathematics is to provide students with the fundamental mathematical and statistical techniques used in actuarial science to assess financial risks in insurance, pensions, and other financial sectors.
Course Out Comes		On successful completion of the course the students shall be able to: 5. Price insurance products and calculate reserves. 6. Construct and analyze life tables and survival models. 7. Apply mortality tables to estimate life expectancies. 8. Evaluate pension plans and retirement benefits. 9. Apply stochastic and financial models to actuarial risks. 10. Compute insurance premiums using actuarial principles.
Course Content:		

Module 1	**Introduction to Actuarial Science**		**7 Classes**
Role of actuaries in insurance and finance, Professional actuarial bodies (SOA, CAS) and exams.			
Module 2	**Interest Theory & Time Value of Money**	**Assignment**	**9 Classes**
Simple vs. compound interest, Annuities (immediate, due, perpetuities), Loans and amortization.			
Module 3	**Probability & Risk Models**		**9 Classes**
Introduction to Probability, Events, Independent and Conditional Probability, Survival models (Life tables, mortality rates), Probability distributions in insurance (Poisson, Exponential, Normal).			
Module 4	**Life Contingencies & Premium Calculation**		**9 Classes**
Present value of life insurance & annuities, Net premiums and reserves, Equivalence principle, Gross			

premiums (including expenses).

Module 5	**Reserving Methods and Applications**	**Assignment**	**9 Classes**

Prospective vs. retrospective reserves, Thiele's differential equation (intro), Cramér-Lundberg model basics, Applications in Insurance & Pensions - Health insurance models, Pension fund valuation.

Targeted Application & Tools that can be used:

- Exams: SOA/CAS exams validate core technical skills.
- Coding: Build projects in R/Python (e.g., mortality model simulator).
- Case Competitions: Join events like the CAS Student Central Challenge.
- Certifications: Consider CFA, FRM, or CERA for niche expertise.
- Internships: Apply skills in real-world reserving/pricing roles.

Assignment:

60% quantitative problem-solving,
30% case studies/projects,
10% participation.
Assignment: 25%
Mid-Term : 25%
End Term : 50%

Text Book

4. Actuarial Mathematics (2nd Ed.) – *Bowers, Gerber, Hickman, Jones, Nesbitt*
5. Actuarial Mathematics for Life Contingent Risks (3rd Ed.) – *Dickson, Hardy, Waters*
6. Mathematics of Investment and Credit – Broverman
7. Introductory Statistics, OpenStax (free online)

References:

- Actuarial Science: Theory and Methodology – *Hossack, Pollard, Zehnwirth*
- Statistical and Probabilistic Methods in Actuarial Science – *Dickson*
- Machine Learning in Insurance – *Antonio, Valdez* (Emerging field)

E-resources/ Web links:

- The Actuarial Guy – Free FM/P exam tutorials.
- EdX – Actuarial Science (ANU) – Introductory courses.
- Coursera – Financial Engineering (Columbia) – Covers stochastic calculus for actuaries.
- Life Contingencies Calculator (Shiny App) – Compute annuities, premiums, reserves.
- Mortality.org (Human Mortality Database) – Free mortality tables for research.
- R for Actuaries (RStudio Cloud) – Learn actuarial modeling in R.
- Actuarial Science: Foundations of Risk Management – SOA's official resources.
- Loss Models (Klugman et al.) – Supplementary Materials – Datasets and errata.
- University of Waterloo ActSci Notes – Lecture notes on life contingencies and risk models.
- MIT OpenCourseWare – Statistics for Applications – Useful for probability/stats review.

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of Basic Statistics & Data Analysis with reference to specific engineering problems.

- **Life Contingencies** (Mortality Tables, Premium Calculations)
- **Loss Distributions** (Severity/Frequency Models)
- **Credibility Theory** (Bühlmann-Straub, Bayesian Methods)
- **Claim Reserving** (Chain Ladder, Bornhuetter-Ferguson)
- **Time Value of Money** (Annuities, Bonds, Duration)

- **Derivative Pricing** (Black-Scholes, Monte Carlo Simulations)
- **Asset-Liability Management (ALM)**
- **Economic Capital Modeling**

Course Code: MAT3043	**Course Title: Financial Mathematics** **Type of Course: 1] Open Elective**	**L-T- P-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	**NIL**					
Course Description	Actuarial Mathematics applies mathematical and statistical methods to assess risk in insurance, finance, and other industries. This course introduces fundamental concepts used by actuaries, including life contingencies, premium calculation, and reserving techniques.					
Course Objective	The course objectives of Business Mathematics, designed to equip students with the quantitative tools needed for decision-making in business, finance, economics, and management.					
Course Out Comes	On successful completion of the course the students shall be able to: • Understand core mathematical models used in finance. • Apply stochastic calculus to price derivatives (e.g., options). • Analyze interest rates, portfolio optimization, and risk metrics. • Gain proficiency in numerical methods (e.g., Monte Carlo simulations).					
Course Content:						
Module 1	**Foundations of Financial Mathematics**					**10 Classes**
Financial markets overview (stocks, bonds, derivatives), Time value of money: Present/future value, annuities, perpetuities, Yield curves, spot rates, and forward rates, Arbitrage and the Fundamental Theorem of Asset Pricing. Interest rates: Nominal vs. effective, compounding, yield curves.						
Module 2	**Stochastic Calculus for Finance**	**Assignment**				**12 Classes**
Review of probability spaces, filtrations, and conditional expectations, Brownian motion (Wiener process): Definition, properties, and simulations, Martingales - Definition, examples (e.g., discounted stock prices under risk-neutral measure). Itô integral: Construction and properties, Itô's Lemma (proof and applications), Examples: Geometric Brownian motion (GBM) for stock price modeling.						
Module 3	**Portfolio Theory & Risk Management**					**8 Classes**
Risk and return: Mean-variance analysis. Markowitz portfolio optimization. Capital Asset Pricing Model (CAPM). Value at Risk (VaR) and Conditional VaR.						
Module 4	**Option Pricing Models and Fixed Income Securities**					**10 Classes**
Basics of options (calls, puts, European/American). Binomial option pricing model. Black-Scholes-Merton model (derivation & applications). Greeks (Delta, Gamma, Vega). Bond pricing, duration, convexity, Term structure models (Vasicek, Cox-Ingersoll-Ross), Interest rate derivatives (swaps, caps, floors).						

Module 5	Numerical Methods in Finance	Assignment	5 Classes

Monte Carlo simulation for pricing. Finite difference methods for PDEs (Black-Scholes). Case studies using Python/Excel.

Targeted Application & Tools that can be used:

- Loan amortization, bond pricing, risk assessment.
- Portfolio optimization, asset allocation.
- Option pricing (basic Black-Scholes).
- Pricing strategies (markup/markdown, elasticity of demand).
- Inventory management (EOQ, reorder points).
- Sales forecasting (time series analysis).

Tools Used:

- **Excel/Google Sheets**
- **Python**

Assignment:

- Quizzes/Assignments: 25%
- Midterm Exam: 25%
- Final Exam: 50%

Text Book

- Business Mathematics – Gary Clendenen & Stanley Salzman
- Mathematics for Economics and Business – Ian Jacques
- Excel-Based Business Modeling – S. Christian Albright

References:

- Statistics for Business and Economics (14th Ed.) – James T. McClave et al.
- The Handbook of Insurance-Linked Securities – P. Barrieu & L. Albertin
- Machine Learning in Insurance – Antonio, Valdez (Emerging field)

E-resources/ Web links:

- Coursera – Financial Engineering (Columbia) – Covers stochastic calculus for actuaries.
- Life Contingencies Calculator (Shiny App) – Compute annuities, premiums, reserves.
- Mortality.org (Human Mortality Database) – Free mortality tables for research.
- Khan Academy – Business Math - khanacademy.org/math/business-mathematics
- Coursera – Business Statistics & Analysis coursera.org/specializations/excel-mysql
- edX – Financial Mathematics - edx.org/course/financial-mathematics
- Excel Easy excel-easy.com
- QuantLib (Python/C++) quantlib.org
- OpenStax – Business Math - openstax.org/details/books/business-mathematics
- MIT OCW – Mathematics for Business - ocw.mit.edu/courses/mathematics
- Paul's Online Math Notes - tutorial.math.lamar.edu

- **Topics relevant to SKILL DEVELOPMENT:** The course focuses on the concepts of Basic Statistics & Data Analysis with reference to specific engineering problems.
- Arithmetic & Algebra (percentages, ratios, equations)
- Functions & Graphs (linear, quadratic, exponential)
- Logarithms & Exponents (growth/decay models)
- Time Value of Money (TVM) (present/future value, annuities)
- Interest Calculations (simple vs. compound interest)

• Loan Amortization & Mortgage Calculations • Investment Appraisal (NPV, IRR, ROI) • Descriptive Statistics (mean, median, variance) • Probability & Distributions (normal, binomial) • Regression & Correlation Analysis (forecasting trends) • Hypothesis Testing (p-values, confidence intervals)

Course Code: MAT3044	**Course Title: Mathematical Modelling** **Type of Course:1] Open Elective**	**L-T- P-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	**NIL**					
Course Description	This course introduces fundamental concepts, techniques, and applications of mathematical modeling across diverse fields, emphasizing problem-solving through clear explanations, real-world examples, and practical case studies. This course also covering deterministic and stochastic models, optimization, differential equations, and real-world applications in science, engineering, biology and economics, with an emphasis on problem-solving, analysis, and computational tools.					
Course Objective	This course objective is to equip students with the skills to formulate, analyze, and interpret mathematical models for real-world problems using analytical and computational techniques, fostering critical thinking and interdisciplinary problem-solving.					
Course Outcomes	On successful completion of the course the students shall be able to: 11. Formulate mathematical models for real-world problems by identifying variables, assumptions, and governing principles. 12. Classify models as deterministic/stochastic, static/dynamic, or discrete/continuous based on system behavior. 13. Apply optimization methods (e.g., linear programming, Lagrange multipliers) to decision-making problems. 14. Simulate dynamical systems (e.g., population growth, epidemics) using ODEs/PDEs and assess stability. **Validate models through dimensional analysis, sensitivity testing, and empirical data comparison.** 15. Implement computational tools (Python/MATLAB) to numerically approximate and visualize solutions.					

Course Content:			
Chapter 1	**Introduction to Mathematical Modelling**		**10 Classes**
Definition, purpose, and scope of mathematical models, Steps in model formulation: Problem identification, assumptions, equations, validation, Types of models: Deterministic vs. stochastic, static vs. dynamic, Buckingham Pi Theorem, Dimensionless variables and similarity principles, Applications in physics and engineering.			
Chapter 2	**Models in Physical Sciences**		**8 Classes**
Mechanics - Particle dynamics, projectile motion, oscillations, Fluid Dynamics - Bernoulli's equation, viscosity models, Heat and Wave Equations - Diffusion, wave propagation			
Chapter 3	**Biological and Medical Models**	**Assignment**	**8 Classes**
Population Dynamics - Malthusian growth, Logistic model (Verhulst), Epidemiology - SIR model (Disease spread), Physiological Systems - Compartmental models (Drug kinetics)			
Chapter 4	**Economic and Social Models**		**8 Classes**
Optimization Models - Linear programming, Lagrange multipliers, Game Theory - Nash equilibrium, payoff matrices, Decision Models - Utility theory, Markov chains			
Chapter 5	**Numerical and Computational Techniques**	**Assignment**	**11 Classes**
Finite difference methods for PDEs, Stability analysis of models, Simulation using software (Python/MATLAB), Real-world applications (climate models, traffic flow, financial markets), Limitations and ethical considerations in modeling.			

Targeted Application & Tools that can be used:

This course applies mathematical modeling to physics (ODEs/PDEs), biology (SIR models), economics (optimization), and environmental science (climate models), using tools like Python (SciPy, NumPy), MATLAB (ODE solvers), R (statistical analysis), and visualization libraries (Matplotlib, ParaView) for simulation, data fitting, and problem-solving.

Assignment:

- Quizzes/Assignments: 25%
- Midterm Exam: 25%
- Final Exam: 50%

Text Book

1. Applied Mathematical Modelling by D. Fowler & A. Meade
2. Mathematical Modelling by J.N. Kapur
3. A First Course in Mathematical Modeling by Giordano, Weir & Fox

References:

1. Mathematical Models in Biology" by Leah Edelstein-Keshet
2. Nonlinear Dynamics and Chaos" by Steven Strogatz (for advanced modeling)

E-resources/ Web links:

Free Online Courses

- https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/
- https://ccl.northwestern.edu/netlogo/
- https://phet.colorado.edu/
- https://www.imagwiki.nibib.nih.gov/
- https://www.andrew.cmu.edu/user/vanhoeve/mdd/
- https://www.r-project.org/

• https://scipy.org/
Topics relevant to SKILL DEVELOPMENT: This course develops skills in problem formulation, analytical reasoning, computational modeling (Python/MATLAB), data analysis, and interdisciplinary collaboration for real-world applications.

Course Code: APT4002	**Course Title:** Introduction to Aptitude **(Audited)**	**L- T-P-C**	0	0	2	0
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	**12 Hours**
	Topics: Introduction to Aptitude, working of Tables, Squares, Cubes				
Module 2	Logical Reasoning	Assignment		Bloom's Level : Application	**18 Hours**
	Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning				
	Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS				
	Text Book 1. Quantitative Aptitude by R S Aggarwal 2. Verbal & Non-Verbal Reasoning by R S Aggarwal				
	References 1. www.indiabix.com 2. 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: **APT4004**	**Course Title: Aptitude Training-Intermediate** Type of Course: Practical Only Course	L- T - P- C	0	0	2	0
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. 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 Out Comes	**On successful completion of this course the students shall be able to:** CO1: Recall all the basic mathematical concepts. CO2: Identify the principle concept needed in a question. CO3: Solve the quantitative and logical ability questions with the appropriate concept. CO4: Analyze the data given in complex problems.					
Course Content:						
Module 1	**Quantitative Ability 1**	Assignment	**16 Hours**			
Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss						

Module 2	Quantitative Ability 2	Assignment	**14 Hours**
Topics: Time Speed and Distance, Boats and Streams, Simple Interest, Compound Interest, Probability, Permutation and Combination			
Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS			
Continuous Evaluation:			
CA1 – Online Test CA2 – Online Test CA3 – Online Test Assignment			
Text Book: 1.Fast Track Objective by Rajesh Verma 2. R S Aggarwal 3. Rakesh Yadav **References:** **1. www.indiabix.com** **2. www.testbook.com** **3. www.youtube.com/c/TheAptitudeGuy/videos**			
Topics relevant to Skill Development: Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through components mentioned in course handout.			

Course Code: APT4026	**Course Title:** Aptitude For Employability **Type of Course:** Practical Only	**L- T-P- C**	0	0	2	0

Version No.		1.0
Course Pre-requisites		Students should have the basic concepts of Quantitative aptitude, Verbal ability along with its applications in real life problems.
Anti-requisites		Nil
Course Description		This course is designed to enable the students to enhance their skills in quantitative aptitude and verbal ability skills.
Course Objective		The objective of the course is to familiarize the learners with concepts in Quantitative Aptitude and Verbal ability through problem solving techniques suitable for their career development.
Course Outcomes		On successful completion of the course the students shall be able to: CO1] **Recall** all the basic mathematical concepts CO2] **Identify** the principle concept needed in a question CO3] **Solve** the quantitative and logical ability questions with the appropriate concept.
Course Content:		

Module 1	Quantitative Ability	Lab-10hrs		Platform Assessment-10hrs	**20 Hours**
	Topics: Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Simple Interest and Compound Interest, Probability, Permutation and Combination.				
Module 2	Verbal Ability	Lab-5hrs		Platform Assessment-5hrs	**10 Hours**
	Topics: - Parts of Speech, Subject Verb Agreement, Spotting Error, Cloze Test, Verbal Analogies, Reading Comprehension, Idioms & Phrases, Para Jumbles				
	Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations.				

	Tools: LMS
Evaluation	**Continuous Evaluation** • Topic wise evaluation

	Text Book 1. Fast track objective by Rajesh Verma 2. R S Aggarwal 3. S.P Bakshi
	References 1. www.indiabix.com 2. www.testbook.com 3. 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.

APT4006	**Type of Course:** Audited					
Version No.	1.0					
Course Pre-requisites	Students should have the basic concepts of Logical reasoning and Critical thinking, along with its applications in real life problems.					
Anti-requisites	Nil					
Course Description	This is a skill-based training program for the engineering students (Undergraduate). This course is designed to enable the students to enhance their skills in Logical reasoning and Critical thinking.					
Course Objective	The objective of the course is to familiarize the learners with concepts in in Logical reasoning and Critical thinking through problem solving techniques suitable for their career development.					
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)					
	CO3] **Analyze** and structure the reasoning techniques and spatial visualization skills					
Course Content:						
Module 1	Logical Thinking	Assignment		**16 Hours**		
	Topics:					
	Syllogisms, Cubes and Dices, Mirror and Water images, Paper cutting and Folding, Embedded figures & Completion of figures, Data Interpretation, Data sufficiency					
Module 2	Critical Thinking	Assignment		**14 Hours**		
	Topics:					
	Analogy, Symbol and Notations, Statement and assumption, Cause of action, Statement and conclusion, Puzzles					
	Targeted Application & Tools that can be used:					
	Application area: Placement activities and Competitive examinations.					
	Tools: LMS					
Evaluation	**Continuous Evaluation**					
	· Topic wise evaluation					
	· Internal Assessments					
	Text Book					
	1. A new approach to reasoning verbal, non-verbal & analytical by BS Sijwali					
	2. R S Aggarwal					
	3. Kiran publications					
	References					
	1. www.indiabix.com					
	2. www.testbook.com					
	3. www.youtube.com/c/TheAptitudeGuy/videos					
	Topics relevant to Skill Development Logical reasoning and Critical thinking for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.					

Course Code: PPS 4027	**Course Title: Preparedness for Interview** Type of Course: Practical Only Course	L- T- P- C	0	0	2	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 to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring.
Course Objective		The objective of the course is to familiarize the learners with the concepts of "**Preparing for Interview**" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.
Course Out Comes		**On successful completion of this course the students shall be able to:** CO1: **Develop** professional Resumes CO2: **Illustrate** Resumes effectively CO3: **Apply** skills and knowledge learnt for active and effective Group Discussions and Interview
Course Content:		

Module 1	**Resume Building**	**Classroom activity**		10 Hours
	Topics: Resume structure, use of templates, Do's and Don'ts, ATS methods, Cover Letter and Video Resume **Activity:** Real world scenarios			

Module 2	**Group Discussion**	**Mock GD**		9 Hours
	Topics: -Group discussion as a placement process, GD techniques like keyword, SPELT & POV of affected parties. Do & Don't of GD, Case-lets and topics for GD practice session and evaluation **Activity:-** Real world scenarios			
Module 3	**Personal Interview**	**Grooming checks + Evaluation + Mock Interview+ Role Play**		9 Hours
	Topics: Placement process, Different interview rounds, HR interviews, Interview questions and desired answers, Different types of interviews, Do's and Don'ts. **Activity: -** Role Play & Real-world scenario			
Module 4	**Recap/Revision /Feedback Session**	**Practice sessions**		2 Hours
	Targeted Application & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Role Play activities			
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
	Continuous Individual Assessment			
	The Topics related to Skill Development: Art Of Presentation and Group Discussion for **Skill Development** through **Participative Learning** Techniques. This is attained through assessment Component mentioned in course handout.			

Course Code: PPS 4027	**Course Title: Preparedness for Interview** Type of Course: Practical Only Course	L- T- P- C	0	0	2	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 to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring.
Course Objective		The objective of the course is to familiarize the learners with the concepts of "**Preparing for Interview**" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.
Course Out Comes		**On successful completion of this course the students shall be able to:** CO1: **Develop** professional Resumes CO2: **Illustrate** Resumes effectively CO3: **Apply** skills and knowledge learnt for active and effective Group Discussions and Interview
Course Content:		

Module 1	**Resume Building**	**Classroom activity**		10 Hours
	Topics: Resume structure, use of templates, Do's and Don'ts, ATS methods, Cover Letter and Video Resume **Activity:** Real world scenarios			

Module 2	**Group Discussion**	**Mock G D**		9 Hours
	Topics: -Group discussion as a placement process, GD techniques like Keyword. SPELT & POV of affected parties. Do & Don't of GD, Case-lets and topics for GD, practice session and evaluation **Activity:-** Real world scenarios			
Module 3	**Personal Interview**	**Grooming checks + Evaluation + Mock Interview+ Role Play**		9 Hours
	Topics: Placement process, Different interview rounds, HR interviews, Interview questions and desired answers, Different types of interviews, Do's and Don'ts. **Activity: -** Role Play & Real-world scenario			
Module 4	**Recap/Revision /Feedback Session**	**Practice sessions**		2 Hours
	Targeted Application & Tools that can be used: 1. TED Talks 2. You Tube Links 3. Role Play activities			
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
	Continuous Individual Assessment			
	The Topics related to Skill Development: Art Of Presentation and Group Discussion for **Skill Development** through **Participative Learning** Techniques. This is attained through assessment Component mentioned in course handout.			