PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

Itgalpura, Rajankunte, Yelahanka, Bengaluru – 560064

PRESIDENCY SCHOOL OF COMPUTER SCIENCE ANDENGINEERING

Program Regulations and Curriculum

2023-2027

BACHELOR OF TECHNOLOGY (B.Tech.) in

Computer Science and Engineering

(Artificial Intelligence and Machine Learning)

B. Tech. [CAI]

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

Regulation Number: PU/AC-21.5/SoCSE2 /CAI/2023-2027

Resolution No. 5 of the 21th Meeting of the Academic Council held on 06th Sept 2023, and ratified by the Board of Management in its 22ndth Meeting held on 02nd Nov 2023.

(As amended upto 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)

September 2023

Table of Contents

PART A – PROGRAM REGULATIONS

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

1.1 Vision of the University

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

1.2 Mission of the University

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

1.3 Vision of Presidency School of Computer Science and Engineering

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

1.4 Mission of Presidency School of Computer Science and Engineering

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

2. Preamble to the Program Regulations and Curriculum

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

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

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

3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2023-2027.
b. These Regulations are subject to, and pursuant to the Academic Regulations.
c. These Regulations shall be applicable to the ongoing Bachelor of Technology Degree Programs of the 2023-2027 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2023-2024.

4. Definitions

In these Regulations, unless the context otherwise requires:

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

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

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

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

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

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

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

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

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

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

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

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

ee. *"Program Regulations" means the Bachelor of Technology Degree Program Regulations and Curriculum, 2022-2026;*

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

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

hh. *"Registrar" means the Registrar of the University;*

ii. *"School" means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;*

jj. *"Section" means the duly numbered Section, with Clauses included in that Section, of these Regulations;*

kk. *"SGPA" means the Semester Grade Point Average as defined in the Academic Regulations;*

ll. *"Statutes" means the Statutes of Presidency University;*

mm. *"Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;*

nn. *"Summer Term" means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;*

oo. *"SWAYAM" means Study Webs of Active Learning for Young Aspiring Minds.*

pp. *"UGC" means University Grant Commission;*

qq. *"University" means Presidency University, Bengaluru; and*

rr. *"Vice Chancellor" means the Vice Chancellor of the University.*

5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2023-2027 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2023-2027 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as 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 (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

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

PEO1. Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values

PEO2. Engage in lifelong learning through research and professional development

PEO3. Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship

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

8.1 Programme Outcomes (PO)

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

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and 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: Employability: Develop technical, managerial, and problem-solving skills for employability and career growth.

PSO2: Research: Apply theoretical knowledge to real-world challenges, fostering research and innovation.

PSO3: Entrepreneurship: Cultivate entrepreneurship, teamwork, and ethical AI/ML solutions for industrial and societal impact.

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 Science and Engineering (Artificial Intelligence and Machine Learning) is "N" Credits, and, if the total credits prescribed in the 1st Year (total credits of the 1st and 2nd Semesters) of the Program concerned is "M" Credits, then the *Minimum Credit Requirements* for the award of the B.Tech. in Computer Science and Engineering (Artificial Intelligence and Machine Learning)for a student who joins the Program through the provision of the Lateral Entry, shall be "N – M" Credits.

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

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

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

10.2.1 The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3.

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

10.2.3 The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.

10.2.4 The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the B.Tech. / B.E. / B.S. Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.

10.2.5 The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

11 Change of Branch / Discipline / Specialization

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

11.1 Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the B.Tech. Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester, shall be eligible for consideration for a change of Branch.

11.2 Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the B.Tech. Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.

11.3 The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the B.Tech. Program, the Fee Policy pertaining to that Branch of the B.Tech. Program, and, all other rules pertaining to the changed Branch existing at the time.

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

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

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

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

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

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

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

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 12.5 of academic regulation) 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 Academics 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.

2.1 Minimum Performance Criteria:

2.1.1 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.

2.1.2 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.

2.1.3 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 Clause 2.1.1 and 2.1.2) in the "Make-Up

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

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

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

3.1 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.

3.2 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.

3.3 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:

3.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 3.3 (as per Academic Regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

3.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 3.3 (as per academic regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

3.3.3 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.

3.3.4 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.

3.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 3.3.2 above.

3.3.6 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.

3.3.7 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.

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

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

Sl. No.	Course Duration	Credit Equivalence
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

3.3.9 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.

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

3.4 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.

3.5 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 Science and Engineering (Artificial Intelligence and Machine Learning)) Program Structure (2023-2027) totalling 160 credits. Table 3.0 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: B.Tech. . Computer Science and Engineering (Artificial Intelligence and Machine Learning) 2023-2027: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Baskets	Credit Contribution
SCHOOL CORE	68
PROGRAM CORE	65
DISCIPLINE ELECTIVE	18
OPEN ELECTIVE	09
TOTAL CREDITS	**Min. 160**

In the entire Program, the practical and skill based course component contribute to an extent of approximately 52% out of the total credits of 160 for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) program of four years duration.

15. Minimum Total Credit Requirements of Award of Degree

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

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

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

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

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

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

c. No dues to the University, Departments, Hostels, Library, and any other such 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

Table 3.1: List of School Core Courses

1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	School Core
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	School Core
3	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	School Core
4	ENG1002	Technical English	1	0	2	2	3	School Core
5	PPS1001	Introduction to soft skills	0	0	2	1	2	School Core

6	CSE1004	Problem Solving Using C	1	0	4	3	5	School Core
7	CHE1018	Environmental Science	1	0	2	0	3	School Core
8	PPS1011	Introduction to Verbal Ability	0	1	0	0	1	School Core
9	MAT1003	Applied Statistics	1	0	2	2	3	School Core
10	ECE2007	Digital Design	2	0	2	3	4	School Core
11	CIV1008	Basic Engineering Sciences	2	0	0	2	2	School Core
12	MEC1006	Engineering Graphics	2	0	0	2	2	School Core
13	CSE1006	Problem Solving using JAVA	1	0	4	3	5	School Core
14	ENG2001	Advanced English	1	0	2	2	3	School Core
15	PPS1012	Enhancing Personality Through Soft Skills	0	0	2	1	2	School Core
16	ECE2010	Innovative Projects Using Arduino	-	-	-	1	1	School Core
17	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	3	School Core
18	CSE2001	Data Structures and Algorithms	3	0	2	4	5	School Core
19	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	School Core
20	ECE2011	Innovative Projects Using Raspberry Pi	-	-	-	1	0	School Core

21	PPS4002	Introduction to Aptitude	0	0	2	1	2	School Core
22	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	School Core
23	PPS4004	Aptitude Training Intermediate	0	0	2	1	2	School Core
24	CSE3216	Mastering Object-Oriented Concepts in Python	0	0	2	1	2	School Core
25	APT4006	Logical and Critical Thinking	**0**	**0**	**2**	0	2	School Core
26	CSE7000	Internship	-	-	-	2	0	School Core
27	APT4026	Aptitude for Employability	**0**	**0**	**2**	0	2	School Core
28	**CSE2274**	Competitive Programming and Problem Solving	0	0	4	2	4	School Core
29	PPS4027	Preparedness for Interview	**0**	**0**	**2**	0	2	School Core
30	CSE7101	Mini Project	-	-	-	5	0	School Core
31	CSE7300	Capstone Project	-	-	-	10	0	School Core
32	CIV7601	Universal Human Values and Ethics	0	0	0	0	0	School Core
33	LAW7601	Indian Constitution	-	-	-	0	-	School Core

Table 3.2 : List of Program Core Courses

1	CSE3155	Data Communications and Computer Networks	3	0	2	4	5	Program Core
2	CSE2009	Computer Organization and Architecture	3	0	0	3	3	Program Core
3	CSE3156	Database Management Systems	3	0	2	4	5	Program Core
4	CSE2014	Software Engineering	3	0	0	3	3	Program Core
5	CSE1005	Programming in Python	1	0	4	3	5	Program Core
6	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	Program Core
7	CSE3157	Artificial Intelligence and Machine Learning	3	0	2	4	5	Program Core
8	CSE3351	Operating System	3	0	0	3	3	Program Core
9	CSE3078	Cryptography and Network Security	3	0	0	3	3	Program Core
10	**CSE2266**	Theory of Computation	3	0	0	3	3	Program Core
11	ISE2504	Image Processing and Computer Vision	3	0	0	3	3	Program Core
12	**CCS2506**	Intrusion Detection and Prevention System	3	0	0	3	3	Program Core
13	CSE2272	Cloud Computing	2	0	0	2	2	Program Core
14	CSE2505	Mobile Application Development	2	0	0	2	2	Program Core
15	CAI2502	Deep Learning	3	0	0	3	3	Program Core
16	CAI2503	Deep Learning Lab	0	0	4	2	4	Program Core

17	CSE2506	Mobile Application Development Lab	0	0	4	2	4	Program Core
18	ISE2505	Image Processing and Computer Vision Lab	0	0	2	1	2	Program Core
19	CSE2273	Cloud Computing Lab	0	0	2	1	2	Program Core
20	CAI2504	Natural Language Processing	3	0	0	3	3	Program Core
21	CAI2506	Numerical Optimization in AI	3	0	0	3	3	Program Core
22	CAI2507	Deep Reinforcement Learning	2	0	0	2	2	Program Core
23	CAI2512	Neural Networks and Fuzzy Logic	3	0	0	3	3	Program Core
24	CAI2505	Natural Language Processing Lab	0	0	2	1	2	Program Core
25	CAI2508	Deep Reinforcement Learning Lab	0	0	2	1	2	Program Core

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.

18.2 Mini Project Work

A student may opt to do a Mini Project Work for a period of 08-10 weeks in an Industry / Company or academic / research institution or the University Department(s) 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 Mini Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

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

18.3 Capstone Project

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

18.3.1 The Capstone Project shall be 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 Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Capstone Project Policy of the University.

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

18.4 Research Project / Dissertation

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

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

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

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

Table 3.3: Discipline Electives Courses/Specialization Tracks – Minimum of 12 credits is to be earned by the student in program specialization basket and 06 from other baskets with overall 18 credits.

Specialization Track 1: Emerging AI and Computational Intelligence

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	CAI3400	Image Processing and Analysis	2	0	2	3	4	S/EM	CSE3157
2	CAI3401	Big Data Analytics for AI	2	0	2	3	4	S/EM	CSE3157
3	CAI3402	Optimization Techniques for Machine Learning	2	0	2	3	4	S/EM	CSE3157
4	CAI3403	Reinforcement Learning	2	0	2	3	4	S/EM	CSE3157
5	CAI3404	AI in Cybersecurity	2	0	2	3	4	S/EM	CSE3157
6	CAI3405	Explainable AI	2	0	2	3	4	S/EM	CSE3157
7	CAI3406	Responsible AI	2	0	2	3	4	S/EM	CSE3157
8	CAI3407	Agentic AI	2	0	2	3	4	S/EM	CSE3157
9	CAI3408	Deep Neural Networks	2	0	2	3	4	S/EM	CSE3157

10	CAI3409	Speech Recognition and Synthesis	2	0	2	3	4	S/EM	CSE3157
11	CAI3410	AI Chatbots without Programming	2	0	2	3	4	S/EM	CSE3157
12	CAI3411	Generative AI	2	0	2	3	4	S/EM	CSE3157
13	CAI3412	Machine Learning for Finance	2	0	2	3	4	S/EM	CSE3157
14	CSE3082	Object Oriented Analysis and Design	3	0	0	3	4	S/EM	CSE3157
15	CSE2021	Data Mining	3	0	0	3	4	S/EM	CSE3157

Specialization Track 2: AI driven Autonomous Systems

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	CAI3413	Industrial IoT	2	0	2	3	4	S/EM	CSE3157
2	CAI3414	Smart Farming	2	0	2	3	4	S/EM	CSE3157
3	CAI3415	AI for Autonomous Systems	2	0	2	3	4	S/EM	CSE3157
4	CAI3416	Edge Computing	2	0	2	3	4	S/EM	CSE3157
5	CAI3417	Cognitive Computing	2	0	2	3	4	S/EM	CSE3157
6	CAI3418	Geospatial Data Analytics	2	0	2	3	4	S/EM	CSE3157
7	CAI3419	AI for energy consumption optimization	2	0	2	3	4	S/EM	CSE3157

Specialization Track 3: Healthcare Data Analytics

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	CAI3420	Bio Medical Informatics	2	0	2	3	4	S/EM	CSE3157
2	CAI3421	Intelligent system for disease prediction and drug discovery	2	0	2	3	4	S/EM	CSE3157
3	CAI3422	AI for Medical Imaging	2	0	2	3	4	S/EM	CSE3157
4	CAI3423	Genomic Data Science	2	0	2	3	4	S/EM	CSE3157
5	CAI3424	Clinical Data Science	2	0	2	3	4	S/EM	CSE3157
6	CAI3425	AI in Epidemiology and Public Health Analytics	2	0	2	3	4	S/EM	CSE3157
7	CAI3426	Time Series Analysis for Patient Monitoring	2	0	2	3	4	S/EM	CSE3157

Specialization Track 4: Applied AI and Full Stack Development

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre-requisites
1	CSE3425	Programming in C# and .NET	1	0	4	3	4	S/EM	CSE3157
2	CSE3426	Front End Full Stack Development	2	0	2	3	4	S/EM	CSE3157
3	CSE3427	Java Full Stack Development	2	0	2	3	4	S/EM	CSE3157
4	CSE3428	.Net Full Stack Development	2	0	2	3			
Track 6 – Special Basket									
1	CAI3427	Language Models for Text Mining	2	0	2	3	4	S/EM	CSE3001
2	CAI3428	Practical Deep Learning with TensorFlow	2	0	2	3	4	S/EM	CSE3001
3	CAI3429	Deep Learning Techniques for Computer Vision	2	0	2	3	4	S/EM	MAT1003
Total # of Credits to be earned from DE = 18									

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

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

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

Sl. No.	Course Code	Course Name	L	T	P	C	Type of Skill/ Focus	Course Caters to	Prerequisites/ Corequisites	Antirequisites	Future Courses that need this as a Prerequisite
Chemistry Basket											
1	CHE1003	Fundamentals of Sensors	3	0	0	3	S	ES	-	-	-
2	CHE1004	Smart materials for IOT	3	0	0	3	S	ES	-	-	-
3	CHE1005	Computational Chemistry	2	0	0	2	S	ES	-	-	-
4	CHE1006	Introduction to Nano technology	3	0	0	3	S	ES	-	-	-
5	CHE1007	Biodegradable electronics	2	0	0	2	S	ES	-	-	-
6	CHE1008	Energy and Sustainability	2	0	0	2	S	ES	-	-	-
7	CHE1009	3D printing with Polymers	2	0	0	2	S	ES	-	-	-
8	CHE1010	Bioinformatics and Healthcare IT	2	0	0	2	S	ES	-	-	-
9	CHE1011	Chemical and Petrochemical catalysts	3	0	0	3	S	ES	-	-	-
10	CHE1012	Introduction to Composite materials	2	0	0	2	S	ES	-	-	-
11	CHE1013	Chemistry for Engineers	3	0	0	3	S	ES	-	-	-

12	CHE1014	Surface and Coatings technology	3	0	0	3	S	ES	-	-	-
13	CHE1015	Waste to Fuels	2	0	0	2	S	ES	-	-	-
14	CHE1016	Forensic Science	3	0	0	3	S	ES	-	-	-
Civil Engineering Basket											
1	CIV1001	Disaster mitigation and management	3	0	0	3	S	-	-	-	-
2	CIV1002	Environment Science and Disaster Management	3	0	0	3	FC	-	-	-	-
3	CIV2001	Sustainability Concepts in Engineering	3	0	0	3	S	-	-	-	-
4	CIV2002	Occupational Health and Safety	3	0	0	3	S	-	-	-	-
5	CIV2003	Sustainable Materials and Green Buildings	3	0	0	3	EM	-	-	-	-
6	CIV2004	Integrated Project Management	3	0	0	3	EN	-	-	-	-
7	CIV2005	Environmental Impact Assessment	3	0	0	3	EN	-	-	-	-
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	0	3	EN	-	-	-	-
9	CIV2044	Geospatial Applications for Engineers	2	0	2	3	EM	-	-	-	-
10	CIV2045	Environmental Meteorology	3	0	0	3	S	-	-	-	-
11	CIV3046	Project Problem Based Learning	3	0	0	3	S	-	-	-	-
12	CIV3059	Sustainability for Professional Practice	3	0	0	3	EN	-	-	-	-
Commerce Basket											
1	COM2001	Introduction to Human Resource Management	2	0	0	2	F	HP/GS	-	-	-
2	COM2002	Finance for Non Finance	2	0	0	2	S	-	-	-	-
3	COM2003	Contemporary Management	2	0	0	2	F	-	-	-	-
4	COM2004	Introduction to Banking	2	0	0	2	F	-	-	-	-
5	COM2005	Introduction to Insurance	2	0	0	2	F	-	-	-	-
6	COM2006	Fundamentals of Management	2	0	0	2	F	-	-	-	-
7	COM2007	Basics of Accounting	3	0	0	3	F	-	-	-	-
Computer Science Basket (not to be offered for Computer Science and Engineering students)											
1	CSE2002	Programming in Java	2	0	2	3	S/EM	-	-	-	-
2	CSE2003	Social Network Analytics	3	0	0	3	S	GS	-	-	-
3	CSE2004	Python Application Programming	2	0	2	3	S/ EM	-	-	-	-
4	CSE2005	Web design fundamentals	2	0	2	3	S/ EM/EN	-	-	-	-
5	CSE3111	Artificial Intelligence : Search Methods For Problem Solving	3	0	0	3	S/ EM/EN	-	-	-	-
6	CSE3112	Privacy And Security In Online Social Media	3	0	0	3	S/ EM/EN	-	-	-	-
7	CSE3113	Computational Complexity	3	0	0	3	S/ EM/EN	-	-	-	-
8	CSE3114	Deep Learning for Computer Vision	3	0	0	3	S/ EM/EN	-	-	-	-
9	CSE3115	Learning Analytics Tools	3	0	0	3	S/ EM/EN	-	-	-	-
Design Basket											
1	DES1001	Sketching and Painting	0	0	2	1	S	-	-	-	-
2	DES1002	Innovation and Creativity	2	0	0	2	F	-	-	-	-
3	DES1121	Introduction to UX design	1	0	2	2	S	-	-	-	-
4	DES1122	Introduction to Jewellery Making	1	0	2	2	S	-	-	-	-
5	DES1124	Spatial Stories	1	0	2	2	S	-	-	-	-
6	DES1125	Polymer Clay	1	0	2	2	S	-	-	-	-

7	DES2001	Design Thinking	3	0	0	3	S	-	-	-	-
8	DES1003	Servicability of Fashion Products	1	0	2	2	F	ES	-	-	-
9	DES1004	Choices in Virtual Fashion	1	0	2	2	F	ES, GS, HP	-	-	-
10	DES1005	Fashion Lifestyle and Product Diversity	1	0	2	2	F	ES, GS, HP	-	-	-
11	DES1006	Colour in Everyday Life	1	0	2	2	F	ES	-	-	-
12	DES2080	Art of Design Language	3	0	0	3	S	-	-	-	-
13	DES2081	Brand Building in Design	3	0	0	3	S	-	-	-	-
14	DES2085	Web Design Techniques	3	0	0	3	S	-	-	-	-
15	DES2089	3D Modeling for Professionals	1	0	4	3	S	-	-	-	-
16	DES2090	Creative Thinking for Professionals	3	0	0	3	S	-	-	-	-
17	DES2091	Idea Formulation	3	0	0	3	S	-	-	-	-
Electrical and Electronics Basket												
1	EEE1002	IoT based Smart Building Technology	3	0	0	3	S	-	-	-	-
2	EEE1003	Basic Circuit Analysis	3	0	0	3	S	-	-	-	-
3	EEE1004	Fundamentals of Industrial Automation	3	0	0	3	S	-	-	-	-
4	EEE1005	Electric Vehicles & Battery Technology	3	0	0	3	S	-	-	-	-
5	EEE1006	Smart Sensors for Engineering Applications	3	0	0	3	S	-	-	-	-
Electronics and Communication Basket												
1	ECE1003	Fundamentals of Electronics	3	0	0	3	F	-	-	-	-
2	ECE1004	Microprocessor based systems	3	0	0	3	F	-	-	-	-
3	ECE3089	Artificial Neural Networks	3	0	0	3	S	-	-	-	-
4	ECE3097	Smart Electronics in Agriculture	3	0	0	3	F/EM	-	-	-	-
5	ECE3098	Environment Monitoring Systems	3	0	0	3	F/EM	-	-	-	-
6	ECE3102	Consumer Electronics	3	0	0	3	F/EM	-	-	-	-
7	ECE3103	Product Design of Electronic Equipment	3	0	0	3	S/F/ EM / EN	-	-	-	-
8	ECE3106	Introduction to Data Analytics	3	0	0	3	F/EM	-	-	-	-
9	ECE3107	Machine Vision for Robotics	3	0	0	3	F/EM	-	-	-	-
English Basket												
1	ENG1008	Indian Literature	2	0	0	2	-	GS/ HP	-	-	-
2	ENG1009	Reading Advertisement	3	0	0	3	S	-	-	-	-
3	ENG1010	Verbal Aptitude for Placement	2	0	2	3	S	-	-	-	-
4	ENG1011	English for Career Development	3	0	0	3	S	-	-	-	-
5	ENG1012	Gender and Society in India	2	0	0	2	-	GS/ HP	-	-	-
6	ENG1013	Indian English Drama	3	0	0	3	-	-	-	-	-
7	ENG1014	Logic and Art of Negotiation	2	0	2	3	-	-	-	-	-
8	ENG1015	Professional Communication Skills for Engineers	1	0	0	1	-	-	-	-	-
DSA Basket												
1	DSA2001	Spirituality for Health	2	0	0	2	F	HP	-	-	-
2	DSA2002	Yoga for Health	2	0	0	2	S	HP	-	-	-
3	DSA2003	Stress Management and Well Being	2	0	0	2	F	-	-	-	-
Kannada Basket												
1	KAN1001	Kali Kannada	1	0	0	1	S	-	-	-	-
2	KAN1003	Kannada Kaipidi	3	0	0	3	S	-	-	-	-
3	KAN2001	Thili Kannada	1	0	0	1	S	-	-	-	-
4	KAN2003	Pradharshana Kale	1	0	2	2	S	-	-	-	-
5	KAN2004	Sahithya Vimarshe	2	0	0	2	S	-	-	-	-
6	KAN2005	Anuvadha Kala Sahithya	3	0	0	3	S	-	-	-	-
7	KAN2006	Vichara Manthana	3	0	0	3	S	-	-	-	-
8	KAN2007	Katha Sahithya Sampada	3	0	0	3	S	-	-	-	-

9	KAN2008	Ranga Pradarshana Kala	3	0	0	3	S	-	-	-	-
Foreign Language Basket											
1	FRL1004	Introduction of French Language	2	0	0	2	S	S	-	-	-
2	FRL1005	Fundamentals of French	2	0	0	2	S	S	-	-	-
3	FRL1009	Mandarin Chinese for Beginners	3	0	0	3	S	S	-	-	-
Law Basket											
1	LAW1001	Introduction to Sociology	2	0	0	2	F	HP		-	-
2	LAW2001	Indian Heritage and Culture	2	0	0	2	F	HP/GS		-	-
3	LAW2002	Introduction to Law of Succession	2	0	0	2	F	HP/GS		-	-
4	LAW2003	Introduction to Company Law	2	0	0	2	F	HP		-	-
5	LAW2004	Introduction to Contracts	2	0	0	2	F	HP	-	-	-
6	LAW2005	Introduction to Copy Rights Law	2	0	0	2	F	HP	-	-	-
7	LAW2006	Introduction to Criminal Law	2	0	0	2	F	HP	-	-	-
8	LAW2007	Introduction to Insurance Law	2	0	0	2	F	HP	-	-	-
9	LAW2008	Introduction to Labour Law	2	0	0	2	F	HP	-	-	-
10	LAW2009	Introduction to Law of Marriages	2	0	0	2	F	HP/GS	-	-	-
11	LAW2010	Introduction to Patent Law	2	0	0	2	F	HP	-	-	-
12	LAW2011	Introduction to Personal Income Tax	2	0	0	2	F	HP	-	-	-
13	LAW2012	Introduction to Real Estate Law	2	0	0	2	F	HP	-	-	-
14	LAW2013	Introduction to Trademark Law	2	0	0	2	F	HP	-	-	-
15	LAW2014	Introduction to Competition Law	3	0	0	3	F	HP	-	-	-
16	LAW2015	Cyber Law	3	0	0	3	F	HP	-	-	-
17	LAW2016	Law on Sexual Harrassment	2	0	0	2	F	HP/GS	-	-	-
18	LAW2017	Media Laws and Ethics	2	0	0	2	F	HP/GS	-	-	-
Mathematics Basket											
1	MAT2008	Mathematical Reasoning	3	0	0	3	S	-	-	-	-
2	MAT2014	Advanced Business Mathematics	3	0	0	3	S	-	-	-	-
3	MAT2041	Functions of Complex Variables	3	0	0	3	S	-	-	-	-
4	MAT2042	Probability and Random Processes	3	0	0	3	S	-	-	-	-
5	MAT2043	Elements of Number Theory	3	0	0	3	S	-	-	-	-
6	MAT2044	Mathematical Modelling and Applications	3	0	0	3	S	-	-	-	-
Mechanical Basket											
1	MEC1001	Fundamentals of Automobile Engineering	3	0	0	3	F	-	-	-	-
2	MEC1002	Introduction to Matlab and Simulink	3	0	0	3	S/EM	-	-	-	-
3	MEC1003	Engineering Drawing	1	0	4	3	S	-	-	-	-

4	MEC2001	Renewable Energy Systems	3	0	0	3	F	ES	-	-	-
5	MEC2002	Operations Research & Management	3	0	0	3	F	-	-	-	-
6	MEC2003	Supply Chain Management	3	0	0	3	S/ EM/ EN	-	-	-	-
7	MEC2004	Six Sigma for Professionals	3	0	0	3	S/EM	-	-	MEC2008	-
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	0	3	F	-	-	-	-
9	MEC2006	Safety Engineering	3	0	0	3	S/EM	ES	-	-	-
10	MEC2007	Additive Manufacturing	3	0	0	3	F/EM	-	-	-	-
11	MEC3069	Engineering Optimisation	3	0	0	3	S/EM	-	-	-	-
12	MEC3070	Electronics Waste Management	3	0	0	3	F/S	ES	-	-	-
13	MEC3071	Hybrid Electric Vehicle Design	3	0	0	3	S/EM	ES	-	-	-
14	MEC3072	Thermal Management of Electronic Appliances	3	0	0	3	S/EM	-	-	-	-
15	MEC3200	Sustainable Technologies and Practices	3	0	0	3	S/EM	-	-	-	-
16	MEC3201	Industry 4.0	3	0	0	3	S/EM	-	-	-	-
Petroleum Basket											
1	PET1011	Energy Industry Dynamics	3	0	0	3	FC	ES	-	NIL	-
2	PET1012	Energy Sustainability Practices	3	0	0	3	FC	ES	-	NIL	-
Physics Basket											
1	PHY1003	Mechanics and Physics of Materials	3	0	0	3	FC / SD				
2	PHY1004	Astronomy	3	0	0	3	FC				
3	PHY1005	Game Physics	2	0	2	3	FC / SD				
4	PHY1006	Statistical Mechanics	2	0	0	2	FC				
5	PHY1007	Physics of Nanomaterials	3	0	0	3	FC				
6	PHY1008	Adventures in nanoworld	2	0	0	2	FC				
7	PHY2001	Medical Physics	2	0	0	2	FC	ES			
8	PHY2002	Sensor Physics	1	0	2	2	FC / SD				
9	PHY2003	Computational Physics	1	0	2	2	FC				
10	PHY2004	Laser Physics	3	0	0	3	FC	ES			
11	PHY2005	Science and Technology of Energy	3	0	0	3	FC	ES			
12	PHY2009	Essentials of Physics	2	0	0	2	FC				
Management Basket- I											
1	MGT2007	Digital Entrepreneurship	3	0	0	3	S/EM/EN	-	-	-	-
2	MGT2015	Engineering Economics	3	0	0	3	S	-	-	-	-
3	MGT2023	People Management	3	0	0	3	S/EM/ EN	HP	-	-	-
Management Basket- II											
1	MGT1001	Introduction to Psychology	3	0	0	3	F	HP	-	-	-
2	MGT1002	Business Intelligence	3	0	0	3	EN	-	-	-	-
3	MGT1003	NGO Management	3	0	0	3	S	-	-	-	-

4	MGT1004	Essentials of Leadership	3	0	0	3	EM/ EN	GS/ HP	-	-	-
5	MGT1005	Cross Cultural Communication	3	0	0	3	S/EM/ EN	HP	-	-	-
6	MGT2001	Business Analytics	3	0	0	3	S/ EM/EN	-	-	-	-
7	MGT2002	Organizational Behaviour	3	0	0	3	F	HP	-	-	-
8	MGT2003	Competitive Intelligence	3	0	0	3	S	-	-	-	-
9	MGT2004	Development of Enterprises	3	0	0	3	S/EM/EN	-	-	-	-
10	MGT2005	Economics and Cost Estimation	3	0	0	3	S/EM	-	-	-	-
11	MGT2006	Decision Making Under Uncertainty	3	0	0	3	S	-	-	-	-
12	MGT2008	Econometrics for Managers	3	0	0	3	S	-	-	-	-
13	MGT2009	Management Consulting	3	0	0	3	S/EM/EN	-	-	-	-
14	MGT2010	Managing People and Performance	3	0	0	3	S/EM/EN	HP/GS	-	-	-
15	MGT2011	Personal Finance	3	0	0	3	F	-	-	-	-
16	MGT2012	E Business for Management	3	0	0	3	S/EM	-	-	-	-
17	MGT2013	Project Management	3	0	0	3	EN / EM	GS/HP/ES	-	-	-
18	MGT2014	Project Finance	3	0	0	3	EN / EM	HP	-	-	-
19	MGT2016	Business of Entertainment	3	0	0	3	EM/ EN	-	-	-	-
20	MGT2017	Principles of Management	3	0	0	3	S/EM/ EN	-	-	-	-
21	MGT2018	Professional and Business Ethics	3	0	0	3	S/EM/ EN	HP	-	-	-
22	MGT2019	Sales Techniques	3	0	0	3	S/EM/ EN	HP	-	-	-
23	MGT2020	Marketing for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
24	MGT2021	Finance for Engineers	3	0	0	3	S/EM/ EN	HP	-	-	-
25	MGT2022	Customer Relationship Management	3	0	0	3	S/EM/ EN	HP	-	-	-
Media Studies Basket											
1	BAJ3050	Corporate Filmmaking and Film Business	0	0	4	2	EM	HP	-	-	-
2	BAJ3051	Digital Photography	2	0	2	3	EM	HP	-	-	-
3	BAJ3055	Introduction to News Anchoring and News Management	0	0	2	1	EM	-	-	-	-

21. List of MOOC Courses for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Program of 12 weeks

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 Science and Engineering (Artificial Intelligence and Machine Learning) Program

Table 3.5 : MOOC Discipline Elective Courses
Discipline Elective Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)

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

21.3 MOOC - Open Elective Courses for B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Program

Table 3.6: MOOC Open Elective Courses
Open Elective Courses Duration is 12 weeks

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

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	Basket
Semester 1 - Physics Cycle						17	28	
1	MAT1001	Calculus and Linear Algebra	3	0	2	4	5	School Core
2	PHY1002	Optoelectronics and Device Physics	2	0	2	3	4	School Core
3	ECE1001	Elements of Electronics Engineering	3	0	2	4	5	School Core
4	ENG1002	Technical English	1	0	2	2	3	School Core
5	PPS1001	Introduction to soft skills	0	0	2	1	2	School Core
6	CSE1004	Problem Solving Using C	1	0	4	3	5	School Core
7	CHE1018	Environmental Science	1	0	2	0	3	School Core
8	PPS1011	Introduction to Verbal Ability	0	1	0	0	1	School Core
Semester 2 - BES Cycle						16	22	
1	MAT1003	Applied Statistics	1	0	2	2	3	School Core
2	ECE2007	Digital Design	2	0	2	3	4	School Core
3	CIV1008	Basic Engineering Sciences	2	0	0	2	2	School Core
4	MEC1006	Engineering Graphics	2	0	0	2	2	School Core
5	CSE1006	Problem Solving using JAVA	1	0	4	3	5	School Core
6	ENG2001	Advanced English	1	0	2	2	3	School Core
7	PPS1002	Soft Skills for Engineers	0	0	2	1	2	School Core

8	ECE2010	Innovative Projects Using Arduino	-	-	-	1	1	School Core
Semester 3						29	34	
1	MAT1002	Transform Techniques, Partial Differential Equations and Their Applications	3	0	0	3	3	School Core
2	CSE2001	Data Structures and Algorithms	3	0	2	4	5	School Core
3	CSE3155	Data Communications and Computer Networks	3	0	2	4	5	Program Core
4	CSE2009	Computer Organization and Architecture	3	0	0	3	3	Program Core
5	MAT2004	Discrete Mathematical Structures	3	0	0	3	3	School Core
6	CSE3156	Database Management Systems	3	0	2	4	5	Program Core
7	CSE2014	Software Engineering	3	0	0	3	3	Program Core
8	ECE2011	Innovative Projects Using Raspberry Pi	-	-	-	1	0	School Core
9	CSE1005	Programming in Python	1	0	4	3	5	Program Core
10	PPS4002	Introduction to Aptitude	0	0	2	1	2	School Core
Semester 4						23	27	
1	MAT2003	Numerical Methods for Engineers	1	0	2	2	3	School Core
2	CSE2007	Design and Analysis of Algorithms	3	0	0	3	3	Program Core
3	CSE3157	Artificial Intelligence and Machine Learning	3	0	2	4	5	Program Core
4	CSE3351	Operating System	3	0	0	3	3	Program Core
5	CSE3078	Cryptography and Network Security	3	0	0	3	3	Program Core
6	CSEXXXX	Professional Elective – I	3	0	0	3	3	Discipline Elective
7	XXXXXXX	Open Elective – I (Management Basket)	3	0	0	3	3	Open Elective

8	PPS4004	Aptitude Training Intermediate	0	0	2	1	2	School Core
9	CSE3216	Mastering Object-Oriented Concepts in Python	0	0	2	1	2	School Core
Semester 5						27	33	
1	CSE2266	Theory of Computation	3	0	0	3	3	Program Core
2	ISE2504	Image Processing and Computer Vision	3	0	0	3	3	Program Core
3	CCS2506	Intrusion Detection and Prevention System	3	0	0	3	3	Program Core
4	CSE2272	Cloud Computing	2	0	0	2	2	Program Core
5	CSE2505	Mobile Application Development	2	0	0	2	2	Program Core
6	CAI2502	Deep Learning	3	0	0	3	3	Program Core
7	CAI2503	Deep Learning Lab	0	0	4	2	4	Program Core
8	CSE2506	Mobile Application Development Lab	0	0	4	2	4	Program Core
9	ISE2505	Image Processing and Computer Vision Lab	0	0	2	1	2	Program Core
10	CSEXXXX	Professional Elective – II	3	0	0	3	3	Discipline Elective
11	CSE2273	Cloud Computing Lab	0	0	2	1	2	Program Core
12	APT4006	Logical and Critical Thinking	0	0	2	0	2	School Core
13	CIV7601	Universal Human Values and Ethics	0	0	0	0	0	School Core
14	CSE7000	Internship	-	-	-	2	0	School Core
Semester 6						21	27	
1	CAI2504	Natural Language Processing	3	0	0	3	3	Program Core
2	CAI2506	Numerical Optimization in AI	3	0	0	3	3	Program Core

3	CAI2507	Reinforcement Learning	2	0	0	2	2	Program Core
4	CAI2512	Neural Networks and Fuzzy Logic	3	0	0	3	3	Program Core
5	CSEXXXX	Professional Elective – III	3	0	0	3	3	Discipline Elective
6	XXXXXXX	Open Elective – II	3	0	0	3	3	Open Elective
7	CAI2505	Natural Language Processing Lab	0	0	2	1	2	Program Core
8	CAI2508	Reinforcement Learning Lab	0	0	2	1	2	Program Core
9	APT4026	Aptitude for Employability	0	0	2	0	2	School Core
10	CSE2274	Competitive Programming and Problem Solving	0	0	4	2	4	School Core
11	LAW7601	Indian Constitution	-	-	-	0	0	School Core
Semester 7						17	14	
1	CSEXXXX	Professional Elective – IV	3	0	0	3	3	Discipline Elective
2	CSEXXXX	Professional Elective – V	3	0	0	3	3	Discipline Elective
3	CSEXXXX	Professional Elective – VI	3	0	0	3	3	Discipline Elective
4	XXXXXXX	Open Elective – III	3	0	0	3	3	Open Elective
5	PPS4027	Preparedness for Interview	0	0	2	0	2	School Core
6	CSE7101	Mini Project	-	-	-	5	0	School Core
Semester 8						10	0	
1	CSE7300	Capstone Project	-	-	-	10	0	School Core

23.Course Catalogue

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

The Course Catalogues for the Courses offered in each basket are attached below:

Course Code: MAT1001	Course Title: Calculus and Linear Algebra Type of Course:1] School Core Lab Integrated	L-T- P- C	3	1	0	4

Version No.		2.0
Course Pre-requisites		Basic Concepts of Limits, Differentiation, Integration
Anti-requisites		NIL
Course Description		The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature.
Course Objective		The objective of the course is to familiarize the learners with the concepts of “CALCULUS AND LINEAR ALGEBRA” and attain Skill Development through problem solving techniques.
Course Out Comes		On successful completion of the course the students shall be able to: 1) Comprehend the knowledge of applications of matrix principles. 2) Understand the concept of partial derivatives and their applications. 3) Apply the principles of integral calculus to evaluate integrals. 4) Adopt the various analytical methods to solve differential equations.
Course Content:		

Module 1	Linear Algebra				16 Classes
	Review: Types of matrices, elementary transformations, Linear Algebra:				

<table>
<tr><td></td><td colspan="6">Echelon form, rank of a matrix, consistency and solution of system of linear equations - Gauss elimination method, Gauss-Jordan method.

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

Engineering Applications of Linear Algebra.</td></tr>
<tr><td colspan="2">Module 2</td><td>Partial Derivatives</td><td></td><td></td><td></td><td>14 CLASSES</td></tr>
<tr><td></td><td colspan="6">Review: Differential calculus with single variable.

Differential Calculus:

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

Engineering Applications of partial derivatives.</td></tr>
<tr><td colspan="2">Module 3</td><td>Integral calculus</td><td></td><td></td><td></td><td>12 Classes</td></tr>
<tr><td></td><td colspan="6">Review: Integral calculus for single integrals.

Integral calculus:

Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates.

Beta and Gamma functions–inter-relation-evaluation of integrals using gamma and beta functions. Evaluate double & triple integrals.</td></tr>
<tr><td colspan="2">Module 4</td><td>Differential Equations</td><td>Assignment</td><td></td><td>Programming</td><td>16 Classes</td></tr>
<tr><td></td><td colspan="6">Definition, types of differential equations, order and degree, Linear Differential Equations, Bernoulli’s Differential Equation, Exact and Non - Exact Differential Equations.

Higher order Differential Equation with constant coefficients and with right hand side of the form eax, sinax, cosax, eaxf(x), xnf(x) etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange’s Equation, Method of Variation of Parameters.

Engineering applications of differential equations.</td></tr>
</table>

	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:
	List at least 3 sets of Matrix Applications concerning the respective branch of Engineering and obtain the solution using C Programming/Python. 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 SKILL DEVELOPMENT: The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software. for Skill Development through Experiential Learning methodologies. This is attained through assessment component mentioned in course handout.

Course Code: PHY1002	Course Title: Optoelectronics and Device Physics Type of Course: 1] School Core & Laboratory integrated	L-T-P-C	2-0-2-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.		
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the concepts of semiconductors, magnetic materials and superconductors. CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices. CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers. CO4: Explain the applications of lasers and optical fibers in various technological fields.		

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

Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling.

Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy.

List of Laboratory Tasks:

Experiment No. 1: Experimental errors and uncertainty using excel

Level 1: Calculation of accuracy and precision of a given data

Level 2: propagation of errors in addition, subtraction, multiplication and division.

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

Level 1: Determination of Wavelength of Laser

Level 2: Finding the particle size of lycopodium powder.

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

Level 1: To determine the proportionality of Hall Voltage and magnetic flux density

Level 2: To determine the polarity of Charge carrier.

Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions.

Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage.

Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance.

Experiment No. 5: To study input and output characteristics of a given Transistor.

Level 1: To determine the input resistance of a given transistor.

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

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

Level 1: Determination of Fermi energy and Fermi temperature of given metal wire. Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire. Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage. Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance. Level 2: To measure the photo-current as a function of the irradiance at constant voltage. Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance. Level 1: To study the I-V characteristics Level 2: I-R characteristics of a solar cell as a function of the irradiance. Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. . Level 1: Calculate the numerical aperture. Level 2: study the losses that occur in optical fiber cable. Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method. Level 1: To determine the magnetic susceptibility of a given diamagnetic substance. Level 2: To determine the magnetic susceptibility of a given paramagnetic substance. Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs and Determination of knee voltage. Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs Level 2: Determination of knee voltage. Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law. Level 1: Determination of Stefan's constant Level 2: Verification of Stefan-Boltzmann Law.
Targeted Application & Tools that can be used:

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

Module 1	Basic Electrical and Electronic Components	Assignment / Quiz	Identification of Practical electronic and electrical components / Memory Recall based Quizzes	10 Sessions

<table>
<tr><td></td><td></td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="6">Topics:

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

ELECTRONIC MATERIALS AND COMPONENTS: Conductors, Insulators, Semi-Conductor Material, P-N Junction diode, Characteristics and Parameters, Ideal Diode approximations, DC load line.</td></tr>
<tr><td>Module 2</td><td>Applications of Diodes and Introduction to BJT</td><td>Assignment / Quiz</td><td></td><td>Simulation Task/ Memory Recall based Quizzes</td><td>12 Sessions</td></tr>
<tr><td colspan="6">Topics:

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

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

BIPOLAR JUNCTION TRANSISTORS: BJT Construction and Operation, BJT Voltages and Currents, Common Base, Common Emitter Configuration and Characteristics, Current amplification Factor alpha and beta, DC Load line w.r.t. fixed bias circuit (Q-Point), AC Analysis.</td></tr>
<tr><td>Module 3</td><td>Digital Electronics and Communication System</td><td>Assignment / Quiz</td><td></td><td>Simulation Task / Memory Recall based Quizzes</td><td>13 Sessions</td></tr>
<tr><td colspan="6">Topics:

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

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

COMMUNICATION SYSTEM: Block diagram of communication system, Modulation: Definition of Modulation, Need of Modulation, Types of Modulation: Amplitude Modulation and Frequency Modulation (Waveforms only).</td></tr>
<tr><td>Module 4</td><td>Microprocessors and Computer Organization</td><td>Assignment / Quiz</td><td colspan="2">Memory recall based Quizzes</td><td>10 Sessions</td></tr>
<tr><td colspan="6">Topics:

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

COMPUTER ORGANISATION:Basic structure of Computer Organisation describing the various Computer types, Functional Units, Basic Operational concepts, Bus Structures, Memory System: RAM and ROM.</td></tr>
<tr><td colspan="6">List of Laboratory Tasks:

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

Level 1:Identification of resistor values from color bands and verification with Multimeter.</td></tr>
</table>

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

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

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

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

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

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

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

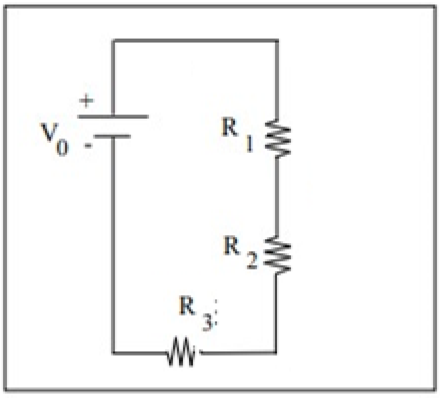
Experiment No. 4:Study of Series and Parallel Resistor Connections.

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

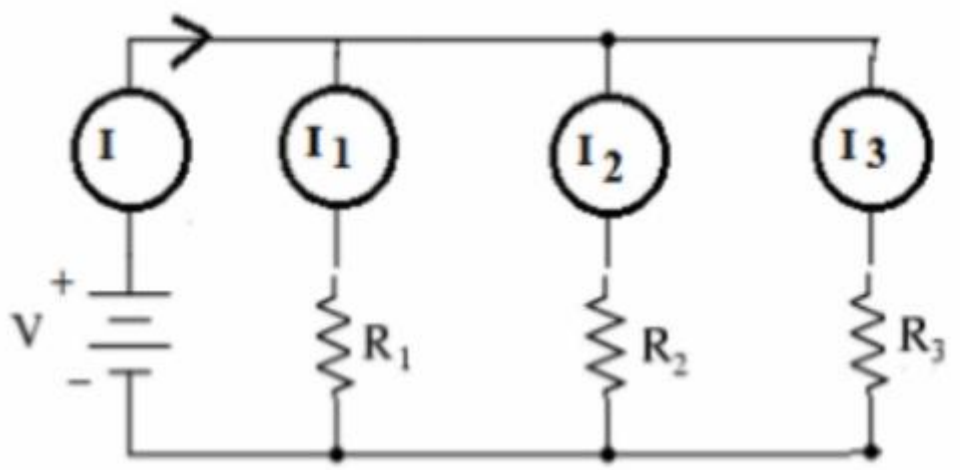
Level 2:Rig up a Current Divider Circuit and a Voltage Divider Circuit and verify the results.

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

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

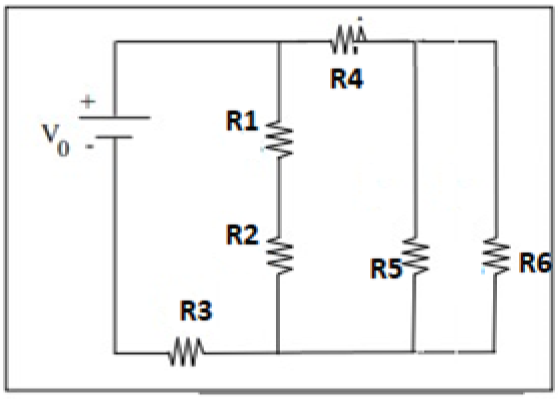


(a)



(b)

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



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

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

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

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

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

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

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

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

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

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

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

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

Targeted Application & Tools that can be used:

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

Professionally Used Software: MultiSim/ PSpice

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

Textbook(s):

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

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

Reference(s):

Reference Book(s):

R1. Smarajit Ghosh, “Fundamentals of Electrical and Electronics Engineering”, PHI, 2nd Edition

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

R3. Rajendra Prasad, “Fundamentals of Electronics Engineering”, Cengane Learning, 3rd Edition

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

Video lectures on “BASIC ELECTRONICS” by Prof. Dr. Chitralekha Mahanta, Department of Electronics and communication Engineering, IIT Guwahati”: https://nptel.ac.in/courses/117/103/117103063/ Lecture Series on “ Useful Laws in Basic Electronics” by Prof. T.S.Natarajan, Department of physics, IIT Madras: https://www.youtube.com/watch?v=vfVVF58FtCc Lecture Series on “Introduction to Bipolar Junction Transistors BJT ” by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=-VwPSDQmdjM&list=PLwjK_iyK4LLDoFG8FeiKAr3IStRkPSxqq Lecture Series on “ PN Junction Diode ” by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=USrY0JspDEg Lecture Series on “Introduction to Digital Electronics” by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=DBTna2ydmC0&list=PLwjK_iyK4LLBC_so3odA64E2MLgIRKafl Lecture Series on “Introduction to Microprocessors” by Bharat Acharya Education :https://www.youtube.com/watch?v=0M74z5jEAyA Lecture Notes on : “Electronic Devices”, Bipolar Junction Transistors, 2nd Chapter, by Shree Krishna Khadka (PDF) Bipolar Junction Transistor (researchgate.net)https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor E-content: V. Milovanovic, R. van der Toorn, P. Humphries, D. P. Vidal and A. Vafanejad, "Compact model of Zener tunneling current in bipolar transistors featuring a smooth transition to zero forward bias current," 2009 IEEE Bipolar/BiCMOS Circuits and Technology Meeting, 2009, pp. 99-102, doi: 10.1109/BIPOL.2009.5314134. https://ieeexplore.ieee.org/document/5314134 M. Oueslati, H. Garrab, A. Jedidi and K. Besbes, "The advantage of silicon carbide material in designing of power bipolar junction transistors," 2015 IEEE 12th International Multi-Conference on Systems, Signals & Devices (SSD15), 2015, pp. 1-6. https://ieeexplore.ieee.org/document/7348149 H. Luo, F. Iannuzzo, F. Blaabjerg, X. Wang, W. Li and X. He, "Elimination of bus voltage impact on temperature sensitive electrical parameter during turn-on transition for junction temperature estimation of high-power IGBT modules," 2017 IEEE Energy Conversion Congress and Exposition (ECCE), 2017, pp. 5892-5898 https://ieeexplore.ieee.org/document/8096974 F. Bauer, I. Nistor, A. Mihaila, M. Antoniou and F. Udrea, "Super junction IGBT Filling the Gap Between SJ MOSFET and Ultrafast IGBT," in IEEE Electron Device Letters, vol. 33, no. 9, pp. 1288-1290, Sept. 2012 https://ieeexplore.ieee.org/document/6246672 https://presiuniv.knimbus.com/user#/home
Topics relevant to “SKILL DEVELOPMENT”: Electrical & Electronic component and laws, Fundamentals of Digital Electronics, Communication Systems, Microprocessors and Computer Organization for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: 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 2	Technical Presentation	Presentations	Speaking Skills	12 Classes
Introduction Planning the Presentation Creating the Presentation Giving the Presentation				

Module 3	Technical Description	Assignment	Group Presentation	12 Classes
Product Description Process Description User Manuals Transcoding: Diagrams, charts and images				
Module 4	Technical Writing	Assignment	Writing Skills	12 Classes
Email Writing Persuasive and Descriptive Language Professional Email Etiquette Writing clear and concise technical emails Communicating technical information effectively Technical Report Writing Types of technical reports (Lab reports, research reports, etc.) Components of technical reports Writing an abstract and executive summary Structure and content organization Transcoding: diagrams, charts and images				
List of Laboratory Tasks: 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.

Course Code: PPS1001	Course Title: Introduction to Soft Skills Type of Course: Practical Only Course	L-T- P- C	0-0-2-1
Version No.	1.0		
Course Pre-requisites	ENG1002		
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			
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: CHE1018	Course Title: Environmental Science	L- T- P- C	1	0	2	0
	Type of Course: School Core- Theory and Lab	Contact hours	1	0	2	3

<table>
<tr><td>Course Pre-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Course Description</td><td colspan="4">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</td></tr>
<tr><td>Course

Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of “Environmental Science” and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">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</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Humans and the Environment</td><td>Assignment</td><td>Data Collection</td><td>01 class</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Natural Resources and Sustainable Development</td><td>Assignment</td><td></td><td>03 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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

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: PPS1011	Course Title: Introduction to Verbal Ability Type of Course: Theory Only Course	L- T- P- C	0	1	0	0
Version No.	1.0					
Course Pre-requisites	Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.					
Anti-requisites	NIL					
Course Description	This course is designed to enable students understand the importance of Verbal Ability and improve confidence, communication and professional skills to give them a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various worksheets and learning methodologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of "Verbal Ability" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.					
Course Out Comes	On successful completion of this course the students shall be able to: CO1: Recognize significance of verbal ability CO2: Utilize the rules of communication CO3: Apply techniques of vocabulary building to showcase effective communication					
Course Content:						

Module 1	INTRODUCTION TO VERBAL ABILITY	Individual Assessment	01 Hour
Topics: Setting Expectations, Ice Breaker, Significance of verbal ability, pre-assessment			

Module 2	EFFECTIVE VERBAL COMMUNICATION	Practice Worksheets	06 Hours
Topics: Different rules of grammar and application, Subject-Verb Agreement, Tenses			
Module 3	VOCABULARY BUILDING	Practice Worksheets	04 Hours
Topics: Root words, Synonyms and antonyms, analogies, para-jumbles			
Module 4	READING COMPREHENSION	Individual Assessment	02 Hours
A session where students will be introduced to speed reading and comprehension, post-assessment			
Targeted Application & Tools that can be used: LMS			
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course			
Individual Assessment LMS MCQ			
The topics related to Skill Development: Communication, grammar rules, vocabulary building, effective presentation for skill development through participative learning techniques. This is attained through learning and practicing the rules of effective communication through worksheets as mentioned in the assessment component.			

Course Code: MAT1003	Course Title: Applied Statistics Type of Course: School Core	L T P C	1	0	2	2
Version No.	3.0					
Course Pre-requisites	None					
Anti-requisites	None					
Course Description	The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of “Applied Statistics” and attain Skill Development Through Problem Solving techniques.			
Expected Outcome:	At the end of this course, students will be in a position to 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.			
Module 1	Descriptive Statistics	Assignment	Coding needed	10 classes
Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson’s Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression .				
Module 2	Probability			6 classes
Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye’s theorem with examples				
Module 3	Random Variables and Probability Distributions		Coding needed	14 classes
Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, Negative Binominal (Self Study), Poisson, Normal and Exponential distributions				
Module 4	Sampling Theory		Coding needed	15 classes
Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and Difference of Means (Self Study), Small Sample Tests: Student’s t-Test for Single Mean and Difference of Means, F-Test, Chi-Square Test.				

Targeted Application & Tools that can be used: The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems. Tools used: R Software / MS-Excel
Text Book 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: 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	ECE1001					
Anti-requisites	NIL					

<table>
<tr><td>Course Description</td><td colspan="4">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.</td></tr>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">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.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Number systems-Boolean algebra and digital logic</td><td>Application Assignment</td><td>Data Analysis task</td><td>06 classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Boolean function simplification</td><td>Application Assignment</td><td>Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Combinational Logic circuits:</td><td>Application Assignment</td><td>Programming Task & Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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

Course Code: CIV1008	Course Title: Basic Engineering Sciences Type of Course: Theory Only	L-T-P-C	2	0	0	2
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering.					
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1] Recognize the significance of various disciplines in Civil Engineering					

	2] Discuss the recent evolutions in Civil Engineering 3] Explain various energies, energy generating machineries and energy consumption machineries 4] Describe the fundamental concept and terminology associated with the Petroleum Industry 5] Distinguish between conventional and modern manufacturing techniques.			
Course Content:				
Module 1	Introduction to various fields in Civil Engineering	Assignment	Case studies on different Civil Engineering Projects	6 Sessions
Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure.				
Module 2	Current Trends and Evolution in Civil Engineering	Assignment	Article Review	6 Sessions
Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities.				
Module 3	Power Production and Consumption Machinery	Assignment & Quiz	Data Collection	6 Sessions
Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications.				
Module 4	Overview of Petroleum Engineering	Assignment & Quiz	Article Review	6 Sessions
Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering				
Module 5	Industry 4.0	Assignment & Quiz	Data Collection	6 Sessions
Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process. Modern Manufacturing process: 3D Printing / Additive Manufacturing.				
Targeted Application & Tools that can be used: Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities				
Project work/Assignment:				
Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering Assignment 2: Review Articles on current evolutions in Civil Engineering.				

Assignment 3: Collect data related to renewable energy generation (Wind, Solar)

Assignment 4: Prepare an energy consumption chart for a compressor or pumps.

Assignment 5: Prepare a report on role of 3D printing across various industries.

Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.

Text Book:

T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers

T2. Elements of Mechanical Engineering, by VK Manglik

T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition

References

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: 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: CSE1006	Course Title: Problem Solving using JAVA Type of Course: Integrated	L-T- P- C	1	0	4	3
Version No.	2.0					
Course Pre-requisites	CSE1004– Problem Solving Using C					
Anti-requisites	Nil					
Course Description	This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real time secure applications by applying these concepts and also for effective problem solving. The students interpret and understand the need for object oriented programming to build applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: C.O. 1: Describe the basic programming concepts. [Knowledge] C.O. 2: Apply the concept of classes, objects and methods to solve problems. [Application] C.O. 3: Apply the concept of arrays and strings. [Application] C.O. 4: Implement inheritance and polymorphism building secure applications. [Application] C.O. 5: Apply the concepts of interface and error handling mechanism. [Application]					
Course Content:						

Module 1	Basic Concepts of Programming and Java	Assignment	Data Collection/Interpretation	12 Sessions
Topics: Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping.				
Module 2	Classes, objects, methods and Constructors	Case studies / Case let	Case studies / Case let	12 Sessions
Topics: Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods. Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes.				
Module 3	Arrays, String and String buffer	Quiz	Case studies / Case let	14 Sessions
Topics: Arrays: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer.				
Module 4	Inheritance and Polymorphism	Quiz	Case studies / Case let	14 Sessions
Topics: Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling.				
Module 5	Input & Output Operation in Java	Quiz	Case studies / Case let	14 Sessions
Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces.				
List of Laboratory Tasks: P1 - Problem Solving using Basic Concepts. P2 - Problem Solving using Basic Concepts and Command Line Arguments. P3 - Programming assignment with class, objects, methods and Constructors. P4 - Programming assignment with method overloading. P5 - Programming assignment with constructor overloading. P6 - Programming assignment with Static members and static methods. P7 - Programming assignment with Nested classes. P8 - Programming assignment using Arrays. P9 - Programming assignment using Strings.				

P10 - Programming assignment using String Builder. P11 - Programming assignment using Inheritance and super keyword. P12 - Programming assignment using Method overriding and Dynamic method invocation. P13 - Programming assignment using Final keywords. P14 - Programming assignment using Abstract keywords. P15 - Programming assignment using Interface. P16 - Programming assignment using Interface. P17 - Programming assignment CharacterStream Classes P18 - Programming assignment Read/Write Operations with File Channel
Targeted Application & Tools that can be used : JDK /eclipse IDE/ net Beans IDE.
Text Book T1 Herbert Schildt, “The Complete Reference Java 2”, Tata McGraw Hill Education.
References R1: Cay S Horstmann and Cary Gornell, “CORE JAVA volume I-Fundamentals”, Pearson R2: James W. Cooper, “Java TM Design Patterns – A Tutorial”, Addison-Wesley Publishers. E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf E book link R2: Java(tm) Design Patterns: A Tutorial([PDF] [7qmsenjl97t0] (vdoc.pub) Web resources 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 Technical English						
Anti-requisites	NIL						
Course Description	The course emphasizes on technical communication at advanced level by exploring critical reading, technical presentation and review writing. The purpose of the course is to enable learners to review literature in any form or any technical article and deliver technical presentations. Extensive activities in practical sessions equip to express themselves in various forms of technical communications. Technical presentations and the module on career setting focus on learners' area of interests and enhance their English language writing skills to communicate effectively.						
Course Out Come	On successful completion of the course the students shall be able to: 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 Presentation	Presentation	Oral Skills	3 Classes
Topics: Planning the presentation Creating the presentation				

Giving the presentation				
Module 3	Writing Reviews	Prezi	Review Writing	4 Classes
Topics: Review Writing Short film reviews Advanced English Grammar (Self Study)				
Module 4	Starting your Career	Online Writing Lab	Writing Skills	4 Classes
Topics: Preparing a Resume Writing Effective Application Letter Creating a Professional Portfolio				
Course Content: Practical Sessions				
Module 1	Critical Reasoning and Writing		8 Classes	
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		
Topics Relevant to "employability": Critical Reasoning, Presentation, Review Writing and Starting Career Topics Relevant to "Human Values and Professional Ethics": Critical reasoning		

Course Code: PPS1002	Course Title: Soft skills for Engineers Type of Course: Practical Only Course	L- T- P- C	0	0	2	1
Version No.		1.0				

Course Pre-requisites		Students are expected to understand Basic English. Students should have desire and enthusiasm to involve, participate and learn.			
Anti-requisites		NIL			
Course Description		This course is designed to develop effective communication skills and boost confidence levels. The activity-based modules cover the art of Questioning, how to ask questions, goal setting with emphasis on time and stress management, creating the first impression and introducing one self and finally culminating with the etiquettes of email writing. 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 "Soft Skills for Engineers and attain Skill Development" through Experiential Learning techniques.			
Course Out Comes		On successful completion of this course the students shall be able to: CO1 Employ effective communication skills CO2 Practice questioning techniques for better decision making CO3 Differentiate individual strengths and weaknesses for self-awareness and stress management CO4 Recognise the need to set SMART GOALS			
Course Content:					
Module 1	Art of Questioning	Role plays			4 classes
	Topics: Note Taking, Framing Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions, Rhetorical questions, 5W1H Technique				
	Vocab Building				Every Class
	Dedicate 5-10minutes towards vocabulary building in every session				
Module 2	Goal Setting & Time Management	Journal + Outbound training			8 Classes
	Goal Setting (SMART Goals), 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				
Module 3	Self-introduction and Creating an Impression	Grooming checks + Evaluation			8 classes

	Topics: Body Language, Grooming guidelines for boys/girls, Common mistakes in Grooming at workplace and social gathering, Etiquettes at work place & social gathering, SWOT – Self-awareness analysis, Self-introduction template, evaluation of self-introduction in class			
Module 4	E-mail Etiquette	Industry expert / Trainer		4 Classes
	Topics: Dos and Don'ts of professional email etiquette, practice writing emails (activity)			
REVISION	Recap & Summary			2 Classes
	Revision of all the modules, overall feedback from the students with regards to the syllabus.			
	The topics related to Skill Development: Communication and professional grooming, SWOT and PEST Analysis time management and goal setting, writing and the art of asking questions for Skill Development through Participative Learning Techniques. This is attained through student self-introduction as mentioned in course handout.			
	Targeted Application & Tools that can be used: LMS			
	Topics relevant to development of "SKILL": Art of Questioning, Goal Setting & Time Management, Self-introduction and Creating an Impression, E-mail Etiquette.			
Catalogue prepared by		Faculty of L&D department		
Recommended by the Board of Studies on		BOS NO 3 Dated 10 Feb 23		
Date of Approval by the Academic Council		20 ACM dated 15 Feb 23		

Course Code: ECE2010	Course Title: Innovative Projects using Arduino	L- T-P- C	-	-	-	1
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide an in-depth understanding of Arduino microcontrollers and their application in various real time projects involving sensors. Throughout the course, students will learn the fundamentals of Arduino programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Arduino boards, read sensor data, and use it to control various output devices This course is suitable for					

	beginners who are interested in exploring the world of electronics and developing practical applications using Arduino and sensors.			
Course Objective	The objective of the course is Employability Skills of student by using PARTICIPATIVE LEARNING techniques.			
Course Outcomes	On successful completion of the course the students shall be able to Explain the main features of the Arduino prototype board Demonstrate the hardware interfacing of the peripherals to Arduino system. Understand the types of sensors and its functions Demonstrate the functioning of live projects carried out using Arduino system.			
Course Content:				
Module 1	Basic concepts of Arduino	Hands-on	Interfacing Task and Analysis	4 Sessions
Topics: Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, API's , Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables, Arduino i/o Functions, Arduino Communications, Arduino IDE, Various Cloud Platforms.				
Module 2	Sensory Devices	Hands-on	Interfacing Task and Analysis	4 Sessions
Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino. Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications. Introduction to online Simulators: Working with Tinkercad Simulator.				
Topics: Types of Arduino boards, sensors, 3D Printer				
Targeted Application & Tools that can be used: Application Area: Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.				

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

Project work/Assignment:

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

2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .

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

Textbook(s):

Monk Simon “Programming Arduino: Getting Started with Sketches”, Mc Graw Hill Publications Second Edition

References

Reference Book(s)

1. Neerparaj Rai “Arduino Projects for Engineers” BPB publishers,first edition, 2016.

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

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

Arduino trending Projects < https://www. https://projecthub.arduino.cc/>

Introduction to Arduino < https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>

Case studies on Wearable technology< https://www.hticiitm.org/wearables>

E-content:

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

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.

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.

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: MAT1002	Course Title: Transform Techniques, Partial Differential Equations and Their Applications Type of Course: BSC & Theory		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		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. CO3 - Employ Z-transform techniques to solve difference equations. 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 2p 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:			
Newton-Raphson Methods, Gauss-Seidel Method, LU Decomposition, Trapezoidal Rule, Simpson's rule, Runge-Kutta 4th Order.			
Text Book Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition 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 E-resources/ Web links: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_140238 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_233298 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_204892 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_246791 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_223548			

https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_134719 https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_32614 https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html 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: CSE2001	Course Title: Data Structures and Algorithms Type of Course: School Core Theory-Integrated Laboratory	L- T-P-C	3-0-2-4
Version No.	1.0		
Course Pre-requisites	Java or Python		
Anti-requisites	NIL		
Course Description	The purpose of the course is to provide the fundamental concepts of data structures and algorithm, to emphasize the importance of choosing an appropriate data structure and algorithm for program development. The student should have basic programming skills, to solve engineering/computational problems. The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills. With a good knowledge in the fundamental concepts of data structures and algorithm the student can gain practical experience in implementing them, enabling the student to be an effective designer, developer for new software applications.		
Course Outcomes	On successful completion of this course the students shall be able to: Implement modularized solutions for given problem using fundamental data structures. 2. Apply an appropriate linear data structure for a given computation. 3. Apply an appropriate non-linear data structure for a given computation		

	4. Analyze complexity of given searching and sorting algorithms.			
Course Content:				
Module 1	Fundamentals of Data Structure (Comprehension)	Assignment	Programming Task	06 Classes
Topics: Data Management concepts, Data types – primitive and non-primitive, Types of Data Structures- Linear & Non Linear Data Structures. Recursion: Recursive Definition and Processes, Programming examples. Fundamentals of Algorithmic problem solving, Important Problem types.				
Module 2	Linear Data Structure Stack, Queues & Linked List (Application)	Case Study	Programming Task	08 Classes
Topics: Stack- Concepts and representation, Stack operations, stack implementation using array. Applications of Stack. Queues- Representation of queue, Queue Operations, Queue implementation using array, Types of Queue, Applications of Queue. Linked List- Singly Linked List, Operation on linear list using singly linked storage structures, Doubly Linked List, Circular List, Applications of Linked list.				
Module 3	Non-linear Data Structures – Trees (Application)	Assignment	Programming Task	04 Classes
Topics: Introduction to Trees, Binary tree: Terminology and Properties, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post-Order traversal.				
Module-4	Non-linear Data Structures –Graphs (Comprehension)	Assignment	Programming Task	03 Classes
Topics: Graph – Basic Concept of Graph Theory and its Properties, Representation Of Graphs.				
Module-5	Searching & Sorting Performance Analysis and Management (Comprehension)	Assignment	Programming Task	06 Classes
Topics:				

Sorting & Searching: Performance Analysis and Management - Time and space analysis of algorithms – Average, best and worst case analysis. Searching – Sequential Search and Binary Search, Sorting – Bubble Sort, Selection Sort.

List of Laboratory Tasks:

Lab sheet 1: [02 Classes]

To implement the Programs on User define functions

Level 1: Implement a program to compute factorial using functions.

Level 2: Implement a program to pass array to a function and manipulate the data in array.

Lab sheet 2: [02 Classes]

To implement the Programs on User define functions

Level 1: Implement a program to compute factorial using recursion.

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

Lab sheet 3: [04 Classes]

To implement the Programs on Stack.

Level 1: Implement the operations of the Stack.

Level 2: Implement the evaluation of postfix expression

Lab sheet 4: [04 Classes]

To implement the programs on Queue.

Level 1: Implement all the operations of the Queue

Level 2: Issuing token for doctor appointment.

Lab sheet 5: [06 Classes] To implement the Programs on Linked List. Level 1: Implement all the operations of the Singly Linked List Level 2: Implement Stack and Queue with Linked List. Lab sheet 6: [04 Classes] To implement the Programs on Trees and Traversals Level 1: Implement construction of the Binary tree. Level 2: Implement tree traversals. Lab sheet 7: [2 Classes] To study and implement the Programs on Graphs. Level 1: Program to implement graph Lab sheet 8: [6 Classes] To analyze time complexity and implement the Programs on searching and sorting. Level 1: Program on searching and sorting. Level 2: To analyze the time complexity.
Targeted Application & Tools that can be used: System software and Application software Programming Professionally Used Software : Eclipse / Jupyter notebook IDE
Project work/Assignment:
Problem Solving: Choose an appropriate data structure and implementation of programs. Programming: Implementation of given scenario using Java or python
REFERENCE MATERIALS: Text Book(s):

R. Venkatesan, S. Lovelyn Rose, ”Data Structures” Wiley, Second edition, January 2019. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education.
References 1. Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008. 2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, PHI Learning Private Limited.
Topics relevant to development of “Foundation Skills”: Fundamentals of Data structure, “Skill Development” – Implementation Linear and nonlinear data structure, “Employability”-Linear & Nonlinear Data Structure

Course Code: CSE3155	Course Title: Data Communications and Computer Networks Type of Course: Program Core Theory–Laboratory integrated	L-T-P-C 3-0-2-4	3	0	2	4
Version No.	1.0					
Course Pre-requisites	ECE2007 - Digital Design					
Anti-requisites	NIL					
Course Description	The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. . The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain Employability through Problem Solving Methodologies.					
Course Out Comes	On successful completion of the course, the students shall be able to: 1] I llustrate the Basic Concepts Of Data Communication and Computer Networks. 2] Analyze the functionalities of the Data Link Layer.					

<table>
<tr><td></td><td colspan="4">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.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction and Physical Layer- CO1</td><td>Assignment</td><td>Problem Solving</td><td>07 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Reference Models and Data Link Layer – CO2</td><td>Assignment</td><td>Problem Solving</td><td>7 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Network Layer – CO 3</td><td>Assignment</td><td>Problem Solving</td><td>10 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 4</td><td>Transport and Application Layer -CO3</td><td>Assignment</td><td>Problem Solving</td><td>10 Classes</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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

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

Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022

References

"Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.

William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.

Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007. E-Resources: 1.https://archive.nptel.ac.in/courses/106/105/106105183/ 2. http://www.nptelvideos.com/course.php?id=393 3.https://www.youtube.com/watch?v=3DZLItfbqtQ 4.https://www.youtube.com/watch?v=_fIdQ4yfsfM 5. https://www.digimat.in/keyword/106.html https://puniversity.informaticsglobal.com/login

Course Code: CSE2009	Course Title: Computer Organization and Architecture		L-T- P-C	3-0-0-3
Version No.	2.0			
Course Pre-requisites	CSE 2015 Digital Design			
Anti-requisites	NIL			
Course Description	This course introduces the core principles of computer architecture and organization from basic to intermediate level. This theory based course emphasizes on understanding the interaction between computer hardware and software. It equips the students with the intuition behind assembly-level instruction set architectures. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Organization and Architecture and attain Skill Development through Participative Learning techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: 1] Describe the basic components of a computer, their interconnections, and instruction set architecture [Comprehension] 2] Apply appropriate techniques to carry out selected arithmetic operations 3] Explain the organization of memory and processor sub-system			
Course Content:				
Module 1	Basic Structure of computers	Assignment	Data Analysis task	12 Classes

Topics: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Computer systems RISC & CISC, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Arithmetic Operations on Signed numbers. Instructions and Instruction Sequencing, Instruction formats, Memory Instructions.				
Module 2	Instruction Set Architecture and Memory Unit	Assignment	Analysis, Data Collection	12 Classes
Topics: Instruction Set Architecture: Addressing Modes, Stacks and Subroutines. Memory System: Memory Location and Addresses, Memory Operations, Semiconductor RAM Memories, Internal Organization of Memory chips, Cache memory mapping Techniques.				
Module 3	Arithmetic and Input/output Design	Case Study	Data analysis task	10 Classes
Topics: Arithmetic: Carry lookahead Adder, Signed-Operand Multiplication, Integer Division, and Floating point operations. Input/output Design: Accessing I/O Devices, I/O communication, Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits				
Module 4	BPU and Pipelining	Assignment	Analysis, Data Collection	11 Classes
Topics: Basic Processing Unit: Fundamental Concepts, Single Bus organization, Control sequence, Execution of a Complete Instruction, Multiple Bus Organization. Pipelining: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Hazards.				
Targeted Application & Tools that can be used: Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc. Tools:				

Virtual Lab, IIT KGP Tejas – Java Based Architectural Simulator, IIT Delhi
Text Book Carl Hamacher, Zvonko Vranesic, Safwat Zaky, “Computer Organization”, Fifth Edition, McGraw-Hill Higher Education, 2016 reprint.
References William Stallings, “Computer Organization & Architecture – Designing for Performance”, 11th Edition, Pearson Education Inc., 2019 David A. Patterson & John L. Hennessy, “Computer Organization and Design MIPS Edition- The Hardware/Software Interface”, 6th Edition, Morgan Kaufmann, Elsevier Publications, November 2020. Web References: NPTEL Course on “Computer architecture and organization” IIT Kharagpur By Prof. Indranil Sengupta, Prof. Kamalika Datta. https://nptel.ac.in/courses/106105163 NPTEL Course on “Computer Organization”, IIT Madras By Prof. S. Raman. https://nptel.ac.in/courses/106106092 https://puniversity.informaticsglobal.com:2229/login.aspx
Topics relevant to “SKILL DEVELOPMENT”: Generation of Computers, CISC and RISC processors, Bus Arbitration, Collaboration and Data collection for Term assignments and Case Studies for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: MAT2004	Course Title: Discrete Mathematical Structures Type of Course: Program Core	L-T- P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	Nil					
Course Description	The course provides insights into the fundamental aspects of mathematical logic and predicate calculus. The course delves deeply into the concepts of algebraic structures, lattices and Boolean					

	algebras which are widely used in computer science and engineering. It also highlights the principles of counting techniques and their applications.			
Course Objective	The objective of the course is Skill Development of student by using Problem Solving Techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Explain logical sentences through predicates, quantifiers and logical connectives. CO2: Comprehend the basic principles of set theory and different types of relations. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Deploy the counting techniques to tackle combinatorial problems.			
Course Content:				
Module 1	Mathematical Logic and Predicate Calculus			12 classes
Propositional Logic, Propositional Logic Equivalences, Normal forms, Inference rules, Introduction to Proofs, Conversion to clausal form, Predicate calculus, The Statement function, Inference theory of the Predicate Calculus.				
Module 2	Algebraic Structures			10 classes
Sets and set-operations, functions, relations and their properties & representations of relation by matrix, closure of different type of relations, equivalence relations, primitive recursive function.				
Module 3	Lattices and Boolean Algebra			11 classes
Partial ordering, Posset, Lattices & Algebraic structures, Sub lattice, Basic properties of algebraic systems by lattices, Distributive lattices, complement of an element in a lattice, Boolean lattice & Boolean algebra, cancellation laws and unique complement theorem.				
Module 4	Principles of Counting Techniques			12 classes
Chinese Remainder Theorem, pigeonhole principle, generalized pigeonhole principle, Generalized Permutations and Combinations, Recurrence Relations.				
Targeted Application & Tools that can be used:				

Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Assignment 1: Logic Equivalences and Predicate calculus. Assignment 2: Equivalence Relations and Lattices Assignment 3: Recurrence Relations
Text Books Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill's 7th Edition, 2011. Kolman, Bernard; Busby, Robert C; Ross, Sharon Cutler," Discrete mathematical structures", Pearson India, 6th Edition, 2015. Liu, C L Mohapatra, D P.," Elements of Discrete Mathematics a Computer oriented approach", New Delhi McGraw Hill Education, 4th Edition, 2015. Mott, Joe L; Kandel, Abraham; Baker, Theodore P, "Discrete Mathematics for Computer Scientists and Mathematicians", Pearson India, 2nd Edition, 2015. Epp, Susanna S, "Discrete Mathematics with applications", New Delhi Cengage Learing, 4th Edition, 2016.
References: Tremblay, J.P. and Manohar.R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017.

Course Code: CSE3156	Course Title: Database Management Systems Type of Course: 1) School Core 2) Laboratory Integrated	L-T-P-C	3	0	2	4
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					

Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve information efficiently. It helps the students to learn and practice data modeling and database designs. The course also introduces the concept of object oriented and object relational databases. The associated laboratory is designed to implement database design using MySQL DATABASE in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Management Systems and attain Employability through Problem Solving Methodologies.
Course Out Comes	On successful completion of the course the students shall be able to: 1] Demonstrate a database system using ER model and relational algebra. [Understanding] 2] Build databases using SQL queries query processing. [Applying] 3] Apply the functional dependencies and design the database using normalization. [Applying] 4] Interpret the concept of object-oriented databases and object-relational databases. [Understanding]
Course Content:	

Module 1	Introduction to Database Modelling and Relational Algebra (Understanding)	Assignment	Problem Solving	8 Classes

Topics:

Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model.

Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.

Module 2	Fundamentals of SQL and Query Optimization (Applying)	Assignment	Programming	8 Classes

Topics:

SQL Database Querying, DDL, DML, Constraints, Operators, Set Operators, Aggregate Functions, Joins, Views, Procedures, Functions and Triggers.

Database programming issues and techniques: Embedded SQL, Dynamic SQL; SQL / PSM and NoSQL.

Query Optimization: Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.				
Module 3	Relational Database Design & Transaction Management (Applying)	Assignment	Problem Solving	12 Classes
Topics: Relational database design: Problems in schema design, redundancy and anomalies, Normal Forms based on Primary Keys-(1NF,2NF, 3NF), Boyce-Codd Normal Form, Multi valued Dependency (Fourth Normal Form), Join Dependencies (Fifth Normal Form), lossy and lossless decompositions, Database De-normalization. Transaction Management: The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery; 2PL, Serializability and Recoverability; Lock Management; The write-ahead log protocol; Check pointing; Recovering from a System Crash; Media Recovery; Other approaches and interaction with concurrency control.				
Module 4	Advanced DBMS Topics (Understanding)	Assignment	Case Study	8 Classes
Topics: Advanced topics: Object oriented database management systems, Deductive database management systems, Spatial database management systems, Temporal database management systems, Constraint database management systems. New database applications and architectures such as Data warehousing, Multimedia, Mobility, NoSQL, Native XML databases (NXD), Document-oriented databases, Statistical databases.				
List of Laboratory Tasks: Create Employee, Student, Banking and Library databases and populate them with required data. Do the following experiments of different lab sheets on those databases. Labsheet-1 [3 Practical Sessions] Experiment No 1: [1 Session] 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]

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]

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]

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]

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]

To study and implement Functions, and Triggers in MySQL DB.

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.

Level 2: Analyze the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-5 [2 Practical Sessions]

Experiment No. 7: [2 Sessions]

To implement the concept of forms and reports.

Level 1: Implement the concept of forms and reports.

Level 2: Analyze the schema relationship.

Labsheet-6 [2 Practical Sessions]

Experiment No. 8: [2 Sessions]

Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.

Level 1: Implement the real time database.

Level 2: Analyze the working of database in real time.

Targeted Application & Tools that can be used:

Application Area: Relational database systems for Business, Scientific and Engineering Applications.

Tools/Simulator used: MySQL DB for student practice.

Also demonstration of ORACLE DB on object-relational database creation and JDBC connection.

Percentage of changes in this version: 50% of changes from earlier version. New topics are highlighted in italic.

1. Problem Solving: Constructing ER-Diagrams for a given real time requirements, Normalizing the databases, querying the databases using relational algebra.

2. Programming: Implementation of any given scenario using MySQL.

Text Book

1] RamaKrishna & Gehrke, “Database Management Systems” 3rd Edition, 2018, McGraw-Hill Education.

2] Avi Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, McGraw-Hill ,7th Edition, 2019.

3] W. Lemahieu, S. vanden Broucke and B. Baesens, “Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data”, Cambridge University Press, 2018.

References

1] Elmasri R and Navathe S B, “Fundamentals of Database System”, Pearson Publication, 7th Edition, 2018.

2] M. Kleppmann, “Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems”, O’Reilly, 2017.

Topics relevant to development of “FOUNDATION SKILLS”: S - Skill Development: Relational database design using ER- Relational mapping, Implementation of given database scenario using MYSQLDB.

Topics relevant to development of Employability: Develop, test and implement computer databases, creating sophisticated, interactive and secure database applications Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Nil	
Catalogue prepared by	Dr. Madhura K Dr. Nagaraja S R
Recommended by the Board of Studies on	BOS NO: SOCSE 2nd BOS held on 10/07/23
Date of Approval by the Academic Council	Academic Council Meeting No 21, Dated 06/09/2023

Course Code: CSE2014	Course Title: Software Engineering Type of Course: School Core [Theory Only]	L-T- P-C	3-0-0-3
Version No.	1.0		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The objective of this course is to provide the fundamentals concepts of Software Engineering process and principles. The course covers software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course covers software quality, configuration management and maintenance.		
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Participative Learning techniques.		
Course Out Comes	On successful completion of this course the students shall be able to: 1] Describe the Software Engineering principles, ethics and process models(Knowledge) 2] Identify the requirements, analysis and appropriate design models for a given application(Comprehension) 3] Understand the Agile Principles(Knowledge) 4] Apply an appropriate planning, scheduling, evaluation and maintenance principles involved in software(Application)		

Module 1	Introduction to Software Engineering and Process Models (Knowledge level)	Quiz		09 Hours
Introduction: Need for Software Engineering, Professional Software Development, Software Engineering Ethics, Software Engineering Practice-Essence of Practice, General Principles Software Development Life Cycle Models: Waterfall Model – Classical Waterfall Model, Iterative Waterfall Model, Evolutionary model-Spiral, Prototype.				
Module 2	Software Requirements, Analysis and Design (Comprehension level)	Assignment	Development of SRS documents for a given scenario	11 Hours
Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, Software Requirements Specification (SRS), Requirement Analysis and validation. Requirements modelling- Introduction to Use Cases, Activity diagram and Swim lane diagram. CASE support in Software Life Cycle, Characteristics of CASE Tools, Architecture of a CASE Environment. Design: Design concepts, Architectural design, Component based design, User interface design.				
Module 3	Agile Principles & Devops (Knowledge level)	Quiz		09 Hours
Agile: Scrum Roles and activities, Sprint Agile software development methods - Scaling, User Stories, Agile estimation techniques, Product backlogs, Stake holder roles, Dynamic System Development Method. Devops: Introduction, definition, history, tools.				
Module 4	Software Testing and Maintenance (Application Level)	Assignment	Apply the testing concepts using Programing	12 Hours
Software Testing-verification and validation, Test Strategies - White Box Testing, Black box Testing. Automation Tools for Testing. Software Quality Assurance-Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management- SCM process, SCM Tools (GitHub). Maintenance- Characteristics of Software Maintenance, Software Reverse Engineering, Software Maintenance Process Models.				
Targeted Application & Tools that can be used: Selenium, GitHub, CASE Tools				
Text Book 1] Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, VII Edition, McGraw-Hill, 2017.				

2] Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, VI Edition, McGraw-Hill, 2018.
References Rajib Mall, “Fundamentals of Software Engineering”, VI Edition, PHI learning private limited, 2015. Ian Sommerville, “Software Engineering”, IX Edition, Pearson Education Asia, 2011. Agile Software Development Principles, Patterns and Practices.1st Edition, Wiley, 2002
Topics Relevant to “Skill Development: Balck box Testing, White box Testing, Automated Testing for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout

Course Code: ECE2011	Course Title: Innovative Projects using Raspberry Pi		L- T-P- C	-	-	-	1
Version No.	1.0						
Course Pre-requisites	NIL						
Anti-requisites	NIL						
Course Description	This course is designed to provide an in-depth understanding of Raspberry-pi Single Board Computers and their application in various real time projects involving sensors. Throughout the course, students will learn Raspberry-pi programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Raspberry-pi, read sensor data, and use it to control various output devices This course is suitable for advance learners who are interested in exploring the world of electronics and developing practical applications using Raspberry-pi and sensors.						
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies by using sensors and their interfacing to solve real-time problems .						
Course Outcomes	On successful completion of the course the students shall be able to Understand the concept of micro python Explain the main features of the Raspberry-pi prototype board Analyse the hardware interfacing of the peripherals to a Single board computer system. Demonstrate the functioning of live projects carried out using Raspberry-pi system						
Course Content:							
Module 1	Introduction to Micro python	Hands-on	Interfacing Task and Analysis	4 Sessions			

Topics:

Introduction to MicroPython, Comparison with other programming languages, Setting up the MicroPython development environment, Basics of MicroPython syntax and structure.

Module 2	Working with Raspberry-pi	Hands-on	Interfacing Task and Analysis	4 Sessions

Introduction to raspberry pi boards, pin-diagram, different types of raspberry pi boards and its application, LED and switch control. Mastering Modules, Setup Raspberry - PuTTY SSH,VNC Viewer to interface with more complicated sensors and actuators. Various Libraries and its functions.

Topics: Micro Python, types of Raspberry-pi boards, sensors, 3D Printer

Targeted Application & Tools that can be used:

Application Area:

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

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

Project work/Assignment:

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

2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .

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

Textbook(s):

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

References

Reference Book(s)

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

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

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

Raspberry-pi Projects < https://magpi.raspberrypi.com/articles/category/tutorials/>

Introduction to internet of things< https://nptel.ac.in/courses/106105166>

Case studies on Wearable technology< https://www.hticiitm.org/wearables>

E-content:

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

Supriya S, 2Dr. Aravinda " Green leaf disease detection and identification using Raspberry Pi https://www.irjet.net/archives/V9/i8/IRJET-V9I847.

Dr. E.N. Ganesh., “Health Monitoring System using Raspberry Pi and IOT" DOI : http://dx.doi.org/10.13005/ojcst12.01.03

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

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

Course Object	The objective of the course is to familiarize the learners with the concepts of Programming in Python and attain Employability through Problem Solving Methodologies.				
Course Outcomes	On successful completion of this course the students shall be able to: Summarize the basic Concepts of python. 2. Demonstrate proficiency in using data structures. 3. Illustrate user-defined functions and exception handling. 4. Identify the various python libraries.				
Course Content:					
Module 1	Basics of Python programming	Assignment	Programming	14 Classes	
Topics: Data types, operators and Expressions, Input and Output Statements. Control Structures – Selective and Repetitive structures					
Module 2	Indexed and Associative Data Structures	Simple applications	Programming	20 Classes	
Topics: Strings, Lists, Sets, Tuples, Dictionaries					
Module 3	Functions, Exception handling and libraries	Case study	Programming	10 Classes	
Topics: User defined functions, exception handling, Introduction to python built-in libraries					
Targeted Application & Tools that can be used: Targeted Application : Web application development, AI, Operating systems Tools: Python IDLE, ANACONDA Application Areas: Web Development Game Development Scientific and Numeric Applications Artificial Intelligence and Machine Learning					

Software Development Enterprise-level/Business Applications Education programs and training courses Language Development Operating Systems Web Scrapping Applications Image Processing and Graphic Design Applications Professionally Used Software: Python IDLE, Spyder, Jupyter Notebook, Google Colab
Project work/Assignment:
Project Assignment: Developing python scripts using built in methods and functions
Text Books: Martin C. Brown, “Python: The Complete Reference”, McGraw Hill Education, Forth edition (20 March 2018). Alex Campbell, “Python for Beginners: Comprehensive Guide to the Basics of Programming, Machine Learning, Data Science and Analysis with Python”, August 29, 2021. Charles Dierbach, “Introduction to Computer Science Using Python”, Wiley India Edition,2015.
References: E. Balagurusamy, “Introduction to Computing and Problem Solving Using Python”, Tata McGraw-Hill, 2016 Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2017 Brady Ellison, “Python for Beginners: A crash course to learn Python Programming in 1 Week (Programming Languages for Beginners)”, August 25, 2021. Python Tutor - Visualize Python, Java, C, C++, JavaScript, TypeScript, and Ruby code execution https://practice.geeksforgeeks.org/courses/Python-Foundation
Topics relevant to development of “FOUNDATIONS SKILLS”- Solve the real time problems by analyzing and visualizing the data. Topics relevant to “HUMAN VALUES & PROFESSIONAL ETHICS”- Data collection and its arrangement

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

Module 1	Quantitative Ability	Assignment	Bloom's Level : Application	02 Hours
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes				
Module 2	Logical Reasoning	Assignment	Bloom's Level : Application	18 Hours
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning				

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

MAT2003	NUMERICAL METHODS FOR ENGINEERS Type of Course: School Core					
Version No.	1.0					
Course Pre-requisites	MAT1002 – Transform Techniques, Partial Differential Equations and Their Applications					
Anti-requisites	Nil					
Course Description	The course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration. This course also deals with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of " NUMERICAL METHODS FOR ENGINEERS" and attain Skill Development Through Problem Solving.					
Course Outcomes	On successful completion of the course the students shall be able to: 1] Solve algebraic and transcendental equations numerically. 2] Adopt numerical techniques to differentiate and integrate functions. 3] Apply numerical methods to solve ordinary differential equations.					
Course Content:						

Module 1	Numerical solution of Algebraic and Transcendental Equations			15 Classes
Algebraic and Transcendental Equations, Regula - Falsi method, Bisection method (Self study), Secant method, Newton-Raphson method, and NR method for non-linear Equations, Fixed-point iteration method. System of Linear Equations: Introduction, LU decomposition method, Gauss-Jacobi method, Gauss-Seidel iteration method, Largest Eigen value and corresponding Eigen vector by Power method & Jacobi Method.				
Module 2	Numerical Interpolation, differentiation and Integration			15 Classes
Numerical Interpolation: Newton's forward and backward interpolation method, Newton's divided difference method, Lagrange's method, numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's Rule. Area between the two curves.				
Module 3	Numerical solution of ODEs and PDEs			15 Classes

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

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

Targeted Application & Tools that can be used:

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

Assignment:

Gauss-Jacobi iteration method.

Numerical differentiation.

Gaussian quadrature rule for numerical integration.

Taylor series method for ODEs.

Implicit and explicit schemes for PDEs.

Text Books

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

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

References:

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

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

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

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

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

through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

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

Version No.		2.1
Course Pre-requisites		CSE2001, Data Structure and Algorithms
Anti-requisites		NIL
Course Description		This intermediate course enables students to design and analyze efficient algorithms to solve problems. This course covers typical design methods such as divide-and-conquer, dynamic programming and greedy method to solve problems. The students shall develop strong analytical skills as part of this course.
Course Objectives		This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.
Course Outcomes		On successful completion of the course the students shall be able to: 1] Identify the efficiency of a given algorithm. [Comprehension] 2] Employ divide and conquer approach to solve a problem. [Application] 3] Illustrate dynamic programming approach to solve a given problem. [Application] 4] Solve a problem using the greedy method. [Application] 5] Discuss the techniques to solve a real-world problem based on its complexity classes. [Comprehension]
Course Content:		

Module 1	Introduction to Algorithms	Assignment		Problem Solving	06 Sessions
	Topics: Algorithm Design and efficiency, measuring of running time of algorithms. Insertion sort and merge sort, Asymptotic Growth and Notations. Recurrences--Masters method. Assignment: Comparatively evaluate bubble sort, insertion sort and mergesort.				

Module 2	Review of Searching and Sorting techniques	Assignment		Programming/ Problem Solving	12 Sessions
	Topics: Divide and Conquer: Examples. Strassen's Matrix multiplication. Sorting: Quicksort, Heapsort, Lower bound of comparison-based sorting, non-comparison-based sorting: Radix sort. Search: Review of Linear Search and Binary Search, Hashing and hash tables. Assignment: Design and develop an algorithm using Divide and Conquer technique for a given scenario.				
Module 3	Greedy Algorithms	Assignment		Programming/ Problem Solving	09 Sessions
	Topics: Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm. Huffman Codes. Assignment: Design and Develop a solution to a given scenario using greedy method.				
Module 4	Dynamic Programming	Assignment		Programming/ Problem Solving	09 Sessions
	Topics: Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Optimal Binary Search Trees, Chain Matrix Multiplication. Assignment: For a given scenario, attempt the three design paradigms learned so far and argue the best approach to solve the problem				
Module 5	Complexity Classes and Heuristics	Assignment		Programming/ Problem Solving	09 Hours
	Topics: Complexity classes: P, NP, and NP-Complete Problems. Backtracking: n-Queens. Branch and bound: Travelling Salesman Problem. Assignment: Apply backtracking algorithmic designing technique for solving queen's problems for 4, 8 and 16 inputs.				
	Targeted Application & Tools that can be used:				

	Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers. Professionally Used Software: GCC compiler.
	Project work/Assignment:
	Problem Solving: Design of Algorithms and implementation of programs. Programming: Implementation of given scenario using Java.
	Text Book: T1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, 'Introduction to Algorithms', MIT Press, 2022. T2. J. Kleinberg and E. Tardos, 'Algorithm Design', Addison-Wesley, 2005.
	References R1. Anany Levitin, 'Introduction to the Design and Analysis of Algorithms', Pearson Education, 2003. R2. Tim Roughgarden, 'Algorithms Illuminated' (books 1 through 3), Soundlikeyourself Publishing, 2017,18,19 respectively. R3. AV Aho, J Hopcroft, JD Ullman, 'The Design and Analysis of Algorithms', Addison-Wesley, 1974.

Course Code: CSE3157	Course Title: Artificial Intelligence and Machine Learning Type of Course:1]Program Core 2] Laboratory integrated		L-T-P-C	3	0	2	4
Version No.		1.0					
Course Pre-requisites		Python Programming					
Anti-requisites		NIL					
Course Description		This course introduces the basic concepts of artificial intelligence(AI) and Machine Learning (ML) which is a subset of Artificial Intelligence. AI & ML provides important set of techniques and algorithms for solving several real world business and social problems. The objective of this course is to discuss machine learning model development using Python. Topics include: Working with Collections and Data Frames; History, Application and Agents of AI; Knowledge Representation ; Hill Climbing, A* and SMA* algorithms; Knowledge representation - Approaches and Issues, Knowledge-Based Systems; Knowledge representation using Propositional logic and Predicate Logic, Unification and lifting, Forward chaining, Backward chaining.					

		Introduction to the Machine Learning (ML) - Framework, types of ML, Concept Learning: Concept learning task, Find-S algorithm, Candidate Elimination Algorithm. Neural and Bayesian Belief networks – Perceptron, Multi-layer feed forward networks, Back propagation algorithm. Nearest Neighbor techniques, Support Vector Machines; Supervised Learning – Classification & Regression – Algorithms; Unsupervised Learning - Clustering & Association – Algorithms
Course Objective		The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Machine Learning Employability through Problem Solving Methodologies.
Course Out Comes		On successful completion of this course the students shall be able to: Describe the basic understanding of the AI and concepts of searching for AI problems. (KNOWLEDGE) Develop knowledge base for representing the given real world data using logic and reasoning methods. (Application) Apply concept learning and Artificial Neural Network techniques for the given problems. (Application) Articulate Machine Learning model using Supervised and Unsupervised learning algorithms. (Application) Develop solutions / mini project on real world problems using AIML domain, either individually or as a part of the team and report the results. (Application)
Course Content:		

Module 1	Introduction to Artificial Intelligence and Searching	Assignment	Programming Activity	15 Hours
	Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agent, Structure of Intelligent agent and its functions, Agents and Environment; Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first; A* - SMA* algorithms.			
Module 2	Knowledge Representation	Assignment	Programming activity	15 Hours
	Topics: Introduction to Knowledge representation, approaches and issues in knowledge representation, Knowledge-based agent and its Structure, Knowledge-Based Systems; Knowledge representation using Propositional logic and Predicate Logic- First-Order Logic - Syntax and Semantics, Knowledge Engineering - Unification and lifting, Forward chaining, Backward chaining			

Module 3	Introduction to Machine Learning & Neural Network	Assignment	Programming activity	15 Hours
	Topics: Introduction to the Machine Learning (ML) Framework, types of ML, types of variables/features used in ML algorithms, Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Candidate Elimination Algorithm. Neural and Belief networks - Perceptron - Multi-layer feed forward networks - Bayesian belief networks, Back propagation algorithm.			
Module 4	Supervised & Unsupervised Learning	Mini Project	Programming activity	15 Hours
	Topics: Supervised Learning – Classification & Regression - Decision Tree Learning, Random Forest - Support Vector Machines ; Simple Linear Regression Algorithm, Multivariate Regression Algorithm Unsupervised Learning – Clustering & Association - K-Means Clustering algorithm , Mean-shift algorithm , Apriori Algorithm, FP-growth algorithm List of Laboratory Tasks: Lab sheet -1 A review of Python programming - Anaconda platform and its installation, Executing programs on Jupyter IDE/ Colab. Programming exercises on Tuples, Nested data structures Lab sheet -2 Introduction to Numpy, Pandas, Scikit-learn and Visualization techniques. Dictionaries, dictionary comprehension , Data Frames using Pandas and working with frames Lab sheet - 3 Search Algorithms – A* & SMA * Lab sheet -4 Tic-tac-toe game simulation using search and heuristics.			

	Describe the Sudoku game and represent the actions using First-order / Propositional logic. Sorting algorithms employing forward chaining. Lab sheet -5 Find-S Algorithm Candidate Elimination Algorithm Back Propagation Algorithm Lab sheet -6 Support Vector Machines ; Simple Linear Regression Algorithm Multivariate Regression Algorithm Lab sheet -7 K-Means Clustering algorithm Mean-shift algorithm Apriori Algorithm Mini Project / Case Study – Real Time Project
	Targeted Application & Tools that can be used: Use of PowerPoint software for lecture slides and use of Google's Colab cloud service https://www.tutorialspoint.com/google_colab/index.html for executing and sharing of lab exercises.
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	1] Programming: Implementation of given scenario using Python and Colab. 2] Assignment: Learning courses for 4 Hours from the following link https://learn.datacamp.com/courses?topics=Machine%20Learning
	Text Book Stuart J. Russell and Peter Norvig, Artificial intelligence: A Modern Approach, 3rd edition, Upper Saddle River, Prentice Hall 2021. Tom Mitchell, "Machine Learning", First Edition, Tata McGraw Hill India, 2017.
	References

	Giuseppe Bonaccorso, “Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning”, Packt Publishing, 2017. Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning Using Python”, Wiley, First Edition 2019. Andreas C Muller, Sarah Guido, “Introduction to Machine Learning with Python :A Guide for Data Scientists”, Oreilly, First Edition, 2016 Elaine Rich, Kevin K and S B Nair, “Artificial Intelligence”, 3rd Edition, McGraw Hill Education, 2017. Pattern Classification 2nd Edition by Richard O. Duda , Peter E. Hart , David G. Stork

Course Code: CSE3351	Course Title: Operating Systems Type of Course: Program Core and Theory Only	L-T- P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2009- Computer Organization, Problem solving using C Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended.					
Anti-requisites	NIL					
Course Description	This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies.					
Course Object	The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain Employability through Problem Solving Methodologies.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] Describe the fundamental concepts of operating Systems and case studies. [Knowledge] 2] Demonstrate various CPU scheduling algorithms. .[Application] 3] Apply various tools to handle synchronization problems.[Application] 4] Demonstrate deadlock detection and recovery methods [Application] 5] Illustrate various memory management techniques.[Application]					
Course Content:						

<table>
<tr><td>Module 1</td><td>Introduction to Operating System</td><td>Assignment</td><td>Programming</td><td>9 Hours</td></tr>
<tr><td colspan="5">Topics:

Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system</td></tr>
<tr><td>Module 2</td><td>Process Management</td><td>Assignment/Case Study</td><td>Programming/Simulation</td><td>11 Hours</td></tr>
<tr><td colspan="5">Topics:

Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority.</td></tr>
<tr><td>Module 3</td><td>Process Synchronization and Deadlocks</td><td>Assignment</td><td>Programming</td><td>11 Hours</td></tr>
<tr><td colspan="5">Topics:

The Critical-Section Problem- Peterson’s Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher’s Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock.</td></tr>
<tr><td>Module 4</td><td>Memory Management</td><td>Assignment</td><td>Programming/Simulation</td><td>10 Hours</td></tr>
<tr><td colspan="5">Topics:

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

Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.
Project work/Assignment
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: CSE3078	Course Title: Cryptography and Network Security Type of Course: Theory	L- T-P- C	3	0	0	3
Version No.	2.0					
Course Pre-requisites						
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: PPS4004	Course Title: Aptitude Training-Intermediate Type of Course: Practical Only Course	L- T - P- C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Students should have the basic concepts of Quantitative aptitude along with its applications in real life problems.					
Anti-requisites	NIL					
Course Description	This is a skill-based training program for the students. 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: Fast Track Objective by Rajesh Verma R S Aggarwal Rakesh Yadav   References: www.indiabix.com www.testbook.com www.youtube.com/c/TheAptitudeGuy/videos
Topics relevant to Skill Development: Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through components mentioned in course handout.

Catalogue prepared by	Faculty of L&D
Recommended by the Board of Studies on	BOS held on
Date of Approval by the Academic Council	Academic Council Meeting held on

Course Code: CSE3216	Course Title: Mastering Object- Oriented Concepts in Python Type of Course: Lab	L- T-P- C	0-0-2-1
Version No.	1		
Course Pre-requisites	CSE1005 – Programming in Python		
Anti-requisites	NIL		
Course Description	This course covers mastering object-oriented concepts in Python, including classes, inheritance, polymorphism, and encapsulation. Students will learn to		

	design and implement robust, reusable code using real-world examples. Ideal for those with basic Python knowledge, it enhances problem-solving skills and software development proficiency.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Mastering Object Oriented Concepts in Python and attain Skill Development through Experiential Learning.				
Course Out Comes	CO1: Explain features of Oops along with creation of Python classes and objects to represent real world Objects. [Understand] CO2: Demonstrate inheritance, polymorphism, and abstraction in Python to build maintainable and extendable software systems.[Apply] CO3: Demonstrate exception handling in Python to build robust error-handling mechanisms and debugging tool and Assess various file handling techniques in Python. [Apply]				
Course Content:					
Module 1	Introduction to OOPS, Classes and Objects	MCQ	Assignment	10 Sessions	
Topics: Introduction to OOPs: Problems in Procedure Oriented Approach, Specialty of Python Language, Features of OOPS - Classes and Objects, Encapsulation, Abstraction, Inheritance and Polymorphism. Classes and Objects: Creating a Class, The Self Variable, Constructor, Destructors, Types of Variables, Namespaces, Types of Methods - Instance Methods, Class Methods, Static Methods, Passing Members of One Class to Another Class, Inner Classes.					
Module 2	Inheritance and Polymorphism	MCQ	Assignment	10 Sessions	
Constructors in Inheritance, Overriding Super Class Constructors and Methods, The Super() Method, Types of Inheritance – Single Inheritance, Multiple Inheritance, Method Resolution Order(MRO), Polymorphism, Duck Typing Philosophy of Python, Operator Overloading, Method Overloading, Method Overriding. Abstract Classes and Interfaces: Abstract Method and Abstract Class, Interfaces in Python, Abstract Classes vs. Interfaces.					
Module 3	Exceptions and Files in Python	MCQ	Assignment	10 Sessions	
Exceptions: Errors in a Python Program – Compile-Time Errors, Runtime Errors, Logical Errors. Exceptions, Exception Handling, Types of Exceptions, The Except Block, The assert Statement, User-Defined Exceptions, Logging the Exceptions. Files in Python: Files, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods.					

Targeted Application & Tools that can be used: Python, PyCharm
Project work/Assignment:
Assignment: Module 1 Assignment: Design and implement a Python application that simulates a banking system using classes and methods for customers and accounts. Module 2 Assignment: Develop a Python application that simulates Library management system that demonstrates inheritance, polymorphism and abstraction concepts. Module 3 Assignment: Develop a Python program that handles different types of exceptions while processing user input for a movie ticket booking system showcasing exception handling and File handling concepts.
Text Book Dr. R Nageshwara Rao, "Core Python Programming", Dreamtech Press, 3rd Edition, 2021.
References Alex Martelli, Anna Ravenscroft & Steve Holden, "Python in a Nutshell The Definitive Reference", O'Reilly Media, 3rd edition, 2017. Luciano Ramalho, "Fluent Python Clear, Concise, and Effective Programming", O'Reilly Media, 2nd edition, 2022. Mark Lutz, "Learning Python: Powerful Object-Oriented Programming", O'Reilly Media, 5th edition, 2013. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media, 3rd edition, 2013. Weblinks: www.learnpython.org https://realpython.com/python3-object-oriented https://www.tutorialspoint.com/python/python_oops_concepts.htm
Topics relevant to "SKILL DEVELOPMENT": Building Real-World Applications Using OOPS Concepts, Error Handling and Debugging Techniques, Concurrency in Python, Advanced File Handling Techniques, Creating and Managing Python Packages and Modules, Designing and Implementing Python Interfaces This is attained through assessment component mentioned in course handout.

Course Code: CSE2266	Course Title: Theory of Computation Type of Course: Theory Only	L- T-P- C	3	0	0	3
Version No.	2.0					

<table>
<tr><td>Course Pre-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Course Description</td><td colspan="4">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.</td></tr>
<tr><td>Course Objective</td><td colspan="4">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.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">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)</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction to automata theory</td><td>Assignment</td><td>Problems on Strings and Language operations</td><td>6 classes</td></tr>
<tr><td colspan="5">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</td></tr>
<tr><td>Module 2</td><td>Finite Automata</td><td>Assignment</td><td>Assignment Problems on DFA, NFA’s</td><td>13 Sessions</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Regular Expressions & Context Free Grammar</td><td>Assignment</td><td>Problems on RE, CFG, PT, PL and Ambiguity</td><td>12 Sessions</td></tr>
</table>

Topics:				
Formal Definition of a Regular Expression, Languages Associated with Regular Expressions, Languages, Regular Languages (RL) and Non-regular Languages: Closure properties of RLs, to show some languages are not RLs, Closure Properties of Regular Context Free Grammars-Examples of Context-Free Languages, Leftmost and Rightmost Derivations, Derivation Trees, Relation Between Sentential Forms and Derivation Trees, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity, Chomsky Normal Form, Gribiche Normal Form.				
Module 4	Push down Automata	Assignment	Problems on pushdown Automaton	08 Sessions
Topics: Definition of a Pushdown Automaton, Language Accepted by a Pushdown Automaton, Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack Equivalence of PDA's and CFG's: From Grammars to Pushdown Automata.				
Module 5	Turing Machine	Assignment	Problems on Turning Machine	07 Sessions
Topics: Definition of a Turing Machine, Turing Machines as Language Accepters, Example Languages to construct Turing machine, Turing Machines as Transducers, Halting Programming Techniques for Turing Machines				
Targeted Application & Tools that can be used: Targeted Application: 1. Text Processing 2. Compilers 3. Text Editors 4. Robotics Applications 5. Artificial Intelligence Tools: 1. JFLAP (Java Formal Language and Automata Package) Software simulation tool. It's interactive educational software written in Java to experiment topics in automata theory. 2. Turing machine Online simulators.				
Text Book(s): 1. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publications 6th Ed, 2018.				

Reference(s): 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

Course Code: ISE2504	Course Title: Image Processing and Computer Vision Type of Course: Discipline Elective - Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course provides an introduction to the fundamental principles and techniques of digital image processing and computer vision. It emphasizes both theoretical foundations and practical applications including image enhancement, segmentation, feature extraction, object detection, and recognition, preparing students for real-world computer vision challenges in areas like robotics, medical imaging, and autonomous systems.					
Course Objective	To understand the fundamentals of digital images and image processing techniques. To explore computer vision algorithms for object detection, tracking, and classification. To implement practical solutions using modern image processing libraries and tools. To apply image and video analytics for real-time intelligent systems.					
Course Outcomes	On successful completion of the course, students will be able to: Apply image enhancement and transformation techniques. Analyze and segment images using appropriate algorithms. Extract, match, and classify features from image data. Implement computer vision models for detection, tracking, and recognition.					
Course Content:						
Module 1	Fundamentals of Digital Image Processing	Assignment		[12] Sessions		
Topics:						

Image formation and perception, ampling, quantization, and pixel relationships, Intensity transformations and histogram processing, Spatial filtering: smoothing and sharpening, Frequency domain processing using Fourier transforms.				
Module 2	Image Segmentation and Morphological Processing	Assignment		[11] Sessions
Topics: Thresholding, region growing, and watershed algorithms, Edge detection: Sobel, Prewitt, Canny, Morphological operations: dilation, erosion, opening, closing, Connected components labelling, Segmentation evaluation techniques.				
Module 3	Feature Extraction and Matching	Assignment		[11] Sessions
Topics: Texture and color features, Corner and blob detection: Harris, FAST, DoG, SIFT, SURF, Feature descriptors and matching (BRIEF, ORB, FLANN), Hough transform for lines, circles, Motion detection and optical flow.				
Module 4	Object Detection, Recognition, and Vision Applications	Assignment		[11] Sessions
Topics: Object detection using Haar cascades and HOG, Face detection and facial recognition, Deep learning in vision: CNNs and YOLO, Video surveillance and real-time tracking, Applications: Medical imaging, AR/VR, Robotics, Self-driving vehicles.				
REFERENCE MATERIALS TEXTBOOKS Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Edition, Pearson Education, 2018. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2nd Edition, 2022. https://szeliski.org/Book/ REFERENCE BOOKS Sonka, Hlavac, and Boyle, Image Processing, Analysis, and Machine Vision, Cengage Learning, 4th Edition, 2014. Mark Nixon and Alberto Aguado, Feature Extraction and Image Processing for Computer Vision, Academic Press, 3rd Edition, 2012. Adrian Rosebrock, Practical Python and OpenCV, PyImageSearch Press, 2016.				

Gary Bradski and Adrian Kaehler, Learning OpenCV: Computer Vision with the OpenCV Library, O'Reilly Media, 2nd Edition, 2016. JOURNALS / MAGAZINES IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34 Computer Vision and Image Understanding (Elsevier) https://www.sciencedirect.com/journal/computer-vision-and-image-understanding International Journal of Computer Vision (Springer) https://www.springer.com/journal/11263 SWAYAM / NPTEL / MOOCs NPTEL – Computer Vision (IIT Hyderabad) – Prof. P.J. Narayanan https://nptel.ac.in/courses/106106210 Coursera – Introduction to Computer Vision (Georgia Tech) https://www.coursera.org/learn/computer-vision-basics edX – Fundamentals of Digital Image and Video Processing (Northwestern University) https://www.edx.org/course/digital-image-and-video-processing Udacity – Intro to Computer Vision with OpenCV and Python https://www.udacity.com/course/introduction-to-computer-vision--ud810

Course Code: CCS2506	Course Title: Intrusion Detection and Prevention System	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Fundamental knowledge in Operating Systems					
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.					

<table>
<tr><td>Course Objectives</td><td colspan="5">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.</td></tr>
<tr><td>Course Out Comes</td><td colspan="5">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.</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Introduction to Intrusion Detection and Prevention

System</td><td>Assignment</td><td>Programming Task</td><td></td><td>11 Sessions</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>Module 2</td><td>Intrusion Prevention System</td><td>Assignment</td><td>Programming Task</td><td></td><td>11 Sessions</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td colspan="2">Module 3</td><td>Applications and tools</td><td>Assignment</td><td>Programming/Data analysis task</td><td>12 Sessions</td></tr>
<tr><td colspan="6">Topics:</td></tr>
</table>

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	11 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: CSE2272	Course Title: Cloud computing Type of Course: Theory	L- T-P- C	2	0	0	2

Version No.	2.0			
Course Pre-requisites				
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 Outcomes	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	Introduction to Cloud and Virtualization	Assignment	Virtualization	10 Sessions
Topics: 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	High Throughput and Data Intensive Computing	Assignment	Virtualization	10 Sessions
Topics: 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	Cloud Security and Standards	Assignment	Virtualization	9 Sessions
Topics: Cloud Security and Standards: Cloud Security Challenges, Software-as-a-Service Security, Application standards, Client standards, Infrastructure and Service standards.				
Module 4	Cloud Platforms	Assignment	Virtualization	9 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				
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				

Course Code: CSE2505	Course Title: Mobile Application Development Type of Course: Theory	L- T-P- C	2	0	0	2
Version No.	2.0					
Course Pre-requisites	CSE2255					
Anti-requisites	NIL					
Course Description	The course deals with the basics of android platform and application life cycle. The goal of the course is to develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server. Topics include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.					

Course Objective	The objective of the course is to familiarize the learners with the concepts of Mobile Applications and Development as mentioned above and attain Employability Skills through Experiential Learning Techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: 1. Discuss the fundamentals of mobile application development and its architecture. (Comprehension) 2. Illustrate mobile applications with appropriate android view. (Application) 3. Demonstrate the use of services, broadcast receiver, Notifications and content provider.(Application) 4. Apply data persistence techniques, to perform CRUD operations. (Application) 5. Use advanced concepts for mobile application development. (Application)			
Course Content:				
Module 1	Introduction and Architecture of Android	Assignment	Simulation/Data Analysis	10 Sessions
Topics: Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.				
Module 2	User Interfaces, Intent and Fragments	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Topics: Views, Layout, Menu, Intent and Fragments.				
Module 3	Components of Android	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Topics: Activities, Services, Broadcast receivers, Content providers, User Navigation				
Module 4	Notifications and Data Persistence	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Topics: Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase.				
Module 5	Advance App Development	Term paper/Assignment	Simulation/Data Analysis	15 Sessions
Topics: Graphics and Animation, App Widgets, Sensors, Performance, Location, Places, Mapping, Custom Views, Canvas.				
Targeted Application & Tools that can be used:				

Applications: Native Android Applications Native iOS Applications Cross Platform mobile Apps Mobile web Applications
Text Book(s): T1. Pradeep kothari “Android Application Development - Black Book”, dreamtechpress T2. Barry Burd (Author), “Android Application Development” ALL – IN – ONE FOR Dummies T3. Jeff Mcherter (Author),Scott Gowell (Author), “Professional mobile Application Development” paperback, Wrox - Wiley India Private Limited T4. Wei-Meng Lee (Author) “Beginning Android Application Development” Wrox – Wiley India Private Limited
Reference(s): 1. Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) “Android Programming” 3rd edition, 2017.The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by” 2. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. 3. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015. 4. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580 5. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2 6. Reto Meier “Professional Android Application Development” E-Resources: https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/

Course Code: CAI2502	Course Title: Deep Learning Type of Course: Theory	L- T- P-C	3	0	0	3

Version No.	1.0			
Course Pre-requisites	CSE3157			
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 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 application-specific deep learning models and provide 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 Outcomes	On successful completion of this course the students shall be able to: CO1: Learn the Fundamental Principles of Deep Learning. (Remember). CO2: Identify the Deep Learning Algorithms for Various Types of Learning Tasks in various domains (Apply). CO3: Build Supervised and Unsupervised Deep Learning techniques to implement effective models for prediction or classification tasks. (Apply). CO4: Make use of appropriate validation metrics to evaluate the performance of Implemented Deep Neural Network. (Apply)			
Course Content:				
Module 1	Introduction to Deep Learning and Neural Networks	Assignment		12 Classes
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		11 Classes
Topics: Convolutional Neural Network, Transfer learning Techniques, Variants of CNN: ResNet, AlexNet				

Sequence Modelling: Recurrent Neural Network and its variants - Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU)				
Module 3	Deep Generative Models	Assignment		11 Classes
Topics: Generative Adversarial Networks, Kohonen Networks, Autoencoders, Boltzman Machine, Restricted Boltzmann Machine, Deep Belief Network				
Module-4	Advanced Deep Learning Architectures	Assignment		11 Classes
Topics: Hopfield Network, Probabilistic Neural Network, Deep Reinforcement Learning - The Basic Framework of Reinforcement Learning Deep Learning applications: Image segmentation, Object detection, Attention model for computer vision tasks, Speech Recognition, Video Analytics				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3 and Module 4)				
REFERENCE MATERIALS: TEXTBOOKS François Chollet, "Deep Learning with Python", 2nd Edition, Manning Publications, 2022 Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017. REFERENCES Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, "Deep Learning", Pearson Publication, 2021. David Foster, "Generative Deep Learning" O'Reilly Publishers, 2020. John D Kellehar, "Deep Learning", MIT Press, 2020. JOURNALS/MAGAZINES IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385				

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

Course Code: CAI2503	Course Title: Deep Learning Lab Type of Course: LAB	L- T- P-C	0	0	4	2
Version No.	1.0					
Course Pre-requisites	CSE3157					
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 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 application-specific deep learning models and provide 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 Outcomes	On successful completion of this course the students shall be able to: CO1: Learn the Fundamental Principles of Deep Learning. (Remember). CO2: Identify the Deep Learning Algorithms for Various Types of Learning Tasks in various domains (Apply). CO3: Build Supervised and Unsupervised Deep Learning techniques to implement effective models for prediction or classification tasks. (Apply). CO4: Make use of appropriate validation metrics to evaluate the performance of Implemented Deep Neural Network. (Apply)					
Course Content:						

List of Lab Tasks:

Experiment No. 1: Working with Deep Learning Framework

Level 1: Explore various Deep Learning Frameworks and identify deep learning frameworks (Keras, Tensorflow, Matplotlib, etc) with various methods available in DL Frameworks to develop a Model.

Experiment No. 2: Build a Basic Artificial Neural Network

Level 1: Create an ANN with DL frameworks and identify suitable ANN Layers using Keras and Tensorflow for pima-indians-diabetes.

Level 2: Create an ANN with DL frameworks and identify suitable ANN Layers using Keras and Tensorflow for any image dataset.

Experiment No. 3: Build a Multi-Layer Perceptron

Level 1: Create a MLP for classification task by identify suitable model for house price prediction.

Level 2: Design a MLP for implementing classification and fine-tuning for speech recognition

Experiment No. 4: Build a Convolutional Neural Network

Level 1: Build CNN architecture for Dog-Cat classification problem.

Level 2: Build Convolution Neural Network (CNN) for fine tuning hyperparameter for improving the performance of model.

Experiment No. 5: Build ResNet Model

Level 1: Build ResNet Model for Medical Imaging Datasets ChestX-ray14

Level 2: Build ResNet Model for Video datasets

Experiment No. 6: Build AlexNet Model

Level 1: Build ResNet Model for CIFAR10 Datasets.

Level 2: Build ResNet Model for Video datasets

Experiment No. 7: Build a Time-Series Model

Level 1: Build RNN/LSTM Model for predicting time series data for sentiment analysis model on IMDB dataset.

Experiment No. 8: Build a Time-Series Model

Level 1: Build RNN/GRU Model for predicting time series data for sentiment analysis model on IMDB dataset.

Experiment No. 9: Build GANs for CIFAR10

Level 1: Develop a GAN to Generate CIFAR10 Small Color Photographs

Experiment No. 10: Build a Transfer Learning Model.

Level 1: Create a Seq2Seq Model. Create Hugging-face API using Transfer learning model.

Experiment No. 11: Build an Auto-Encoder model

Level 1: Implement an Encoder-Decoder Recurrent neural network model for Neural Machine Translation.

Experiment No. 12: Build Generative Adversarial Networks.

Level 1: Design GAN Architecture for Image generations.

Level 2: Design a Age Prediction model by Applying Generative Adversarial

Experiment No. 13: Build an Attention Mechanism Model

Level 1: Implement a basic Attention mechanism for text classification using TensorFlow/Keras.

Level 2: Extend the Attention model for Machine Translation tasks (e.g., English to French translation).

Experiment No. 14: Build a BERT Model for Text Classification

Level 1: Fine-tune a pre-trained BERT model for binary text classification (e.g., movie reviews sentiment analysis).

Level 2: Fine-tune BERT for multi-label classification on a real-world dataset (e.g., news article categorization).

Experiment No. 15: Build a Deep Reinforcement Learning Model

Level 1: Implement a basic Deep Q-Network (DQN) for a simple environment like CartPole using TensorFlow.

Level 2: Implement a DQN-based agent for a complex game environment like Atari Breakout.

REFERENCE MATERIALS:

TEXTBOOKS

François Chollet, “Deep Learning with Python”, 2nd Edition, Manning Publications, 2022

Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.

REFERENCES Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra , “Deep Learning”, Pearson Publication, 2021. David Foster, “Generative Deep Learning” O’Reilly Publishers, 2020. John D Kellehar, “Deep Learning”, MIT Press, 2020. JOURNALS/MAGAZINES IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385 IEEE Transactions on Pattern Analysis and Machine Intelligence https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x SWAYAM/NPTEL/MOOCs: Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview Coursera – Neural Networks and Deep Learning Andrew Ng Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Code: CSE2506	Course Title: Mobile Application Development Lab Type of Course: Lab	L- T-P- C	0	0	4	2
Version No.	2.0					
Course Pre-requisites	CSE2256					
Anti-requisites	NIL					
Course Description	The course provides hands-on experience in designing, developing, and deploying mobile applications for Android and iOS platforms. Students will work with native development frameworks such as Android Studio (Java/Kotlin) and Xcode (Swift), as well as explore cross-platform tools like Flutter or React Native.					
Course Objective	The objective of the course is to develop Native and Cross-Platform Mobile Applications, design Interactive and Responsive User Interfaces, integrate Backend Services and APIs, implement State Management and Performance Optimization, ensure Mobile App Security and Data Protection					
Course Outcomes	On successful completion of the course the students shall be able to:					

<table>
<tr><td></td><td colspan="4">1. Develop Functional Mobile Applications
2. Design and Implement Interactive UIs
3. Integrate Cloud Services and APIs
4. Integrate Backend Systems and Data Management
5. Deploy, Publish, and Maintain advanced Mobile Application</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction and Architecture of Android</td><td>Assignment</td><td>Simulation/Data Analysis</td><td>10 Sessions</td></tr>
<tr><td colspan="5">1.a. Design an app to read user inputs using edit text and display the result of arithmetic operations using toast message.
1.b. Create an android app to calculate the current age of yourself, select your DOB using date picker.
2. Design an app to input your personal information. Use an autocomplete text view to select your place of birth.</td></tr>
<tr><td>Module 2</td><td>User Interfaces, Intent and Fragments</td><td>Term paper/Assignment</td><td>Simulation/Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="5">3. a. Design an app to select elective course using spinner view and on click of the display button,
toast your ID and selected elective course.
3. b. Design a restaurant menu app to print the total amount of orders.</td></tr>
<tr><td>Module 3</td><td>Components of Android</td><td>Term paper/Assignment</td><td>Simulation/Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="5">4. Develop an android app that uses intent to maintain the following scenario.
Check the eligibility criteria for voting. Input the Aadhar no., Name & age in the first activity. If the age is above 18, display the voter's detail in the second activity. Else, display, “You are not eligible to vote” in the second Activity.
5. Demonstrate the use of fragment with list of buttons representing various colors, and on click of these buttons, the appropriate color is filled in the next fragment. Create an Android application to input the vitals of a person (temperature, BP). If the vitals are abnormal, give proper notification to the user.
6. Create an android app to for movie ticket booking. Save the user name of the customer using shared preferences. After completion of booking, retrieve the username from the shared preferences and print the ticket details.</td></tr>
<tr><td>Module 4</td><td>Notifications and Data Persistence</td><td>Term paper/Assignment</td><td>Simulation/Data Analysis</td><td>15 Sessions</td></tr>
<tr><td colspan="5">7. Create an android application to manage the details of students' database using SQLite.Use necessary UI components, which perform the operations such as insertion, modification, removal and</td></tr>
</table>

view.Presidency University needs an APP for Admission eligibility checking for students, for that you need to take the following information from the Student: registration ID, physics, chemistry and mathematics marks (PCM), fees is allotted as below criteria.

PCM (Total marks %) Fee concession

90 above 80 %

70 to 89 60 %

Below 69 % no concession

On click on the button "Registration" details should be stored in the database using SQLite. Create button DISPLAY ALL (full students list) on click on the button it should display the students list per the fee

concession.

8. A company need to design an app that plays soft music automatically in the background. Create an app to achieve this functionality.

9. Create an android application such that your view object in the Activity can be Animated with fade-in effect. Create an appropriate XML file named fade-in and write the application to perform the property animation.

Module 5	Advance App Development	Term paper/Assignment	Simulation/Data Analysis	15 Sessions

10. Demonstrate how to send SMS and email.

11. Create an android application to transfer a file using WiFi. Create an android application "Where am I" with an Activity that uses the GPS Location provider to find the device's last known location.

Targeted Application & Tools that can be used:

Applications:

Native Android Applications (Java/Kotlin)

Android Mobile Apps built for Android smartphones and tablets using Java or Kotlin programming languages.

Target audience: Android users.

Native iOS Applications (Swift)

iOS Mobile Apps designed for iPhone and iPad using Swift.

Target audience: iOS users (Apple ecosystem).

Cross-Platform Mobile Apps (Flutter, React Native)

Cross-platform apps designed to run on both Android and iOS from a single codebase using frameworks like Flutter or React Native.

Target audience: Users on both Android and iOS platforms.

Mobile Web Applications (Progressive Web Apps - PWA)

Mobile-optimized web applications using HTML5, CSS3, and JavaScript that run in a browser with native-like functionality (offline support, push notifications).

Target audience: Users accessing apps via mobile browsers.

Development Tools and Frameworks

Integrated Development Environments (IDEs)

Android Studio (for Android): The official IDE for Android development, supporting Java, Kotlin, and Android SDK.

Xcode (for iOS): The official IDE for iOS development with Swift and Objective-C, providing a comprehensive suite of development tools for iPhone/iPad applications.

Visual Studio Code (VS Code): Lightweight IDE for working with Flutter, React Native, and web development projects.

Cross-Platform Development Frameworks

Flutter: Open-source UI framework by Google for building natively compiled applications for mobile, web, and desktop from a single codebase.

React Native: Open-source framework developed by Facebook for building cross-platform apps with JavaScript and React.

Backend & Cloud Tools

Firebase: Google's backend-as-a-service (BaaS) platform offering authentication, real-time databases, cloud storage, and push notifications for mobile apps.

AWS Amplify: Cloud platform for backend services (API, storage, authentication) and mobile deployment.

SQLite / Realm: Local storage solutions for mobile apps to manage data storage and retrieval on-device.

Mobile App Testing and Debugging Tools

Android Emulator (for Android): A virtual device to run and test Android apps without needing physical devices.

Xcode Simulator (for iOS): A tool to simulate different iOS devices and test apps during development.

Appium: Open-source tool for automated testing across native, hybrid, and mobile web applications.

Version Control and Collaboration

Git: Version control system for managing code changes and collaborating with teams.

GitHub / GitLab / Bitbucket: Online platforms for hosting Git repositories, collaboration, and version control management.

Mobile App Deployment Tools

Google Play Console: For managing Android app publishing, distribution, and monitoring.

Apple App Store Connect: For managing iOS app submissions, reviews, and releases on the Apple App Store.

UI/UX Design Tools

Figma / Adobe XD: Tools for UI/UX design and wireframing to create the visual elements of mobile applications before development. Sketch: Vector-based design tool for iOS UI design and prototyping
Text Book(s): T1. Pradeep kothari “Android Application Development - Black Book”, dreamtechpress T2. Barry Burd (Author), “Android Application Development” ALL – IN – ONE FOR Dummies T3. Jeff Mcherter (Author),Scott Gowell (Author), “Professional mobile Application Development” paperback, Wrox - Wiley India Private Limited T4. Wei-Meng Lee (Author) “Beginning Android Application Development” Wrox – Wiley India Private Limited
Reference(s): 1. Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) “Android Programming” 3rd edition, 2017.The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by” 2. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. 3. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015. 4. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580 5. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2 6. Reto Meier “Professional Android Application Development” E-Resources: https://puniversity.informaticsglobal.com/login Or http://182.72.188.193/

Course Code: ISE2505	Course Title: Image Processing and Computer Vision Lab Type of Course: Discipline Elective - Laboratory	L- T-P- C	0	0	2	1
Version No.	1.0					

Course Pre-requisites	CSE2264
Anti-requisites	NIL
Course Description	This lab course provides hands-on experience in the foundational techniques and applications of digital image processing and computer vision. Students will gain practical skills in reading, manipulating, and analyzing images using Python, OpenCV, and deep learning frameworks to solve real-world visual tasks.
Course Objective	To provide practical exposure to image acquisition, processing, and enhancement To understand and implement key computer vision algorithms To apply feature extraction, segmentation, and classification techniques To develop small-scale vision-based applications using Python and OpenCV
Course Outcomes	Upon successful completion, students will be able to: Apply image transformation and enhancement operations Implement segmentation and object detection techniques Extract and match visual features from images Build vision-based projects using OpenCV and CNN models

List of Laboratory Tasks

Lab 1: Read and Display Images using OpenCV
Objective: Load and visualize images using OpenCV
Task: Read image files and convert between color spaces
Activity: Display images in grayscale, RGB, and HSV formats

Lab 2: Image Enhancement Techniques
Objective: Apply contrast and brightness enhancement
Task: Use histogram equalization and contrast stretching
Activity: Compare results on different image datasets

Lab 3: Perform Image Filtering and Smoothing
Objective: Reduce noise using filters
Task: Apply Gaussian, median, and bilateral filters
Activity: Observe effects of different kernels on noisy images

Lab 4: Edge Detection Techniques
Objective: Detect edges using gradient-based methods

Task: Use Sobel, Prewitt, and Canny edge detectors
Activity: Tune thresholds and visualize edge maps

Lab 5: Geometric Transformations of Images
Objective: Apply image transformation techniques
Task: Perform translation, rotation, scaling, and affine transformations
Activity: Warp an image using transformation matrices

Lab 6: Image Thresholding and Binarization
Objective: Segment images using intensity values
Task: Apply global, adaptive, and Otsu's thresholding
Activity: Visualize segmentation results and contours

Lab 7: Morphological Operations
Objective: Use structuring elements for shape-based processing
Task: Apply dilation, erosion, opening, and closing
Activity: Clean up binary images using morphological filters

Lab 8: Color-based Object Detection
Objective: Segment objects based on color
Task: Use HSV color space for object detection
Activity: Detect colored objects (e.g., red ball) in real-time

Lab 9: Feature Detection using SIFT and ORB
Objective: Extract and match image features
Task: Use SIFT and ORB for keypoint detection
Activity: Match features between two images and draw correspondences

Lab 10: Object Tracking in Videos
Objective: Track moving objects in video streams
Task: Implement object tracking using meanshift or CSRT
Activity: Track objects with bounding boxes in webcam input

Lab 11: Face Detection using Haar Cascades
Objective: Detect faces in images and videos
Task: Load pre-trained Haar classifiers
Activity: Draw bounding boxes around detected faces

Lab 12: Image Classification using Pre-trained CNNs
Objective: Classify images using deep learning

Task: Use MobileNet, VGG, or ResNet for classification Activity: Load and predict labels for input images Lab 13: Implement Background Subtraction Objective: Separate foreground from background in video Task: Use frame differencing or background subtraction algorithms Activity: Detect motion and isolate moving objects Lab 14: Create an Image Stitching Pipeline Objective: Stitch overlapping images into panoramas Task: Detect and match features, compute homography Activity: Combine images to form a wide-view panorama Lab 15: Mini Project – Build a Real-Time Computer Vision Application Objective: Apply techniques learned to solve a real-world problem Task: Choose a task (e.g., face mask detection, barcode scanner) Activity: Develop and present the complete working prototype
REFERENCE MATERIALS TEXTBOOKS Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 4th Edition, Pearson Education, 2018 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2022 🔗 https://szeliski.org/Book/ REFERENCE BOOKS Sonka, Hlavac, and Boyle, Image Processing, Analysis, and Machine Vision, Cengage Learning, 2014 Adrian Rosebrock, Practical Python and OpenCV, PyImageSearch Press Gary Bradski & Adrian Kaehler, Learning OpenCV, O'Reilly, 2nd Edition, 2016

Course Code: CSE2273	Course Title: Cloud computing Type of Course : Lab	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 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

<table>
<tr><td>Course Code: APT4006</td><td>Course Title: Logical and Critical Thinking

Type of Course: Audited</td><td>L- T-P- C</td><td>0</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td>Version No.</td><td colspan="6">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="6">Students should have the basic concepts of Logical reasoning and Critical thinking, along with its applications in real life problems.</td></tr>
<tr><td>Anti-requisites</td><td colspan="6">Nil</td></tr>
<tr><td>Course Description</td><td colspan="6">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.</td></tr>
<tr><td>Course Objective</td><td colspan="6">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.</td></tr>
<tr><td rowspan="4">Course Outcomes</td><td colspan="6">On successful completion of the course the students shall be able to:</td></tr>
<tr><td colspan="6">CO1] Understand all the concepts.</td></tr>
<tr><td colspan="6">CO2] Apply the concepts in problem solving (Bloom’s taxonomy Level 3)</td></tr>
<tr><td colspan="6">CO3] Analyze and structure the reasoning techniques and spatial visualization skills</td></tr>
<tr><td colspan="7">Course Content:</td></tr>
</table>

<table>
<tr><td>Module 1</td><td>Logical Thinking</td><td>Assignment</td><td></td><td>16 Hours</td></tr>
<tr><td rowspan="2"></td><td colspan="4">Topics:</td></tr>
<tr><td colspan="4">Syllogisms, Cubes and Dices, Mirror and Water images, Paper cutting and Folding, Embedded figures & Completion of figures, Data Interpretation, Data sufficiency</td></tr>
<tr><td>Module 2</td><td>Critical Thinking</td><td>Assignment</td><td></td><td>14 Hours</td></tr>
<tr><td rowspan="2"></td><td colspan="4">Topics:</td></tr>
<tr><td colspan="4">Analogy, Symbol and Notations, Statement and assumption, Cause of action, Statement and conclusion, Puzzles</td></tr>
<tr><td rowspan="3"></td><td colspan="4">Targeted Application & Tools that can be used:</td></tr>
<tr><td colspan="4">Application area: Placement activities and Competitive examinations.</td></tr>
<tr><td colspan="4">Tools: LMS</td></tr>
<tr><td>Evaluation</td><td colspan="4">Continuous Evaluation</td></tr>
</table>

	· 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: 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: Recognize the importance of Value Education through the process of self-exploration Explain the human being as the co-existence of the self and the body in harmony. Describe the role of foundational values in building harmonious relationships. 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*: UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview 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 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 Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.
Reference Books E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers. A N Tripathy, 2003, Human Values, New Age International Publishers.

E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA. Resources: https://onlinecourses.swayam2.ac.in/imb25_mg195/preview https://onlinecourses.nptel.ac.in/noc25_mg141/preview https://onlinecourses.swayam2.ac.in/ini25_hs52/preview https://onlinecourses.nptel.ac.in/noc25_hs219/preview https://onlinecourses.swayam2.ac.in/cec25_mg14/preview https://onlinecourses.swayam2.ac.in/imb25_mg195/preview https://onlinecourses.swayam2.ac.in/imb25_mg196/preview
Topics relevant to Skill Development: An attitude of enquiry. Write reports The topics related to Human values and Professional ethics: All topics in are relevant to Human values and Professional ethics.

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: 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)

Course Code: CAI2504	Course Title: Natural Language Processing Type of Course: Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE3157					
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: Define different problems related to natural language processing. [Understand] Discuss using NLP techniques for different applications. [Apply] Propose solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply] 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:12
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:11
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:11
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 Applications and Ethical AI	Assignment	NLP Applications and Ethical AI	No. of Sessions: 11
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: 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. Lab 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 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):				

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). 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: CAI2506	Course Title: Numerical Optimization in AI Type of Course: Discipline Elective - Theory	L- T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE3157					
Anti-requisites	NIL					
Course Description	This course explores numerical optimization techniques essential to Artificial Intelligence and Machine Learning. Students will understand optimization foundations, techniques for both unconstrained and constrained problems, and learn how optimization drives performance improvements in AI systems. Emphasis is on algorithmic understanding and real-world applications in training AI models.					
Course Objective	To introduce various types of optimization problems and solution strategies. To enable students to apply optimization techniques in AI models. To develop skills in both deterministic and stochastic optimization methods. To implement optimization algorithms in practical machine learning tasks.					

<table>
<tr><td></td><td colspan="4"></td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of the course, students will be able to:
Formulate and analyze various optimization problems in AI.
Implement unconstrained and constrained optimization algorithms.
Apply gradient-based and stochastic techniques to train AI models.
Evaluate the effectiveness of optimization strategies in real-world AI tasks.</td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td>Foundations of Optimization</td><td>Assignment</td><td></td><td>[12]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Optimization in AI and ML: Role and importance, Classification: Linear, Nonlinear, Convex, Non-convex problems, Mathematical tools: Vectors, matrices, gradients, Hessians
Objective functions and optimality conditions.</td></tr>
<tr><td>Module 2</td><td>Unconstrained Optimization Methods</td><td>Assignment</td><td></td><td>[11]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Gradient Descent, Momentum, Nesterov’s Accelerated Gradient, Newton's Method, Conjugate Gradient Method, Quasi-Newton Methods (BFGS, L-BFGS), Line Search and Trust Region Strategies, Convergence behavior and numerical stability.</td></tr>
<tr><td>Module 3</td><td>Constrained Optimization Techniques</td><td>Assignment</td><td></td><td>[11]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Equality and Inequality constraints, Lagrange multipliers, KKT conditions, Penalty and Barrier Methods, Sequential Quadratic Programming (SQP), Applications in AI models such as SVM and regularization.</td></tr>
<tr><td>Module 4</td><td>Stochastic and Heuristic Optimization in AI</td><td></td><td></td><td>[11]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Stochastic Gradient Descent (SGD) and Adaptive Variants: Adam, Adagrad, RMSprop, Evolutionary Algorithms: Genetic Algorithms, Differential Evolution, Swarm Intelligence: PSO, Ant Colony Optimization, Applications in Deep Learning and Reinforcement Learning.</td></tr>
<tr><td colspan="5">REFERENCE MATERIALS:

TEXTBOOKS</td></tr>
</table>

Jorge Nocedal and Stephen J. Wright, Numerical Optimization, Springer, 2nd Edition, 2006.

Edwin K. P. Chong and Stanislaw H. Zak, An Introduction to Optimization, Wiley, 4th Edition, 2013.

REFERENCES

Dimitri P. Bertsekas, Nonlinear Programming, Athena Scientific, 3rd Edition, 2016.

Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004.

Andreas Antoniou and Wu-Sheng Lu, Practical Optimization: Algorithms and Engineering Applications, Springer, 2007.

Yaochu Jin, Multi-Objective Machine Learning, Springer, 2006.

Russell & Norvig, Artificial Intelligence: A Modern Approach, Pearson – Latest Edition (selected chapters).

John D Kellehar, “Deep Learning”, MIT Press, 2020.

JOURNALS/MAGAZINES

IEEE Transactions on Evolutionary Computation
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4235

IEEE Transactions on Neural Networks and Learning Systems
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385

Journal of Optimization Theory and Applications (Springer)
https://www.springer.com/journal/10957

Mathematical Programming (Springer)
https://www.springer.com/journal/10107

International Journal of Approximate Reasoning (Elsevier)
https://www.sciencedirect.com/journal/international-journal-of-approximate-reasoning

SWAYAM/NPTEL/MOOCs:

NPTEL – Optimization Techniques (IIT Kharagpur)
Instructor: Prof. P.K. Biswas
https://nptel.ac.in/courses/108105088

NPTEL – Convex Optimization (IIT Madras)
Instructor: Prof. S. Sundaram
https://nptel.ac.in/courses/110106138

Coursera – Numerical Methods for Engineers (Georgia Tech)
https://www.coursera.org/learn/numerical-methods-engineers

Coursera – Discrete Optimization (University of Melbourne)
https://www.coursera.org/learn/discrete-optimization

edX – Convex Optimization (Stanford University – Stephen Boyd) https://www.edx.org/course/convex-optimization

Course Code: CAI2507	Course Title: Reinforcement Learning Type of Course: Theory	L- T- P-C	2	0	0	2
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course is designed for students and researchers in Computer Science who aim to model real-world scenarios and develop effective solutions. In highly stochastic environments, innovative problem-solving is crucial. The course introduces various reinforcement learning (RL) techniques, a powerful approach for stochastic decision-making in the modern era. Beginning with the fundamentals of stochastic processes, the course covers industry-standard RL techniques. By mastering these concepts, students will gain the ability to design efficient solutions for complex, real-world challenges characterized by uncertainty and variability.					
Course Outcomes	On successful completion of the course the students shall be able to: 1. Describe dynamic programming concepts to find an optimal policy in a gaming environment [Understanding] 2. Identify on-policy and off-policy Monte Carlo methods for finding an optimal policy in a reinforcement learning environment. [Understanding] 3. Apply Temporal Difference learning techniques to the Frozen Lake RL environment [Apply] 4. Distinguish various exploration-exploitation strategies of the Multi-Armed Bandit (MAB) problem [Analyse]					
Course Content:						

Module 1	Introduction to Reinforcement Learning	Assignment		8 Classes
Topics:				

<table>
<tr><td colspan="5">Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types, episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope</td></tr>
<tr><td>Module 2</td><td>Monte-Carlo(MC) methods</td><td>Assignment</td><td></td><td>8
Classes</td></tr>
<tr><td colspan="5">Topics:
Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method.</td></tr>
<tr><td>Module 3</td><td>Temporal Difference(TD) Learning</td><td>Assignment</td><td></td><td>7
Classes</td></tr>
<tr><td colspan="5">Topics:
Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing the optimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods</td></tr>
<tr><td>Module-4</td><td>Multi-Armed Bandit (MAB) problem</td><td>Assignment</td><td></td><td>7
Classes</td></tr>
<tr><td colspan="5">Topics:
Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits.</td></tr>
<tr><td colspan="5">Project work/Assignment:</td></tr>
<tr><td colspan="5">Assignment 1 on (Module 1 and Module 2)
Assignment 2 on (Module 3 and Module 4)</td></tr>
<tr><td colspan="5">REFERENCE MATERIALS:

TEXTBOOKS
Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction”, MIT press, Second Edition, 2018.
SudharshanRavichandiran, “Deep Reinforcement Learning with Python”, Packt Publishers, Second Edition, 2020</td></tr>
</table>

REFERENCES

Maxim Lapan , "Deep Reinforcement Learning Hands-On", Packt Publishing,2023

LaurraGraesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022

Marco Wiering, Martijn van Otterlo,"Reinforcement Learning: State-of-the-Art", Springer,

https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

JOURNALS/MAGAZINES

IEEE Transactions on Deep Reinforcement Learning: A Survey

https://ieeexplore.ieee.org/document/9904958

IEEE Transactions on A Survey on Offline Reinforcement Learning: Taxonomy, Review, and Open Problems

https://ieeexplore.ieee.org/document/9904958

IEEE Spectrum
https://www.technologyreview.com/

SWAYAM/NPTEL/MOOCs:

Swayam Nptel – Reinforcement Learning By Prof. Balaraman Ravindran|IITMadras
https://onlinecourses.nptel.ac.in/noc20_cs74/preview

Coursera- Reinforcement Learning Specialization

https://www.coursera.org/specializations/reinforcement-learning

3.Coursera - Unsupervised Learning, Recommenders, Reinforcement Learning

https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning

Course Code: CAI2512	Course Title: Neural Networks and Fuzzy Logic Theory Course	L-T-P-C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	CSE2264				
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 is designed to improve the learners' EMPLOYABILITY SKILLS through PROBLEM SOLVING METHODOLOGIES.				
Course Outcomes	On successful completion of this course the students shall be able to: Demonstrate the concept of Neural Networks. [Understand] Illustrate the ideas behind the most common learning algorithms in Neural networks. [Apply] Discuss the concepts of Fuzzy Sets and Relations. [Understand] Employ Neural Network and Fuzzy logic concepts to solve real-world problems. [Apply]				
Course Content:					
Module 1	Introduction to Neural Network	Quiz	Single Layer Perceptron		12 Hours
Topics: Introduction to NN: Artificial and biological neural networks, Artificial intelligence and neural networks. Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models, activation functions. Single Layer Perceptron: Least mean square algorithm, Competitive Learning, Learning rates, Perceptron.					
Module 2	Multilayer Perceptron	Quiz	Multilayer Perceptron		11 Hours
Topics: Multilayer Perceptron: The XOR, XNOR problems, 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		11 Hours
	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, Types of fuzzy membership functions. 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		11 Hours
	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 problem.					
	Targeted Application & Tools that can be used: Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.) 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): Haykin, Simon. “Neural networks and learning machines”, 3/E. Pearson Education India, 2020. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553 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:					

	Shivanandam, Deepa S, “Principles of Soft computing”, N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374 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 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 ”: Neural Network design, application of Fuzzy sets and operations. This is attained through Seminar Presentation as mentioned in the assessment component

Course Code: CAI2505	Course Title: Natural Language Processing Lab Course Type: PCC Lab	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	NIL					
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: Define different problems related to natural language processing. [Knowledge]					

	Discuss using NLP techniques for different applications. [Comprehension] Propose solutions for a particular NLP problem using different machine learning and deep learning techniques. [Application] Learn to use different NLP tools and packages. [Application]

List of Laboratory Tasks:

Introduction to Using Word Representations and NLP Tools

Complex Word Identification

Sentiment Analysis and Named Entity Recognition

Lexical Simplification

Cross-Lingual NLP

Extracting PoS features

Building PoS Tagger

Building HMM for Title Case Conversion

Machine Translation Using Transformers

Lexical Candidate Generation and Ranking Using Pre-trained Language Models

Targeted Application & Tools that can be used:

Google Colab

NLTK

Huggingface Transformers

Project work/Assignment:

Group project on some NLP Task like text classification, sentiment analysis, etc.

Textbook(s):

Daniel Jurafsky, James H. Martin. “Speech and Language Processing: An Introduction to Natural Language Processing”, Computational Linguistics and Speech, Pearson Publication, 2023 (3rd Edition Draft).

Aditya Joshi, Pushpak Bhattacharyya. “Natural Language Processing”, Wiley Publication, 2023 (1st Edition).

References:

1. Chris Manning and Hinrich Schütze. “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA. 1999.

Weblinks:

NPTEL online course: https://nptel.ac.in/courses/106106211 Latest edition of Text Book: https://web.stanford.edu/~jurafsky/slp3/

Course Code: CAI2508	Course Title: Reinforcement Learning Lab Type of Course: Lab	L-T-P-C	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Artificial Intelligence and Machine Learning					
Anti-requisites	NIL					
Course Description	This lab course offers hands-on experience in implementing and experimenting with Deep Reinforcement Learning (DRL) algorithms in simulated environments. Students will explore core concepts such as Q-learning, Deep Q-Networks (DQNs), Policy Gradient methods, and Actor-Critic algorithms through practical coding exercises. The course emphasizes building and training DRL models using libraries like TensorFlow, PyTorch, and OpenAI Gym. Learners will design agents that can learn optimal behaviors through interaction with dynamic environments such as games, navigation tasks, and robotic simulations. By the end of the course, students will be equipped to design, implement, and evaluate deep reinforcement learning solutions for complex decision-making 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: 1. Apply dynamic programming concepts to find an optimal policy in a gaming environment [Application] 2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy in a reinforcement learning environment. [Application] 3. Apply Temporal Difference learning techniques to the Frozen Lake RL environment [Application] 4. Apply various exploration-exploitation strategies of the Multi-Armed Bandit (MAB) problem[Application] Here are well-structured Course Outcomes (COs) for the Deep Reinforcement Learning Lab, aligned with practical and implementation-based objectives:					

	Course Title: Deep Reinforcement Learning Lab Course Outcomes (COs) By the end of this course, students will be able to: CO1: Implement basic reinforcement learning algorithms such as Q-learning and SARSA in simulated environments. [Level: Apply] CO2: Design and train Deep Q-Networks (DQNs) to solve complex decision-making tasks using neural networks. [Level: Create] CO3: Apply policy gradient methods and understand their use in continuous and high-dimensional action spaces. [Level: Apply] CO4: Analyze the performance of different DRL algorithms based on metrics such as learning efficiency, stability, and convergence. [Level: Analyze]
Course Content:	

List of Lab Tasks: 1 .Software Setup :installalling Anaconda, OpenAI Gym and Universe. Basic simulations of some gaming environments in Gym 2. Working with Gym environments to create agents with random policy 2.1 Create the Frozen Lake GYM environment and explore the states, action, transition probability, reward functions and generating episodes. 2.2 Create an agent for the Cart-Pole environment using a random policy and record the game 3. Finding the optimal policy for the agent using Dynamic Programming 3.1 Compute the optimal policy for the Frozen Lake Environment using value iteration method 3.2 Compute the optimal policy for the Frozen Lake Environment using policy iteration method 4. Build and train a basic DQN agent using PyTorch or TensorFlow 5. Add experience replay and target network updates to enhance learning 6. Implementing Temporal Difference prediction for the Frozen lake environment for a random policy 7. Computing the optimal policy using on-policy TD control – SARSA 8. Computing the optimal policy using off-policy TD control – Q-learning 9. Multi-Armed Bandit problem 9.1 Creating a MAB in Gym	

9.2 Compute the best arm using various exploration strategies such as epsilon-greedy and softmax exploration method. 10. Implement variations of DQN to improve performance and stability	
Targeted Application & Tools that can be used : Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or Jupyter Notebook. Lab tasks will be implemented using the necessary libraries available in Python	
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course	
Students can be given group assignments to develop different gaming environments and implement the RL algorithms	
Text Book Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018. Sudharshan Ravichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020	
References LaurraGraesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022 https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/	

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 Fast track objective by Rajesh Verma R S Aggarwal S.P Bakshi					
	References www.indiabix.com www.testbook.com					

	www.youtube.com/c/TheAptitudeGuy/videos
	Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.

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

	CO4: Creating efficient solutions of CP problems using the learnt algorithmic approaches.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Competitive Programming and Problem Solving and attain Skill Development through Experiential Learning techniques.

Module 1: Introduction to Competitive Programming

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

Module 2: Number Theory for Problem-Solving

Use of Number Theory for problem-solving: reducing time/space complexity of brute force 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:

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.

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.

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).

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.

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.

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.

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.

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.

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.

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.

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).

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.

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.

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.

Given a string, find the number of occurrences of a specific substring within the string. Focus: Basic string manipulation, string matching (brute-force approach).

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.

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.

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.

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).

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.

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).

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.

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.

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.

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.

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.

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.

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.

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.

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:

C or C++ Compiler (g++): The standard compiler for CP. Familiarize students with compilation flags (e.g., -O2 for optimization).

IDE (Integrated Development Environment): Code:: Blocks, Visual Studio, CLion, or similar IDEs. These provide debugging capabilities, code completion, and other helpful features.

Online Judges (CodeChef, Codeforces, LeetCode, HackerRank): Essential for practicing and submitting solutions.

Debugger (gdb): Crucial for understanding code execution and finding bugs. Origin, excel and Mat lab soft wares for programming and data analysis.

Number Theory Libraries: Some libraries provide pre-built functions for number theory operations (though often it's better to implement them yourself for learning).

Wolfram Alpha: A useful tool for verifying number theory calculations and exploring concepts.

String Libraries: Familiarize students with the string manipulation functions available in C++.

Graph Visualization Tools: Tools like Graphviz can be helpful for visualizing graphs and understanding graph algorithms.

DP Debugging Techniques: Practice debugging DP solutions, as they can be complex. Visualizing the DP table can be helpful.

Text Books:

Guide to Competitive Programming: Learning and Improving Algorithms Through Contests" (3rd Edition), Antti Laaksonen, springer, 2024

"Data Structures and Algorithms in Java: A Project-Based Approach" – Dan S. Myers, Cambridge University Press

Reference Books:

Data Structures and Algorithmic Thinking with Python/C++/Java", Narasimha Karumanchi, 5th Edition, Career Monk, 2017.

Introduction to Algorithms, Thomas H. Cormen (Author), Charles E. Leiserson (Author), Ronald L. Rivest , fourth edition April 2022

Web Resources

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

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

Course Code: LAW7601	Indian Constitution Type of Course: MOOC course	L- T- P- C	-	-	-	0
		Contact hours	-	-	-	-
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamentals of Indian Constitution concepts and their relevance to 75+ Years of Republic of India (https://constitution75.com/) as well as #AzaadiKaAmrutMahotsav / Azadi Ka Amrit Mahotsav (https://amritmahotsav.nic.in). It is designed to equip students with the knowledge about the Constitution of India. This course aims to introduce the constitutional law of India to students from all walks of life and help them understand the constitutional principles as applied and understood in everyday life. The objective of making the Constitution of India, familiar to all students, and not only to law students, this course aims and objectifies legal understanding in the simplest of forms. This course is designed to cater to Constitutional Studies.					
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: Describe the basic understanding of the Indian Constitution and the concepts and issues relevant to day-to-day life of the nation and to equip the Citizen with the zeal of capacity building. Recognizing and identify the values of the Constitution of India. Enabling the Citizen-centric Awareness of Rights and Responsibilities of the State Explain the role of the State actors in building India.					

	Understanding the Gandhian vision over the power of the LSG (Local Self-Governance)
Course Content:	
Module 1	Understanding the Making of the Constitution: The Constituent Assembly & The Constitution of India
Topics: Historical Context of Constituent Assembly - Compositions & Functions of Constituent Assembly What is a Constitution? – Why have a Constitution? – Constitutional Change - Features of Indian Constitution – Preamble of Indian Constitution	
Module 2	Citizen's Fundamental Rights and State's Responsibilities (Directive Principles)
Topics: Introduction to Fundamental Rights - Right to Equality – Facets of Right to Equality - Right to Freedom - Constitutional Position of Some Democratic Rights - Right Against Exploitation - Right to Freedom of Religion - Right to Constitutional Remedies Directive Principles of the State Policy	
Module 3	Organs Of the Government
Topics: Executive: The President of India - Powers and Functions of President of India - Emergency Powers and the Position of the President Legislature: Union Council of Ministers - Prime Minister - The Rajya Sabha - The Lok Sabha - Relation between the Lok Sabha & Rajya Sabha - Office of the Speaker – Important Parliamentary Committees Judiciary: The Structure and Organization of the Judiciary & the High Court - The Supreme Court - Role of The Supreme Court - Judicial Activism in India - Basic Structure Doctrine & PIL	
Module 4	Federalism & Decentralization
Topics: What is Federalism? - Centre-State Legislative Relations - Centre-State Administrative Relations - Centre-State Financial Relations The 5th & 6th Schedules - Municipality- (History of Indian Municipality, Organization & Functions) – Panchayat 1 (Idea of Panchayat, Organization and Powers of Panchayats in India)	
Targeted Application & Tools that can be used: Application areas to familiarize students with fundamentals of Indian Constitutional concepts. Tools: Online Tools – NPTEL and Swayam.	
Project work/Assignment:	

Assessment Type Online end term exam will be conducted as notified by the Presidency University.
Online Link*: Prof. Amitabha Ray, SWAYAM Course: “Constitutional Government & Democracy in India” https://onlinecourses.swayam2.ac.in/cec19_hs13/preview * Other source links are available in below Resources link. Text Book Durga Das Basu --- Introduction to the Constitution of India, 23rd Edition (Gurgaon; LexisNexis, 2018). MP Jain’s Constitutional Law of India, Lexis Nexis V.N Shukla’s Indian Constitutional Law, M.P Singh 13th Edition MV Pylee’s Constitution of India J.C.Johari -- The Constitution of India: A Politico-Legal Study (Greater Noida: Sterling Publishers Pvt. Ltd. 2013). Himangshu Roy and M.P.Singh – Indian Political System, 4th Edition (Bengaluru; Pearson Education, 2018) Vidya Bhushan & Vishnoo Bhagwan--- Indian Administration (S. Chand, 2011) S.R.Maheswari --- Indian Administration (Orient Blackswan, 2001) Dr. A.Avasthi & A.P. Avasthi --- Indian Administration (L.N. Agarwal Educational Publishing, 2017). B. L. Fadia --- Indian Government and Politics (Sahitya a. Bhawan, 13th Revised Edition, 2017). P.M.Bakshi – The Constitution of India (Prayagraj, UP; a. Universal Law Publishing, January, 2018)
Reference Books HM Seervai, Constitutional Law of India, 4th Ed. Vol I, II, & III Uday Raj Rai, Constitutional Law-I Democracy and Constitutionalism in India, Oxford University Press 2009 Resources: https://onlinecourses.nptel.ac.in/noc20_lw03/course?&force_user=true https://onlinecourses.swayam2.ac.in/cec19_hs13/course?&force_user=true https://nptel.ac.in/courses/129106003 https://nptel.ac.in/courses/129106411 https://nptel.ac.in/courses/129105608 https://nptel.ac.in/courses/129106002

Topics relevant to Skill Development: An attitude of inquiry. Write reports The topics related to Constitutional Studies and its application : All topics in theory component are relevant to Indian Constitution.

Course Code: PPS4027	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: TED Talks You Tube Links 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.				

Catalogue prepared by		Faculty of L&D
Recommended by the Board of Studies on		BOS held on
Date of Approval by the Academic Council		Academic Council Meeting held on

Course Code: CSE7101	Course Title: Mini Project Type of Course:	L- T-P- C	0	0	0	5
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: 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: Identify problems based on societal /research needs. (Understand) Apply Knowledge and skill to solve societal problems in a group. (Apply) Develop interpersonal skills to work as member of a group or leader. (Apply) Analyze the inferences from available results through theoretical / Experimental / Simulations. (Analyze) Analyze the impact of solutions in societal and environmental context for sustainable development. (Analyze) Improve in written and oral communication. (Create)					

	Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. (Understand)

Course Code: CAI3400	Course Title: Image Processing and Analysis Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course provides an advanced understanding of image processing techniques with a strong emphasis on multidimensional data analysis, image restoration, compression, registration, and fusion. It builds on foundational concepts and explores real-world applications such as remote sensing, medical imaging, and super-resolution techniques. Students will gain hands-on experience with emerging methods in image enhancement and analysis, including both classical and learning-based approaches.					
Course Objective	▯ To understand the principles and methods for acquiring and processing multidimensional and multispectral image data. ▯ To develop proficiency in advanced image enhancement, denoising, and restoration techniques for improving image quality. ▯ To explore modern approaches for image representation and compression, enabling efficient storage and transmission. ▯ To analyze and apply techniques for image registration, fusion, and super-resolution in domain-specific applications.					
Course Outcomes	After successful completion of this course, students will be able to: CO1: Analyze and interpret multispectral and hyperspectral image data for advanced image understanding and classification. CO2: Apply state-of-the-art enhancement and restoration algorithms for improving degraded or low-quality images. CO3: Evaluate and implement modern image compression techniques and assess their impact on visual fidelity and analytical tasks. CO4: Design and execute complex image analysis workflows including registration, fusion, and resolution enhancement for specific applications in medical imaging, remote sensing, and forensics.					
Course Content:						

Module 1	Multidimensional Imaging and Spectral Analysis	Assignment 1	11 Sessions
Topics: Explore advanced image acquisition beyond the visible spectrum, including thermal, multispectral, and hyperspectral imaging. Learn calibration and correction methods for spectral distortion and noise. Understand the role of spectral signatures in material classification and environmental monitoring. Analyze image data cubes using PCA and band selection techniques.			
Module 2	Advanced Image Enhancement and Restoration Techniques	Assignment 1	11 Sessions
Topics: Delve into adaptive histogram equalization, homomorphic filtering, and Retinex-based enhancement. Study advanced denoising using non-local means, total variation, and wavelet shrinkage. Restoration methods include blind deconvolution and Poisson noise models. Applications in medical and astronomical imaging are emphasized.			
Module 3	Image Compression and Representation for Analysis	Assignment 2	11 Sessions
Topics: Understand the mathematical foundations of image redundancy and learn state-of-the-art compression schemes such as JPEG2000, SPIHT, and wavelet-based methods. Explore sparse coding, dictionary learning, and transform coding. Learn how compression affects diagnostic image quality and analysis performance.			
Module 4	Image Registration, Fusion, and Super-Resolution		12 Sessions
Topics: Study geometric transformations and intensity-based registration using mutual information. Apply image fusion techniques in multi-modal imaging, such as combining CT-MRI or visible-infrared images. Learn deep learning approaches to image super-resolution, including SRCNN and GAN-based models. Explore applications in precision medicine, remote sensing, and digital forensics.			
Project work/Assignment:			
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3)			
REFERENCE MATERIALS: Textbooks			

1. Gonzalez, R.C., & Woods, R.E. – Digital Image Processing, 4th Edition, Pearson Education.

2. Chan, T.F., & Shen, J. – Image Processing and Analysis: Variational, PDE, Wavelet, and Stochastic Methods, SIAM.

Reference Books

1. Sonka, M., Hlavac, V., & Boyle, R. – Image Processing, Analysis, and Machine Vision, Cengage Learning.

2. Umbaugh, S.E. – Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIPtools, 3rd Edition, CRC Press.

3. Jähne, B. – Digital Image Processing, 6th Edition, Springer.

JOURNALS/MAGAZINES

1. IECE Journal of Image Analysis and Processing (JIAP):

2. Medical Image Analysis:

3. IPOL Journal (Image Processing On Line):

SWAYAM/NPTEL/MOOCs:

1. Digital Image Processing

2. Computer Vision and Image Processing – Fundamentals and Applications

3 Medical Image Analysis

Course Code: CAI3401	Course Title: Big Data Analytics for AI Type of Course: Integrated	L- T - P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces students to the principles and technologies of big data analytics, with a particular emphasis on its role in AI systems. Students will learn how to process, store, and analyze massive volumes of data using distributed systems and scalable machine learning techniques. The course blends theoretical concepts with practical experience using industry-standard tools and platforms.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of course Big Data Analytics for AI to attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING TECHNIQUES.					

Course Outcomes	On successful completion of the course the students shall be able to: CO1: Understand core concepts of big data and its intersection with AI. CO2: Gain hands-on experience with big data tools like Hadoop, Spark, and NoSQL databases. CO3: Build and optimize data pipelines and machine learning models at scale. CO4: Explore real-world AI applications driven by big data analytics.				
Course Content:					
Module 1	Introduction to Big Data and AI	Participative Learning			No. of Classes L-5 P-5
Introduction to Big Data and AI: Characteristics of Big Data (5Vs), Role of Big Data in AI applications, Overview of AI models driven by large-scale data Big Data Ecosystem and Architecture: Hadoop ecosystem overview, Spark vs. Hadoop, Lambda and Kappa architectures					
Module 2	Data Storage Systems	Participative Learning			No. of Classes L-5 P-5
Data Storage Systems: HDFS: Hadoop Distributed File System, NoSQL Databases: MongoDB, Cassandra, Data warehousing and lakes					
Module 3	Data Ingestion and Preprocessing	Experiential Learning			No. of Classes L-6 P-6
Data Ingestion and Preprocessing, ETL processes, Tools: Apache NiFi, Sqoop, Flume, Data cleaning and transformation techniques Distributed Computing with Hadoop and MapReduce, Hadoop architecture, Writing MapReduce jobs, Practical applications					
Module 4	Spark MLlib	Experiential Learning			No. of Classes L-7 P-6
Introduction to Apache Spark: Spark architecture and RDDs, Spark DataFrames and Datasets, Performance tuning basics Machine Learning with Spark MLlib, ML pipelines, Classification, regression, clustering, Model tuning and cross-validation					
List Of Laboratory Tasks:					

Lab 1: Introduction to Hadoop and HDFS Objective: Understand the Hadoop architecture and HDFS storage system. Tasks: Set up a single-node Hadoop cluster. Upload and retrieve files from HDFS. Explore file distribution and block replication. Lab 2: MapReduce Programming Objective: Implement basic MapReduce jobs for large-scale data processing. Tasks: Write a word count MapReduce program in Java or Python. Analyze performance and test on a large dataset. Modify the job to perform sorting or filtering. Lab 3: NoSQL Databases with MongoDB/Cassandra Objective: Explore document-based and column-family NoSQL databases. Tasks: Install MongoDB/Cassandra. Create collections and insert/query documents. Perform analytics queries (aggregation, indexing, etc.). Lab 4: Apache Spark Basics Objective: Use Spark for distributed data processing. Tasks: Set up Apache Spark on local or cloud environment. Load and transform data using RDDs and DataFrames. Perform word count and basic transformations. Lab 5: Machine Learning with Spark Mllib Objective: Apply scalable ML models using Spark MLlib. Tasks: Use logistic regression and decision trees on large datasets. Build a pipeline for preprocessing and model training. Evaluate model accuracy using cross-validation.
Text Book(s)
"Big Data: Principles and Best Practices of Scalable Real-Time Data Systems" Author: Nathan Marz, James Warren Publisher: Manning Publications

"Hadoop: The Definitive Guide" (4th Edition) Author: Tom White Publisher: O'Reilly Media "Learning Spark: Lightning-Fast Big Data Analysis" (2nd Edition) Authors: Jules S. Damji, Brooke Wenig, Tathagata Das, Denny Lee Publisher: O'Reilly Media
References:
"Spark: The Definitive Guide" Authors: Bill Chambers, Matei Zaharia Publisher: O'Reilly Media "Designing Data-Intensive Applications" Author: Martin Klepp mann Publisher: O'Reilly Media "Mining of Massive Datasets" (3rd Edition) Authors: Jure Leskovec, Anand Rajaraman, Jeff Ullman Publisher: Cambridge University Press "Practical Deep Learning for Cloud, Mobile, and Edge" Authors: Anirudh Koul, Siddha Ganju, Meher Kasam Publisher: O'Reilly Media
Topics relevant to SKILL DEVELOPMENT: Ethical decision-making in AI & data usage for Skill Development through Participative Learning techniques. This is attained through the Assignment/ Class Presentation/Group Discussion/Flipped Class as mentioned in the assessment component.

Course Code: CAI3402	Course Title: Optimization Techniques for Machine Learning Type of Course: Integrated	L- T- P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
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: Describe fundamentals of Optimization Techniques [Remember]. Explain Optimization Techniques for Machine learning. [Understand]. Discuss Convex optimization models [Understand]. Apply Methods for convex optimization [Apply].					

Course Content:				
Module 1:	Optimization Basics	Quiz	Knowledge based Quiz	16[8L+8 P]Sessions
Topics: Introduction, The Basics of Optimization: Bivariate and Multivariate, Convex Objective Functions, Properties of Optimization in Machine Learning: Least-Square Classification, Support Vector Machines, Logistic Regression, Optimization Models for Binary Targets, Optimization Models for the Multiclass Setting, Coordinate Descent.				
Module 2:	Optimization Solutions	Quiz	Comprehension based Quiz	15[8L+7 P]Sessions
Topics: Introduction, Challenges in Gradient-Based Optimization: Momentum-Based Learning, RMSProp, Newton Method, Newton Methods in Machine Learning: Computationally Efficient Variations of Newton Method, The Subgradient Method, Proximal Gradient Method, Non-differentiable Optimization Functions: Designing Surrogate Lose Functions.				
Module 3	Constrained Optimization	Assignment	Batch-wise Assignments	14[7L+7 P]Sessions
Topics: Introduction, Primal Gradient Descent Methods: Primal Gradient Descent, Lagrangian Relaxation and Duality: Fundamentals of SVM Dual, Optimization Algorithms for the SVM Dual				
Module 4:	Optimization in Computational Graphs	Assignment and Presentation	Batch-wise Assignment and Presentations	15[7L+8 P]Sessions
Topics: Introduction, basics, Optimization in Directed Acyclic Graphs: Optimizations in Directed Acyclic Graphs, Broad Framework, Application: Node-to-Node derivations using Brute Force				
Targeted Application & Tools that can be used: Use of Matlab tool				
Project work/Assignment: Survey on Methods for convex optimization Survey on Machine learning models related to optimization				
Introduction to Optimization Problems using Python/Matlab. Implement Bivariate and Multivariate Optimization. Solve Least-Square Classification Problem. Implement Support Vector Machine (SVM) Optimization. Logistic Regression Model Optimization. Coordinate Descent Algorithm Implementation. Gradient Descent and Stochastic Gradient Descent Techniques. Implement Momentum-based Gradient Descent.				

RMSProp Optimization Method Application. Newton Method Implementation for Machine Learning. Subgradient Method for Non-differentiable Functions. Proximal Gradient Method Implementation. Solve Constrained Optimization Problems with Lagrangian Methods. Optimization in Directed Acyclic Graphs. Survey and Comparative Analysis of Optimization Algorithms.
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 for Skill Development through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CAI3403	Course Title: Deep Reinforcement Learning Type of Course: Integrated	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. It is of utmost importance to come up with innovative solutions for scenarios that are highly stochastic. The objective of this course, is to introduce different reinforcement learning techniques which is a promising paradigm for stochastic decision making in					

	the forthcoming era. Starting from the basics of stochastic processes, this course introduces several RL techniques that are as per the industry standard. With a good knowledge in RL, the students will be able to develop efficient solutions for complex and challenging real-life problems that are highly stochastic in nature.			
Course Objectives	This course is designed to improve the learners 'EMPLOYABILITY SKILLS' by using EXPERIENTIAL LEARNING techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply dynamic programming concepts to find an optimal policy in a gaming environment [Application] 2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy in a reinforcement learning environment. [Application] 3. Apply Temporal Difference learning techniques to the Frozen Lake RL environment [Application] 4. Apply various exploration-exploitation strategies of the Multi-Armed Bandit (MAB) problem[Application]			
Course Content:				
Module 1	Introduction to Reinforcement Learning	Assignment	Programming using the OpenAI Gym environment	No. of Classes L – 5 P – 6
Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types, episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope				
Module 2	Monte-Carlo(MC) methods	Assignment	Programming using the OpenAI Gym environment	No. of Classes L-5 P-6
Topics: Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method.				
Module 3	Temporal Difference(TD) Learning	Assignment/Quiz	Programming using the OpenAI Gym environment	No. of Classes

<table>
<tr><td></td><td></td><td></td><td></td><td>L-7 P -6</td></tr>
<tr><td colspan="5">Topics: Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing the optimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods.</td></tr>
<tr><td>Module 4</td><td>Multi-Armed Bandit (MAB) problem</td><td>Assignment</td><td>Programming using the OpenAI Gym environment</td><td>No. of Classes
L-6 P -4</td></tr>
<tr><td colspan="5">Topics: Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits, introduction to Deep Reinforcement Learning(DRL) Algorithm – Deep Q Network (DQN)</td></tr>
</table>

List of Lab Tasks:

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

Basic simulations of some gaming environments in Gym

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

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

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

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

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

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

4. Implementing Monte Carlo prediction method using blackjack game

4.1 Every-visit MC prediction

4.2 First-visit MC prediction

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

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

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

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

9. Multi-Armed Bandit problem

9.1 Creating a MAB in Gym

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

10. Application of MAB – Finding the best advertisement banner for a web site using MAB

Targeted Application & Tools that can be used : Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or Jupyter Notebook. Lab tasks will be implemented using the necessary libraries available in Python
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
Students can be given group assignments to develop different gaming environments and implement the RL algorithms
Text Book Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018. SudharshanRavichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020
References LaurraGraesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022 https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

Course Code: CAI3404	Course Title: AI in Cyber Security Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces students to the fundamentals of applying artificial intelligence techniques to cyber security. It covers threat detection, anomaly detection, malware classification, and the application of machine learning/deep learning methods in securing data and systems. It includes hands-on lab exercises to help students build AI models for real-world cyber security challenges.					

<table>
<tr><td>Course Objective</td><td colspan="4">This course is designed to improve learners' employability skills by applying experiential learning techniques in cybersecurity and artificial intelligence.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
Apply AI techniques to detect and mitigate cyber threats.
Analyze network and system data to uncover anomalies.
Build intelligent systems to classify and predict malicious activity.
Use tools and frameworks to develop cyber security solutions using machine learning.</td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to AI in Cyber Security</td><td>Assignment</td><td></td><td>18[8L+10P]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Fundamentals of Cyber Security: CIA Triad, Threats & Vulnerabilities, Role of Artificial Intelligence in Cyber Security, Cyber Attack Lifecycle and Defense Mechanisms, Overview of Machine Learning and Deep Learning Techniques, Introduction to Data Sources: Network logs, system logs, NetFlow, and packet capture data, Overview of Threat Intelligence Platforms (TIPs),
AI-based Cyber Security Use Cases in Industry, Challenges in Deploying AI for Cyber Defense (adversarial attacks, data imbalance, etc.).</td></tr>
<tr><td>Module 2</td><td>Anomaly and Intrusion Detection Systems</td><td>Assignment</td><td></td><td>14[7L+7P]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Types of Intrusion Detection Systems (IDS): Signature-based vs. Anomaly-based, Dataset Exploration: KDDCup, NSL-KDD, CICIDS2017, Data Preprocessing: Feature Engineering, Label Encoding, Normalization, Supervised Learning for Intrusion Detection: SVM, Random Forest, Decision Trees, Unsupervised Learning: K-Means Clustering, Isolation Forests, Autoencoders,
Model Evaluation: Confusion Matrix, ROC Curve, Precision/Recall, Real-time Detection Systems with Streaming Data (e.g., using Kafka or PySpark), Case Study: Building and Deploying a ML-based IDS.</td></tr>
<tr><td>Module 3</td><td>Malware Detection and Classification</td><td>Assignment</td><td></td><td>14[6L+8P]
Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction to Malware Types: Virus, Worm, Trojan, Ransomware, Spyware, Static and Dynamic Malware Analysis Techniques, Feature Extraction: Opcode, API Call Sequences, Binary Analysis,
Deep Learning Techniques: CNN for image-based malware classification, RNN/LSTM for sequence learning, Model Training with Malimg and Microsoft Malware Dataset, Model Optimization Techniques (Dropout, Early Stopping, Hyperparameter Tuning), Use of Embeddings for Malware Behavior Analysis, Adversarial Examples and Evasion Techniques in Malware Detection.</td></tr>
</table>

Module 4	AI for Cyber Threat Intelligence and Response			

Threat Intelligence Fundamentals and Sources (OSINT, commercial feeds), Natural Language Processing for Cyber Threat Intelligence (CTI) extraction, Entity Recognition and Classification from Threat Reports, URL and Email Phishing Detection using ML/NLP, Behavioral Biometrics: Keystroke Dynamics, Mouse Movement Analysis, Deep Learning for Security Information and Event Management (SIEM), AI in Incident Response and Automation (SOAR platforms),

Case Study: Detecting phishing websites using NLP and ensemble models.

Project work/Assignment:

Assignment 1: Threat Detection using Supervised Learning

Assignment 2: Malware Classification using Deep Learning

Mini Project (Team-based): AI-Driven Cyber Threat Intelligence Dashboard

Lab 1: Explore Python libraries for cyber security (Scikit-learn, TensorFlow, Keras, Pandas).

Lab 2: Data preprocessing and feature extraction from KDD Cup dataset.

Lab 3: Develop a basic binary classifier to detect malicious network traffic.

Lab 4: Implement an SVM model for intrusion detection.

Lab 5: Build a deep neural network to classify attacks using NSL-KDD dataset.

Lab 6: Train an autoencoder for anomaly detection in log files.

Lab 7: Use Random Forest for malware classification.

Lab 8: Text mining of phishing emails using NLP.

Lab 9: Create a spam classifier using Naïve Bayes.

Lab 10: Train an LSTM model for real-time anomaly detection.

Lab 11: Visualize threat patterns using t-SNE and PCA.

Lab 12: Use a GAN to generate synthetic attack data.

Lab 13: Build a model for phishing URL detection.

Lab 14: Implement behavioral biometrics using keystroke dynamics.

Lab 15: Develop a dashboard integrating AI-driven threat alerts.

REFERENCE MATERIALS:

TEXTBOOKS

Mark Stamp, Introduction to Machine Learning with Applications in Information Security, CRC Press, 2020.

Clarence Chio, David Freeman, Machine Learning and Security: Protecting Systems with Data and Algorithms, O'Reilly, 2018.

REFERENCES

Xiaofeng Chen, Cyber Security: AI and Big Data Perspective, Springer, 2021.

Sumeet Dua, Xian Du, Data Mining and Machine Learning in Cybersecurity, CRC Press, 2011.

Richard E. Smith, Elementary Information Security, Jones & Bartlett Learning, 2021.

JOURNALS/MAGAZINES

IEEE Transactions on Information Forensics and Security
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8858
Covers the theory and practice of information forensics, cyber defense, and security.

ACM Transactions on Privacy and Security (TOPS)
https://dl.acm.org/journal/tops
Peer-reviewed research on cyber security systems, privacy-preserving AI, and secure protocols.

Computers & Security (Elsevier)
https://www.sciencedirect.com/journal/computers-and-security
Practical and academic articles on cyber threats, security analytics, and AI applications in security.

Journal of Cybersecurity (Oxford Academic)
https://academic.oup.com/cybersecurity
Multidisciplinary research on digital threats and AI-driven defensive mechanisms.

IEEE Security & Privacy Magazine
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8013
Blends academic depth with industry relevance; covers AI, forensics, and emerging cyber threats.

Cybersecurity Magazine
https://cybersecurity-magazine.com
Regularly features expert opinion, trends, and technologies including AI in cyber security.

SWAYAM/NPTEL/MOOCs:

NPTEL – Introduction to Machine Learning (IIT Kharagpur)
https://onlinecourses.nptel.ac.in/noc22-cs58

AI for Cybersecurity Specialization – IBM
https://www.coursera.org/specializations/ai-cybersecurity
Covers: AI and ML techniques to detect malware, phishing, and threats in network traffic. Hands-on labs included.

Course Code: CAI3405	Course Title: Explainable AI Type of Course: Integrated	L- T-P- C				

<table>
<tr><td></td><td colspan="3"></td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="7">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">CSE2264</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">This course introduces the concepts, techniques, and challenges of Explainable Artificial Intelligence (XAI). Students will learn to build interpretable models and apply explainability tools to demystify complex AI decisions, making AI systems transparent, trustworthy, and accountable. Emphasis will be on practical implementation and evaluation using real-world datasets.</td></tr>
<tr><td>Course Objective</td><td colspan="7">1 Understand the need for and principles of explainable AI
2 Explore techniques for explaining model predictions
3 Gain hands-on experience with state-of-the-art XAI tools and libraries
4 Build models that are interpretable and meet regulatory or ethical standards</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On successful completion of this course the students shall be able to:
Explain the importance and scope of explainability in AI
Compare interpretable models with black-box models
Apply XAI techniques (e.g., LIME, SHAP) to real-world datasets
Develop systems with enhanced transparency and traceability
Evaluate explainability metrics and their impact on model trustworthiness</td></tr>
<tr><td colspan="8">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to Explainable AI</td><td>Understand</td><td colspan="3"></td><td colspan="2">13[7L+4P]
Sessions</td></tr>
<tr><td colspan="8">Topics:
What is Explainability? Why it matters, Challenges in interpreting ML/DL models
AI Ethics and Responsible AI</td></tr>
<tr><td>Module 2</td><td>Interpretable Models vs. Black-box Models</td><td>Apply</td><td colspan="3"></td><td colspan="2">14[7L+7P]
Sessions</td></tr>
<tr><td colspan="8">Topics:
Decision Trees, Linear Models, Rule-based Models,
Black-box models: Neural Networks, Ensemble methods,
Trade-offs between accuracy and explainability</td></tr>
</table>

Module 3	Post-Hoc Explanation Techniques	Assignment		14[6L+8P] Sessions

Topics:

Local vs. Global explanations,

LIME (Local Interpretable Model-Agnostic Explanations),

SHAP (SHapley Additive exPlanations),

Partial Dependence Plots, Feature Importance

Module 4	Visual and Textual Explanations	Assignment	14[6L+8P] Sessions

Saliency maps for CNNs,

Attention mechanisms in NLP,

Counterfactual and contrastive explanations

Project work/Assignment:

Assignment 1 on (Module 1 and Module 2)

Assignment 2 on (Module 3)

List of Lab Tasks:

Lab 1 – Compare interpretable vs. black-box models

Lab 2 – Implement LIME for image/text classification

Lab 3 – Apply SHAP to a random forest classifier

Lab 4 – Visualize CNN saliency maps for image predictions

Lab 5 – Use What-If Tool (TensorBoard) for exploring model fairness

Lab 6 – Build a decision support tool using explainable outputs

Lab 7 – Case Study: Explainability in credit scoring models

Lab 8 – Final Project: Explainable AI dashboard for real-world data

REFERENCE MATERIALS:

TEXTBOOKS

- Christoph Molnar – Interpretable Machine Learning, 2022 Edition (Free online)
- Sameer Singh et al. – Explainable AI: A Guide for Practitioners
- Gunning & Aha – DARPA's XAI Program Publications

REFERENCES

IEEE XAI publications

Research papers from NeurIPS, ICML, and ACL on XAI

XAI Fairness & Bias Toolkits by Google, IBM, and Microsoft

JOURNALS/MAGAZINES

IEEE Transactions on Artificial Intelligence

Journal of Artificial Intelligence Research (JAIR)

ACM Transactions on Intelligent Systems and Technology (TIST)

Artificial Intelligence Journal (Elsevier)

SWAYAM/NPTEL/MOOCs:

NPTEL: Responsible AI by IIT Madras

Coursera: Explainable AI with Google Cloud

FastAI: Modules on Model Interpretation

IBM AI Explainability 360 Toolkit

Course Code: CAI3406	Course Title: Responsible AI Type of Course: Integrated		L- T-P- C	2	0	2	3
Version No.		1.0					
Course Pre-requisites		CSE2264					
Anti-requisites		NIL					
Course Description		Responsible AI emphasizes transparency and explainability, ensuring that AI-driven decisions are understandable and justifiable. It also prioritizes security, reliability, and sustainability, aiming to create AI systems that are safe, efficient, and environmentally conscious. Ultimately, Responsible AI seeks to align technology with human values, promoting trust and ensuring that AI enhances rather than harms society.					
Course Objective		The objective of Responsible AI is to develop and deploy artificial intelligence in a way that is ethical, fair, transparent, and aligned with human values.					

Course Out Comes		On successful completion of this course the students shall be able to: To state aspects of responsible AI such as fairness, accountability, bias, privacy etc.[Remember] To assess the fairness and ethics of AI models.[Understand] To enforce fairness in models and remove bias in data.[Understand] To preserve the privacy of individuals while learning from them and apply it to various domains.[Apply]			
Course Content:					
Module 1	Introduction to Responsive AI (Remember)	Assignment			11 Sessions
	Topics: Artificial Intelligence Fundamentals, definition of responsible AI, Importance of responsible AI, core principles of responsible AI, Regulations and Policies, challenges, Responsible AI in practice.				
Module 2	Fairness and Bias (Understand)	Assignment			11 Sessions
	Topics: Sources of Biases, Exploratory data analysis, limitation of a dataset, Preprocessing, in processing and postprocessing to remove bias, Group fairness and Individual fairness, Counterfactual fairness				
Module 3	Interpretability and explainability, Ethics and Accountability (Understand)	Assignment			12 sessions
	Topics: Interpretability through simplification and visualization, Intrinsic interpretable methods Post Hoc interpretability, Explainability through causality, Model agnostic Interpretation, Auditing AI models, fairness assessment, Principles for ethical practices				
Module 4	Privacy preservation (Apply)	Assignment			11 sessions
	Topics: Attack models, Privacy-preserving Learning, Differential privacy, Federated learning, Case Study- Recommendation systems, Medical diagnosis, Hiring/ Education, Computer Vision, Natural Language Processing				
	Lab Experiments:				

	Lab 1 – Real-time sentiment analysis from live social media feed Lab 2 – Build an AI-powered chatbot using Dialogflow or Rasa Lab 3 – Create a user-adaptive recommendation engine Lab 4 – Implement online learning for a dynamic classification problem Lab 5 – Emotion recognition from facial expressions using webcam input Lab 6 – Deploy a low-latency AI model using TensorFlow Lite Lab 7 – Build a real-time fraud detection prototype using streaming data Lab 8 – Mini Project: End-to-end responsive AI application
	Targeted Application & Tools that can be used: ChatGPT, DeepSeek
	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
	Case Study in different domains
	Text Book Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 04-Nov-2019;ISBN-10 : 3030303705, ISBN-13 : 978-3030303709 Christoph Molnar "Interpretable Machine Learning".Lulu, 1st edition, March 24, 2019; eBook. ISBN-10 : 0244768528, ISBN-13 : 978-0244768522 [available online]
	References R1. Voeneky S, Kellmeyer P, Mueller O, Burgard W, eds. The Cambridge Handbook of Responsible Artificial Intelligence. In: The Cambridge Handbook of Responsible Artificial Intelligence: Interdisciplinary Perspectives. Cambridge Law Handbooks. Cambridge University Press; 2022:i-ii. Web links W1. Responsible AI for generative models: Designing for responsibility W2. Responsible AI W3. Microsoft Responsible AI - Fairness
	Topics relevant to development of "Employability": Responsible AI ethics, Fairness and Bias, ethics and accountability

Course Code: CAI3407	Course Title: Agentic AI Type of Course: Integrated	L- T-P- C				

			2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course provides a comprehensive introduction to *Agentic AI*, focusing on building autonomous, tool-using systems powered by Large Language Models (LLMs). Students will explore the foundations of multi-step LLM workflows, prompt engineering, and asynchronous execution while gaining hands-on experience with leading frameworks like OpenAI API, CrewAI, LangGraph, and AutoGen. Through modules on multi-agent collaboration, graph-based agent design, and model context protocols, the course emphasizes practical skills in designing, orchestrating, and deploying intelligent agents capable of communication, memory management, and decision-making. Real-world case studies across domains such as robotics, finance, and smart cities will illustrate the transformative potential of agentic systems.					
Course Objective	1. Introduce the concept of Agentic AI and equip students with the foundational knowledge of LLM-based agent workflows. 2. Develop practical skills in designing and deploying single-agent and multi-agent systems using modern frameworks such as OpenAI API, CrewAI, LangGraph, and AutoGen. 3. Explore orchestration techniques, communication models, and collaboration strategies among intelligent agents. 4. Enable students to build graph-based workflows and memory-augmented agents for solving real-world problems. 5. Familiarize students with context-aware protocol design using Model Context Protocol (MCP) for structured and scalable agent communication.					
Course Outcomes	On successful completion of this course the students shall be able to: **CO1**: Explain the core concepts of Agentic AI, including agent workflows, prompt engineering, and LLM function execution. **CO2**: Use OpenAI APIs and asynchronous Python to build simple autonomous agentic systems after configuring the development environment. **CO3**: Design multi-agent workflows using CrewAI with task coordination, memory, and collaboration strategies. **CO4**: Construct graph-based agent workflows using LangGraph, leveraging state machines, reducers, and checkpointing. **CO5**: Manage agent messaging protocols using AutoGen and Model Context Protocol (MCP). **CO6**: Apply agentic AI systems to real-world domains such as robotics, finance, and smart infrastructure through case studies.					
Course Content:						

Module 1	Introduction to Agentic AI and Foundations of LLM Workflows	Assignment		16[8L+8P] Sessions
Concept of Agentic AI & Multi-step LLM workflows, Building your first agentic system using OpenAI API, Setting up environments (Windows/Mac, Git, Cursor IDE, APIs), Prompt engineering for tool-based autonomy, Agent vs workflow patterns, Async Python and LLM function calling, Tool use and function execution in LLMs, Sequential and parallel processing in agentic workflows				
Module 2	Multi-Agent Workflows and LLM Orchestration	Assignment		16[8L+8P] Sessions
Designing with CrewAI: Agents, tasks, tools, processes, crews, memory, building a web search tool; Multi-agent: Architectures, Designing a Multi Agent Structure with Message Passing, Modes of Collaboration Among AI Agents, communication and collaboration, Case Studies: Robotics, Finance, Smart Cities and Energy Grids, Pydantic AI: Introduction, Creating Simple Agent, Building agent with personas, goals, and dynamic memory.				
Module 3	Graph-Based Agent Design with LangGraph	Assignment		16[8L+8P] Sessions
LangGraph architecture and components, State machines: Nodes, edges, reducers, Workflow graphs and supersteps, Checkpointing and persistent memory, Web automation with Playwright + LangGraph, Structured outputs and feedback loops, LangChain tool integration				
Module 4	AutoGen and Model Context Protocol (MCP)	Assignment		12[6L+6P] Sessions
AutoGen : agents, messaging, single agent, multiple agent. MCP: Introduction, Architecture, context fragmentation, clients, servers and protocol.				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3)				
List of Lab Tasks: Lab 1: Setting Up the Agentic AI Development Environment Objective: Install and configure required tools for agentic system development. Task: Set up Python, Git, OpenAI API key, Cursor IDE, and environment variables. Activity: Perform a guided installation and validate API access with a basic GPT query.				

Lab 2: First Agentic System using OpenAI API

Objective: Understand LLM workflows through simple agent design.

Task: Build a basic Python agent that takes user input and responds using GPT-4.

Activity: Implement asynchronous function calling and test multiple prompts.

Lab 3: Prompt Engineering for Tool Use

Objective: Design effective prompts for LLMs to interact with tools.

Task: Create prompt templates for a calculator, summarizer, and code explainer tools.

Activity: Compare output quality with different prompting strategies.

Lab 4: Agent vs Workflow Pattern

Objective: Distinguish between agent-based and workflow-based models.

Task: Implement both an agent and a predefined workflow for a document summarizer.

Activity: Analyze performance and flexibility trade-offs.

Lab 5: Building a Multi-Agent CrewAI System

Objective: Learn to coordinate multiple agents in a single task.

Task: Design a system with researcher, summarizer, and presenter agents.

Activity: Use CrewAI to assign roles, tools, and memory, then simulate a research task.

Lab 6: Case Study – Multi-Agent System for Web Search

Objective: Apply multi-agent collaboration to a real-world problem.

Task: Implement a system that searches the web and compiles a report.

Activity: Assign different sub-tasks to agents and use memory for tracking.

Lab 7: Building an Agent with Persona and Goals using Pydantic AI

Objective: Customize agent behavior using metadata.

Task: Create an agent with a defined personality, goals, and memory.

Activity: Use Pydantic schemas to enforce structure and simulate goal-seeking behavior.

Lab 8: LangGraph Basics – Nodes and Edges

Objective: Design workflows as state machines.

Task: Build a LangGraph with nodes for input, processing, and output.

Activity: Visualize the graph and simulate input-output flows.

Lab 9: Checkpointing and Feedback Loops in LangGraph

Objective: Implement persistent memory and iterative feedback.

Task: Add checkpoint nodes and feedback validation in LangGraph.

Activity: Re-run tasks based on user feedback or system failure.

Lab 10: Web Automation using LangGraph + Playwright

Objective: Enable agents to perform automated web tasks.

Task: Build an agent that logs into a site and extracts content.

Activity: Integrate Playwright actions into LangGraph nodes.

Lab 11: Building AutoGen Agents with Messaging

Objective: Explore agent communication and message passing.

Task: Create single-agent and multi-agent setups using AutoGen.

Activity: Simulate collaborative planning via structured messaging.

Lab 12: Model Context Protocol (MCP) – Context Fragmentation

Objective: Handle large context and multi-client coordination.

Task: Build an agent system using MCP to divide and manage context fragments.

Activity: Simulate a client-server model and trace message flows.

REFERENCE MATERIALS:

TEXTBOOKS

Building Agentic AI Systems, Anjanava Biswas Wrick Talukdar, 2025 Packt Publishing

REFERENCES

Michael Wooldridge, An Introduction to MultiAgent Systems, 2nd Ed

AI research papers from IJCAI, AAAI, AAMAS

OpenAI research on agentic models and autonomous systems

Case studies on autonomous robotics and virtual agent behavior

JOURNALS/MAGAZINES

Autonomous Agents and Multi-Agent Systems (Springer) Journal of Artificial Intelligence Research (JAIR) Artificial Intelligence Journal (Elsevier) IEEE Transactions on Cognitive and Developmental Systems   SWAYAM/NPTEL/MOOCs: NPTEL: Artificial Intelligence – Search Methods for Problem Solving Coursera: Autonomous Agents – University of Alberta edX: Multi-Agent Systems and Distributed AI OpenAI Blog: Research articles on emerging agentic models (e.g., AutoGPT)

Course Code: CAI3408	Course Title: Deep Neural Networks Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
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: CO1: Explain the fundamentals of Neural Network. CO2: Apply Unsupervised Learning Networks for feature extraction. CO3: Apply CNN and its variants for suitable applications. CO4: Apply Recurrent Neural Network for their suitable applications.					

Course Content:				
Module 1	INTRODUCTION	Assignment		16[8L+8P] Sessions
Topics: Fundamentals of Neural Networks: Model of Artificial Neuron and Biological Neuron, Learning rules and various activation functions. Single layer Feed-forward networks. Multilayer Feed-forward networks. Back Propagation networks, Early Stopping, Bagging and Dropout - batch normalization, Regularization.				
Module 2	UNSUPERVISED LEARNING NETWORKS	Assignment		16[8L+8P] Sessions
Topics: Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks- -Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Radial, Autoencoders, Boltzmann Machine, Generalized Adversarial Network.				
Module 3	CONVOLUTIONAL NEURAL NETWORKS	Assignment		16[8L+8P] Sessions
Topics: Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Applications: Computer Vision, Image Generation, Image Compression.				
Module-4	RECURRENT NEURAL NETWORKS	Assignment		12[6L+6P] Sessions
Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Deep Recurrent Networks, Applications: Image Generation, Image Compression, Natural Language Processing.				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 2) 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 Multi-Layer Feed Forward Network

Objective: Create a Multi-Layer Feed Forward Network for classification task.

Task: Identify suitable model for house price prediction.

Activity: Design a Multi-Layer Feed Forward Network for implementing classification and fine-tuning using House price.csv

Lab 5: 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 6: 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

Lab 7: 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 8 and Lab 9: 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 10: 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 11 and Lab 12: 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

REFERENCE MATERIALS:

TEXT BOOKS:

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

2. Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021. 106

REFERENCES:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly, 2018.

2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

3. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.

4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018

5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.

7. S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.

8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

9. James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

JOURNALS/MAGAZINES

IEEE Transactions on Neural Networks and Learning Systems

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

IEEE Transactions on Pattern Analysis and Machine Intelligence

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

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

SWAYAM/NPTEL/MOOCs:

Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview

Coursera – Neural Networks and Deep Learning Andrew Ng

Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

<table>
<tr><td>Course Code: CAI3409</td><td>Course Title: Speech Recognition and Synthesis
Type of Course: Integrated</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="6">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="6">CSE2264</td></tr>
<tr><td>Anti-requisites</td><td colspan="6">NIL</td></tr>
<tr><td>Course Description</td><td colspan="6">This course introduces fundamental principles and practical aspects of speech signal processing. It covers techniques in speech analysis, recognition, and synthesis, enabling students to build interactive voice-based AI systems. Emphasis is placed on acoustic modeling, feature extraction, and the use of machine learning and deep learning models for speech applications.</td></tr>
<tr><td>Course Objective</td><td colspan="6">To understand the basic concepts and characteristics of speech signals.
To explore feature extraction and pattern matching techniques used in ASR.
To study the principles of speech synthesis and TTS systems.
To provide hands-on experience with speech processing tools and APIs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On successful completion of this course, students will be able to:
Analyze speech signals and extract key features.
Apply pattern recognition and machine learning methods for ASR.
Design speech synthesis systems using classical and deep learning models.
Develop real-time applications using speech APIs and open-source tools.</td></tr>
<tr><td colspan="7">Course Content:</td></tr>
</table>

Module 1	Speech Signal Fundamentals	Assignment		18[8L+10P] Sessions
Topics: Human speech production and auditory perception, Speech signal representation: time and frequency domains, Preprocessing: sampling, quantization, windowing, pre-emphasis, Speech signal features: pitch, formants, energy, ZCR, Spectrogram and Short-Time Fourier Transform (STFT).				
Module 2	Feature Extraction & Modeling Techniques	Assignment		14[7L+7P] Sessions
Topics: MFCC, PLP, LPC, Delta features, DTW (Dynamic Time Warping), GMM-HMM based acoustic modelling, Viterbi decoding and alignment, Basics of phonetics and phoneme modelling				
Module 3	Automatic Speech Recognition (ASR)	Assignment		14[6L+8P] Sessions
Topics: Architecture of ASR systems, Language modeling: N-grams, smoothing, Deep learning for speech: DNN, CNN, LSTM, End-to-end models: CTC, Attention, Transformers, Tools: Kaldi, CMU Sphinx, DeepSpeech.				
Module 4	Speech Synthesis and TTS	Assignment		14[6L+8P] Sessions
Topics: Concatenative, Parametric, and Neural synthesis, TTS pipeline: text normalization, phoneme mapping, HMM-based synthesis, Tacotron and WaveNet architectures, APIs: Google TTS, Amazon Polly, Festival, eSpeak.				
List of Lab Tasks: Lab 1: Introduction to Speech Signal Processing Objective: Understand the nature of speech signals. Task: Record and visualize a speech waveform using a microphone and Python. Activity: Capture audio input, analyze waveform, and visualize with matplotlib. Lab 2: Time Domain Analysis of Speech Signals Objective: Analyze speech features in the time domain. Task: Compute Zero Crossing Rate (ZCR) and short-time energy of speech samples. Activity: Implement ZCR and energy plots for different speech segments using Python.				

Lab 3: Frequency Domain Analysis Using Spectrogram

Objective: Understand frequency components of speech.

Task: Apply Short-Time Fourier Transform (STFT) to speech signals.

Activity: Generate and interpret spectrograms using Librosa and Matplotlib.

Lab 4: Extraction of MFCC Features

Objective: Extract key speech features using MFCC.

Task: Extract and visualize MFCC features from recorded speech.

Activity: Use Librosa or python_speech_features to extract MFCCs.

Lab 5: Linear Predictive Coding (LPC)

Objective: Implement LPC-based feature extraction.

Task: Apply LPC to model the vocal tract.

Activity: Compute LPC coefficients and analyze spectral envelope.

Lab 6: Implement Dynamic Time Warping (DTW)

Objective: Understand time alignment of speech.

Task: Compare two speech signals using DTW.

Activity: Use fastdtw to align utterances of the same word.

Lab 7: Acoustic Modeling using GMM-HMM

Objective: Implement basic acoustic modeling.

Task: Train a GMM-HMM model for a simple digit recognition task.

Activity: Use hmmlearn or HTK for acoustic modeling.

Lab 8: Viterbi Algorithm for Speech Alignment

Objective: Apply sequence decoding in speech.

Task: Use Viterbi decoding to find the best state path in an HMM.

Activity: Implement Viterbi algorithm in Python and visualize state paths.

Lab 9: Build a Simple ASR System using CMU Sphinx

Objective: Use open-source ASR toolkit.

Task: Set up CMU Sphinx and perform isolated word recognition.

Activity: Create language and acoustic models and test recognition.

Lab 10: Real-time Speech Recognition using DeepSpeech

Objective: Apply deep learning in ASR.

Task: Use Mozilla DeepSpeech to transcribe audio files.

Activity: Install DeepSpeech, load pre-trained model, and test transcription.

Lab 11: Evaluate ASR using Google Speech-to-Text API

Objective: Explore cloud-based speech recognition.

Task: Use Google Cloud API to transcribe different accents.

Activity: Send audio to API and analyze word error rate.

Lab 12: Introduction to Text-to-Speech (TTS) using Festival

Objective: Create basic speech synthesis output.

Task: Convert written text to speech using Festival.

Activity: Install Festival, input text, and generate synthesized speech.

Lab 13: Implement a Neural TTS system using Tacotron 2

Objective: Use deep learning for speech synthesis.

Task: Synthesize speech from text using Tacotron 2.

Activity: Use pre-trained Tacotron 2 model and generate speech samples.

Lab 14: Speech Synthesis using Google TTS and Amazon Polly

Objective: Use cloud-based TTS systems.

Task: Convert sample sentences into speech using APIs.

Activity: Use Python SDKs to access TTS services and compare outputs.

Lab 15: Mini Project – Build a Voice Assistant

Objective: Integrate ASR and TTS.

Task: Build a simple voice-controlled assistant.

Activity: Combine speech recognition, intent detection, and speech synthesis using tools like SpeechRecognition + gTTS + Pyttsx3.

REFERENCE MATERIALS

TEXTBOOKS

Lawrence Rabiner and Ronald Schafer, Theory and Applications of Digital Speech Processing, Pearson, 2011.

Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson, 3rd Edition (Draft). https://web.stanford.edu/~jurafsky/slp3/

REFERENCE BOOKS

Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, Wiley, 2nd Edition, 2011.

Thomas Dutoit, An Introduction to Text-to-Speech Synthesis, Springer, 1997.

Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, Spoken Language Processing, Prentice Hall, 2001.

Tokuda et al., Speech Synthesis: Algorithms for Text-to-Speech and Speech Modification, Springer, 2021.

JOURNALS / MAGAZINES

IEEE Transactions on Audio, Speech and Language Processing https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10376

Computer Speech & Language (Elsevier) https://www.sciencedirect.com/journal/computer-speech-and-language

Speech Communication (Elsevier) https://www.journals.elsevier.com/speech-communication

SWAYAM / NPTEL / MOOCs

NPTEL – Spoken Language Processing (IIT Madras) https://nptel.ac.in/courses/106106168

Coursera – Audio Signal Processing for Music Applications (UPF) https://www.coursera.org/learn/audio-signal-processing

edX – Speech Processing (KTH Royal Institute of Technology) https://www.edx.org/course/speech-processing

Fast.ai – Practical Deep Learning (TTS + ASR projects) https://course.fast.ai/

Course Code: CAI3410	Course Title:	L- T-P- C				

	AI Chatbots without Programming Type of Course: Integrated		2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course enables students to design and develop intelligent chatbots using no-code/low-code platforms. It covers the fundamentals of natural language processing, conversational AI, and chatbot design strategies. Students will gain hands-on experience building functional chatbots for domains such as customer service, education, and e-commerce using tools like Dialogflow, Chatfuel, Microsoft Power Virtual Agents, and other no-code frameworks.					
Course Objective	This course aims to democratize chatbot development by empowering students to create intelligent conversational agents without programming knowledge, using experiential learning on visual platforms.					
Course Outcomes	Course Outcomes On successful completion of this course, students will be able to: Understand the architecture and functioning of AI-powered chatbots. (Understand) Design conversational flows using drag-and-drop tools. (Apply) Analyze user intent and train NLP models using no-code tools. (Analyze) Create and deploy domain-specific chatbots for real-world use cases. (Create)					

Course Content:

Module 1	Introduction to Conversational AI and Chatbots	Assignment		18[8L+10P] Sessions

Topics:

History and evolution of chatbots,Types of chatbots: rule-based vs. AI-based,Components of chatbot architecture,Use cases across industries

Module 2	Designing Conversational Experiences	Assignment		14[7L+7P] Sessions

<table>
<tr><td colspan="5">Topics:

Conversation design principles, User personas and intent mapping, Flowcharting and decision trees, Multilingual and accessibility considerations</td></tr>
<tr><td>Module 3</td><td>Building AI Chatbots on No-Code Platforms</td><td>Assignment</td><td></td><td>14[6L+8P]

Sessions</td></tr>
<tr><td colspan="5">Topics:

Overview of no-code tools: Dialogflow, Chatfuel, Landbot, Microsoft PVA,NLP basics: intents, entities, training phrases, Contexts and session handling, Integrations with messaging platforms (WhatsApp, Telegram, Web)</td></tr>
<tr><td>Module 4</td><td>Testing, Deployment, and Analytics</td><td>Assignment</td><td></td><td>14[6L+8P]

Sessions</td></tr>
<tr><td colspan="5">Topics:

Bot testing and improvement strategies, Connecting to APIs and databases, Deployment to websites and social media, Analyzing user behavior and feedback.</td></tr>
<tr><td colspan="5">Project work/Assignment:</td></tr>
<tr><td colspan="5">Design a customer support chatbot using Chatfuel or Dialogflow

Develop a feedback collection chatbot for educational use

Group project: Cross-platform chatbot for a chosen domain</td></tr>
<tr><td colspan="5">List of Lab Tasks:

Lab 1: Introduction to chatbot interfaces and no-code tools

Lab 2: Create a simple rule-based chatbot using Chatfuel

Lab 3: Design a user flow using decision trees in Landbot

Lab 4: Build an FAQ chatbot using Dialogflow intents and responses

Lab 5: Implement intent recognition and entity extraction in Dialogflow

Lab 6: Add context-based conversations in a Dialogflow chatbot

Lab 7: Build a WhatsApp-integrated chatbot using Twilio

Lab 8: Design a chatbot using Microsoft Power Virtual Agents

Lab 9: Create multi-lingual responses and fallback messages

Lab 10: Integrate a chatbot with Google Sheets to log user responses</td></tr>
</table>

Lab 11: Embed a chatbot on a website using iframe or script Lab 12: Analyze user interaction logs for performance metrics Lab 13: Customize chatbot appearance and branding elements Lab 14: Develop a feedback chatbot with sentiment-based responses Lab 15: Final project: Design and deploy a fully functional domain-specific chatbot
REFERENCE MATERIALS TEXTBOOKS Jason D. Brown, Designing Bots: Creating Conversational Experiences, O'Reilly Media, 2017. Akshay Kulkarni and Adarsha Shivananda, Building Chatbots with Google Dialogflow, Apress, 2019. REFERENCES Rashid Khan, Build Better Chatbots: A Complete Guide to Getting Started with Chatbots, Apress, 2017. Michael McTear, Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots, Springer, 2020. Navin Sabharwal et al., Designing Human-Centric AI Experiences, Apress, 2021. JOURNALS / MAGAZINES ACM Transactions on Interactive Intelligent Systems AI Magazine (Association for the Advancement of Artificial Intelligence) Journal of Web Engineering SWAYAM/NPTEL/MOOCs Coursera – Building AI Powered Chatbots Without Programming (IBM) edX – Introduction to Chatbots (Microsoft) Udemy – Chatbot Development Without Coding

Course Code: CAI3411	Course Title: Generative AI Type of Course: Integrated		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	No. of classes L-8 P-8

				Langchain Framework	
	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:				
	Certification course in Generative AI through Google 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,				
	List of Lab Tasks:				
	Experiment No.1: Setting up Python IDE(Spyder) and OpenAI API key. Introduction to OpenAI playground and prompting Level 1: Document the installation and the process for generating models in OpenAI Level 2: Solve various GenAI models of OpenAI from Playground using prompts				
	Experiment No.2: Text classification, summarization, sentiment analysis, chatbot application, code explanation with generating single and multiple response(S). Level 1: Practice the text generation model of OpenAI and Spyder IDE to implement various applications.				
	Experiment No.3: Embeddings – for words, similarity between words, text embeddings, plagiarism check of documents Level 1: Use generating embeddings for words, text and documents Level 2: Apply the embeddings API to develop applications for plagiarism check				

	Experiment No.4: Image generation using Dall E. Using GPT-Vision model for text to image generation and image-to-text. Level 1: Apply GPT-vision model for text-to-image generation and image-to-image
	Experiment No.5: Transformer based text and email classification Level 1: Develop transformer-based AI models for classifying text/email
	Experiment No.6: BERT for masked token generation Level 1: Develop BERT based model for generating masked tokens
	Experiment No.7: Creating applications using different types of LangChains – Simple Sequential, Sequential and map reduce Level 1: List the various types of chains in Langchain Level 2: Practice different types of chains using Spyder IDE and OpenAI
	Experiment No.8: Information retrieval using agents and tools in Langchain. Level 1: Use agents and tools with Langchain for information retrieval
	Experiment No.9: Custom Document loading and retrieval in LangChain using ChromaDB Level 1: Understand ChromeDb Level 2: Apply chromed with Langchain to generate information retrieval model from custom document
	Experiment No.10: Create a GPT like Chatbot using the memory component and RALM in LangChain Level 1: Show GPT like chatbot using memory component and retrieval augmented language model
	Experiment No.11: Using action agents, human as a tool and plan and execute agents for information retrieval. Level 1: Understand action agents and plan and execute agents Level 2: Use agents and tools for information retrieval
	Experiment No.12: Implement GAN for neural style transfer Level 1: Demonstrate a style transfer algorithm using generative models and experiment with the transformation of images by applying different artistic styles, assessing both the technical aspects and the aesthetic outcomes
	Experiment No.13: Text to Image generation using Dall-e/stable diffusion using prompts Level 1: List various image generation models Level 2: Use an image generation model to generate image from prompts

	Experiment No.14: Image to Image generation using stable diffusion Level 1: Apply stable diffusion to generate image from an image using prompts
	Experiment No.15: Speech to text and multi-modal generative models using Whisper for Audio Level 1: Identify the generative model for text, image and audio data Level 2: Use Langchain to create models for generating different data modalities. Ex: Audio-to-text
	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

Introduction to Generative AI (Beginner)

Gemini for Google Cloud (Intermediate)

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-93597050b15d2

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: CAI3412	Course Title: Machine Learning for Finance Type of Course: Integrated		L-T-P-C			
			2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course explores the intersection of machine learning and finance. Students will learn to model financial data, predict market trends, manage risk, and develop algorithmic trading strategies using ML techniques. It emphasizes hands-on experience with financial datasets and real-world case studies.					
Course Objective	To enable students to apply machine learning methods to financial data analysis, portfolio optimization, and risk modeling. Students will gain practical knowledge to build ML-based financial systems using Python and related libraries.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand machine learning applications in the financial domain. (Understand) 2. Apply supervised and unsupervised learning to model financial data. (Apply) 3. Analyze risk and optimize portfolios using ML models. (Analyze) 4. Design and implement algorithmic trading strategies. (Create)					
Course Content:						
Module 1	Introduction to Financial Data and ML	Assignment 1			18[8L+10P] Sessions	
Topics: Overview of financial markets, financial data types, returns and risk, ML in finance, financial time-series analysis, introduction to supervised learning models used in finance.						
Module 2	Financial Forecasting and Risk Modeling	Assignment 1			14[7L+7P] Sessions	
Topics: Time series forecasting (ARIMA, LSTM), volatility modeling, Value at Risk (VaR), credit risk modeling, regression and classification models for default prediction.						

Module 3	Portfolio Optimization and Strategy Design	Assignment 2	14[6L+8P] Sessions
Topics: Portfolio theory, efficient frontier, ML for asset allocation, reinforcement learning in portfolio management, backtesting trading strategies.			
Module 4	Algorithmic Trading and Fraud Detection		14[6L+8P] Sessions
Topics: Overview of algorithmic trading, strategy development using ML, anomaly detection for fraud, real-time data analysis, regulatory and ethical considerations.			
Project work/Assignment:			
Assignment 1 on (Module 1 and Module 2) Assignment 2 on (Module 3)			
List of Lab Tasks: 1. Load and analyze historical stock prices using pandas and yfinance. 2. Visualize financial time-series data and calculate returns. 3. Implement linear regression for stock price forecasting. 4. Build logistic regression model to predict credit default. 5. Use Random Forests to classify high-risk vs low-risk customers. 6. Implement ARIMA model for time-series forecasting. 7. Use LSTM model to predict stock prices with Keras/TensorFlow. 8. Apply K-Means clustering on customer transaction data. 9. Calculate and visualize Value at Risk (VaR) for a portfolio. 10. Optimize asset allocation using ML-based mean-variance optimization. 11. Backtest a trading strategy using historical stock data. 12. Implement reinforcement learning for portfolio management. 13. Detect financial fraud using anomaly detection techniques. 14. Build a real-time financial dashboard using Streamlit. 15. Mini-project: Develop and evaluate an ML model for a selected finance use case.			

REFERENCE MATERIALS: TEXTBOOKS 1. Yves Hilpisch, “Python for Finance: Mastering Data-Driven Finance”, O’Reilly Media, 2nd Edition, 2018. 2. Marcos Lopez de Prado, “Advances in Financial Machine Learning”, Wiley, 2018. REFERENCES 1. Tucker Balch, “Machine Learning for Trading”, Udacity course materials. 2. David Aronson, “Evidence-Based Technical Analysis”, Wiley, 2006. 3. E. Tsang, “Foundations of Computational Finance with Machine Learning”, Springer, 2021 JOURNALS/MAGAZINES 1. Journal of Financial Data Science 2. Quantitative Finance 3. Journal of Computational Finance SWAYAM/NPTEL/MOOCs: 1. Machine Learning for Engineering and Science Applications 2. Artificial Intelligence: Search Methods for Problem Solving 3 Deep Learning

Course Code: CAI3413	Course Title: Industrial IoT Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces the foundational concepts and applications of the Industrial Internet of Things (IIoT), emphasizing industrial automation, smart manufacturing, and predictive analytics. Students will gain hands-on experience with sensor integration, cloud platforms, and industrial communication protocols necessary for developing and managing IIoT systems.					

Course Objective	To provide practical skills and theoretical knowledge for designing, implementing, and managing Industrial IoT applications in real-world industrial and manufacturing environments.			
Course Outcomes	On successful completion of the course, students will be able to: Understand the architecture and ecosystem of Industrial IoT systems. Integrate sensors and edge devices for real-time industrial data monitoring. Utilize cloud computing and analytics for IIoT-based applications. Apply communication protocols and security mechanisms relevant to industrial environments.			
Course Content:				
Module 1	Introduction to Industrial IoT	Assignment		18[8L+10P] Sessions
Topics: Fundamentals of IoT and IIoT: Definitions, history, evolution, IIoT vs. Consumer IoT, IIoT Architecture Layers: Perception, Network, Middleware, Application Industrial applications: Smart factories, Energy grids, Process automation Introduction to Industry 4.0 and its pillars (Cyber-Physical Systems, Big Data, Cloud Computing), Business benefits and ROI of IIoT deployment Challenges in IIoT: Scalability, legacy systems, interoperability, security, Standards and regulatory compliance in IIoT (ISA-95, ISO/IEC 30141).				
Module 2	Devices and Communication Protocols	Assignment		14[7L+7P] Sessions
Topics: Types of Sensors and Actuators: Environmental, Proximity, Motion, Flow, Vibration, Microcontrollers and Development Boards: Arduino, Raspberry Pi, ESP32, IIoT Gateways and Edge Devices: Intel NUC, Jetson Nano, Communication Technologies: Wired: Modbus RTU, CAN, Ethernet/IP,Wireless: Zigbee, LoRaWAN, Wi-Fi, NB-IoT, Bluetooth LE, Protocols for IIoT:MQTT: Publish-Subscribe Model,OPC-UA: Industrial interoperability and data exchange, CoAP, HTTP/HTTPS,Integration with SCADA and PLC Systems,Device provisioning and configuration management, Network Topologies and Addressing in IIoT environments.				
Module 3	IIoT Data Processing and Analytics	Assignment		14[6L+8P] Sessions
Topics: Data Acquisition: Sampling rate, ADC/DAC, Signal conditioning, Local Storage: SQLite, Edge databases, Stream Processing: Apache Kafka, Apache Flink, Data Preprocessing: Noise reduction, outlier detection, filtering techniques, Introduction to Edge Computing and Fog Computing, Real-time vs. Batch Analytics:Predictive Analytics in Manufacturing:Predictive maintenance models,Failure prediction using historical data,Machine Learning for Sensor Data: Regression, Clustering, Classification,Anomaly Detection				

in Industrial Systems,Data Encryption and Access Control at Edge and Cloud,Security Threats: DDoS, firmware tampering, man-in-the-middle attacks, Best practices for data governance and GDPR compliance				
Module 4	IIoT Cloud Integration and Applications			
Overview of Cloud Computing Models (IaaS, PaaS, SaaS) in IIot, IIoT Cloud Platforms: AWS IoT Core: Device Shadow, Rule Engine, Azure IoT Hub and IoT Central, Google Cloud IoT Core, Device-to-Cloud Communication Models, Storage Solutions: Amazon S3, Azure Blob Storage, InfluxDB, Visualization Tools: Grafana, Power BI, Google Data Studio, Case Studies:Digital Twin of a robotic arm, Smart HVAC system for energy optimization,Real-time supply chain visibility, Building Custom Dashboards and Alerts,Integration with ERP and MES Systems,Final Capstone Project:Design, simulate, and evaluate an end-to-end IIoT system, Include edge device, communication, cloud, analytics, and visualization.				
Project work/Assignment:				
Assignment 1: Sensor Data Acquisition and Visualization Assignment 2: Edge-Based Analytics for Predictive Maintenance Mini Project (Team-based): End-to-End IIoT System for a Smart Industry Scenario				
Setup Raspberry Pi/Arduino for IIoT applications. Interface DHT11, vibration, and ultrasonic sensors. Send sensor data via MQTT to a cloud broker. Create Node-RED dashboards for IIoT data. Build OPC-UA server and client communication. Log and visualize sensor data using Python. Apply edge analytics using Raspberry Pi and filtering techniques. Stream real-time data using Kafka. Integrate with AWS IoT Core for data monitoring. Forecast sensor values using LSTM (predictive maintenance). Detect anomalies in sensor data using Scikit-learn. Connect multiple IIoT devices into a secure network. Simulate a digital twin for a production line. Develop a simple IIoT-based security alert system. Capstone Project: Deploy an end-to-end IIoT prototype for a smart manufacturing scenario.				
REFERENCE MATERIALS: TEXTBOOKS Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.				

Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things, Springer, 2017.

REFERENCES

Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015.

Hakima Chaouchi, The Internet of Things: Connecting Objects, Wiley, 2010.

Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann, 2016.

JOURNALS/MAGAZINES

IEEE Internet of Things Journal
https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6488907
Publishes articles on the design, development, and deployment of IoT applications in industrial settings.

ACM Transactions on Internet of Things (TIOT)
https://dl.acm.org/journal/tiot
Covers architectures, algorithms, and applications related to IoT including edge computing and real-time analytics.

Sensors (MDPI - Special Issue on Industrial IoT)
https://www.mdpi.com/journal/sensors
Features studies on sensor development, wireless communication, and industrial sensor networks.

Journal of Industrial Information Integration (Elsevier)
https://www.sciencedirect.com/journal/journal-of-industrial-information-integration
Focuses on integrating data from industrial systems for smart manufacturing and digital twins.

IEEE Spectrum – IoT and Industry 4.0
https://spectrum.ieee.org/
Publishes accessible articles on cutting-edge tech including IIoT, smart robotics, and industrial AI.

Industrial IoT World – Insights & Reports
https://www.iiot-world.com/
Offers case studies, whitepapers, and expert commentary on real-world IIoT deployments.

Automation World
https://www.automationworld.com/
Covers automation systems, IIoT trends, cloud integration, and edge devices.

Industry 4.0 Magazine (Industry40.today)
https://industry40.today/
Industry-focused magazine offering updates on cyber-physical systems, smart factories, and digital transformation.

Regularly features expert opinion, trends, and technologies including AI in cyber security.

SWAYAM/NPTEL/MOOCs:

NPTEL – Industrial Internet of Things (IIT Kharagpur)

Instructor: Prof. Sudip Misra
https://onlinecourses.nptel.ac.in/noc23_cs69/preview

NPTEL – Introduction to Industry 4.0 and Industrial Internet of Things (IIT Roorkee) Instructor: Prof. Sudeb Dasgupta 📎 https://onlinecourses.nptel.ac.in/noc21_me88/preview ?

Course Code: CAI3414	Course Title: Smart Farming Type of Course: Integrated			L- T-P- C	2	0	2	3
Version No.	1.0							
Course Pre-requisites	CSE2264							
Anti-requisites	NIL							
Course Description	This course introduces the interdisciplinary domain of Smart Farming, integrating IoT, AI, cloud computing, and sensor networks to enable precision agriculture. Students will learn how to design, develop, and deploy data-driven agricultural systems for real-time monitoring, crop management, and decision-making.							
Course Objective	To provide practical and theoretical insights into the application of smart technologies in agriculture, with emphasis on sustainable practices, yield optimization, and automation.							
Course Outcomes	On successful completion of this course, students will be able to: Understand the fundamentals of smart agriculture and its ecosystem. Apply IoT and sensors for environmental and crop monitoring. Analyze agricultural data for predictive insights using AI/ML. Design and deploy smart farming solutions using cloud and mobile platforms.							
Course Content:								
Module 1	Introduction to Smart Farming and Precision Agriculture	Assignment		18[8L+10P] Sessions				
Topics: Evolution from traditional to precision agriculture, Components and architecture of Smart Farming systems, Applications: crop monitoring, irrigation control, pest detection, Overview of remote sensing and satellite-based agriculture, Soil health and weather data integration.								
Module 2	IoT and Sensor Systems in Agriculture	Assignment		14[7L+7P] Sessions				

Topics:

Sensor types: soil moisture, temperature, humidity, pH, NDVI, Microcontrollers: Arduino, ESP32, Raspberry Pi,Wireless communication protocols: LoRa, Zigbee, Wi-Fi, GSM, Energy harvesting and power management for field devices, Edge computing in agriculture.

Module 3	Data Analytics and AI in Agriculture	Assignment		14[6L+8P] Sessions

Topics:

Introduction to agri-data lifecycle, Data preprocessing and anomaly detection, AI/ML techniques: regression, classification, clustering for yield prediction and disease detection,Time series forecasting for rainfall, irrigation, and climate impact, Decision support systems and dashboards.

Module 4	Cloud, Mobile, and Drone Integration			

Cloud platforms for agriculture: ThingSpeak, AWS IoT, Blynk, Azure IoT, Mobile app integration for farmer advisory systems, Role of drones in smart agriculture: aerial imaging, spraying, crop health assessment, Case studies: smart greenhouses, hydroponics, aquaponics, Capstone: End-to-end smart farming system design.

Project work/Assignment:

Assignment 1: Real-Time Crop and Soil Monitoring System

Assignment 2: Crop Yield Prediction using Machine Learning

Mini Project (Team-based): Smart Farm Automation System

List of Lab Tasks :

- Setup Arduino/ESP32 for collecting soil and climate data
- Interface with soil moisture, DHT11, and pH sensors
- Transmit data wirelessly using LoRa or Wi-Fi
- Real-time dashboard for field data (using Blynk/ThingSpeak)
- Predict crop yield using linear regression
- Train an image classifier for leaf disease detection
- Setup automated irrigation control system
- Use GPS for geotagging sensor data
- Drone-based simulation for crop monitoring
- Preprocess and visualize multivariate agri-data using Python
- Connect field devices to cloud platform (AWS IoT or Firebase)
- Alert system for low soil moisture via SMS/email
- Forecast rainfall using time series techniques
- Build a mobile-based decision support system (low-code platform)

? Capstone: Build and present a complete Smart Farm prototype
REFERENCE MATERIALS: TEXTBOOKS ? Rajesh Singh, Anita Gehlot, Bhupendra Singh, Internet of Things and Wireless Sensor Networks in Smart Agriculture, CRC Press, 2021. ? Subhas Chandra Mukhopadhyay, Internet of Things in Smart Agriculture, Springer, 2020. REFERENCES Himanshu Patel, Smart Farming Technologies for Sustainable Agricultural Development, IGI Global, 2020. G. R. Kanagachidambaresan, Internet of Things for Sustainable Community Development, Springer, 2021. IEEE Papers and Reports on Smart Agriculture, Remote Sensing, and Precision Farming JOURNALS/MAGAZINES ? EEE Access – Special Section on Smart Agriculture ? Computers and Electronics in Agriculture (Elsevier) ? Agricultural Systems Journal ? Smart Farming Magazine ? IoT for Agri-Tech (IoT World Today) SWAYAM/NPTEL/MOOCs: ? NPTEL – Introduction to Smart Agriculture (IIT Kanpur) 📎 https://onlinecourses.nptel.ac.in/noc22_ge15/preview ? NPTEL – Applications of IoT in Agriculture (IIT Kharagpur) 📎 https://onlinecourses.nptel.ac.in/noc23_cs91/preview ? Coursera – Smart Agriculture with IoT 📎 https://www.coursera.org/learn/smart-agriculture-iot ?

Course Code: CAI3415	Course Title: AI for Autonomous Systems Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					

Course Description	This course introduces the principles and technologies involved in developing intelligent autonomous systems using Artificial Intelligence. It focuses on perception, decision-making, control systems, and learning-based approaches to build real-time, autonomous agents such as self-driving vehicles, drones, and mobile robots.
Course Objective	To equip students with knowledge and practical skills in using AI techniques to develop safe, adaptive, and intelligent autonomous systems that can sense, plan, and act in dynamic environments.
Course Outcomes	On completion of this course, students will be able to: Understand the architectural components of autonomous systems. Apply computer vision and sensor fusion for environmental perception. Develop path planning and control strategies for autonomous navigation. Implement learning-based models for real-time decision making.

Course Content:

Module 1	Introduction to Autonomous Systems	Assignment		18[8L+10P] Sessions

Definition and types of autonomous systems, Key components: perception, planning, control, learning, Applications: Self-driving cars, drones, mobile robots, AGVs, Architecture of an autonomous system: sensors, actuators, processors, ROS (Robot Operating System) overview, Ethical and safety concerns in autonomy.

Module 2	Perception and Sensor Fusion	Assignment		14[7L+7P] Sessions

Topics:

Sensor types: LiDAR, Radar, Ultrasonic, IMU, GPS, Cameras, Environment mapping: Occupancy grid, SLAM, Visual perception: Object detection (YOLO, SSD), semantic segmentation, Sensor fusion techniques: Kalman filter, EKF, particle filter,Case study: Lane detection using OpenCV

Module 3	Planning and Navigation	Assignment		14[6L+8P] Sessions

Topics:

Path planning algorithms: Dijkstra, A*, RRT, D*, Obstacle avoidance: Dynamic Window Approach, Potential Fields, Localization: Monte Carlo Localization, Graph-based SLAM,Trajectory generation and smoothing,Behavior trees and state machines for task execution,Indoor vs. outdoor navigation.

Module 4	Learning-based Control and Decision Making			

Reinforcement learning: Q-learning, Deep Q-Networks, Policy-based learning and imitation learning, Decision making under uncertainty (Markov Decision Processes)Learning from simulation (Gazebo, CARLA,

Webots), Edge AI deployment for low-latency inference, Case studies: Autonomous driving stack, warehouse robot planner.
Project work/Assignment:
Assignment 1: Object Detection and Lane Tracking System Assignment 2: Path Planning Simulator Mini Project (Team-based): Autonomous System Prototype
List of Lab Tasks (15 Labs): Simulate a differential drive robot in ROS Interface camera and distance sensors with Raspberry Pi Perform object detection using pre-trained YOLOv5 Apply color-based segmentation for road/lane detection Fuse GPS and IMU data using a Kalman filter Build a simple SLAM model using GMapping or Cartographer Implement obstacle avoidance using LiDAR data Visualize path planning using A* on a grid map Simulate autonomous vehicle in CARLA/Gazebo Implement PID control for motor speed regulation Train a reinforcement learning agent to navigate a maze Deploy a TensorFlow Lite model for edge object recognition Evaluate decision trees for robotic task selection Use OpenCV to detect traffic signs and lights Capstone: Build and test a mini autonomous robot prototype
REFERENCE MATERIALS: TEXTBOOKS Raj Madhavan, Autonomous Systems: Issues and Challenges, Springer, 2021 Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer, 2017 REFERENCES Sebastian Thrun et al., Probabilistic Robotics, MIT Press, 2005 Benjamin Kuipers, Principles of Intelligent Autonomous Systems, MIT Press, 2016 Deepak Khemani, A First Course in Artificial Intelligence, McGraw-Hill, 2013 JOURNALS/MAGAZINES IEEE Transactions on Robotics

Journal of Field Robotics (Wiley)

Autonomous Robots (Springer)

IEEE Transactions on Intelligent Vehicles

SWAYAM/NPTEL/MOOCs:

NPTEL – Robotics: Perception, Planning and Control (IIT Kanpur)
📎 https://onlinecourses.nptel.ac.in/noc21_ee68/preview

NPTEL – Artificial Intelligence: Search Methods for Problem Solving (IIT Madras)
📎 https://onlinecourses.nptel.ac.in/noc21_cs53/preview

Self-Driving Cars Specialization (University of Toronto)
📎 https://www.coursera.org/specializations/self-driving-cars

Course Code: CAI3416	Course Title: Edge Computing Type of Course: Integrated	L- T-P- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces the fundamentals of edge computing, an emerging paradigm that enables data processing and analytics at the network's edge. It covers system architecture, communication protocols, edge AI, and real-time applications with a hands-on approach using edge devices.					
Course Objective	To equip students with knowledge and skills in designing and deploying edge computing systems that offer low-latency, energy-efficient, and scalable solutions for real-time and distributed applications.					
Course Outcomes	After successful completion, students will be able to: Explain the principles and architecture of edge computing systems. Develop and deploy applications on edge devices like Raspberry Pi, Jetson Nano, etc. Integrate edge computing with IoT, cloud, and AI systems. Analyze and optimize performance of edge-based applications.					
Course Content:						

Module 1	Introduction to Edge Computing	Assignment		18[8L+10P] Sessions

Topics:

Evolution from cloud to fog to edge, Edge computing architecture: core, edge, and device layers, Use cases: smart cities, industrial automation, healthcare, autonomous systems, Edge vs. Cloud: latency, bandwidth, privacy, scalability, Edge device overview: Raspberry Pi, Nvidia Jetson, Coral Dev Board

Module 2	Edge Devices and Communication	Assignment		14[7L+7P] Sessions

Topics:

Edge device setup and configuration, Operating systems: Raspbian, Ubuntu Core, Yocto, Edge and fog networking protocols: MQTT, CoAP, 6LoWPAN, Containerization with Docker at the edge, Device orchestration and provisioning, Energy and resource management in constrained devices.

Module 3	Edge AI and Analytics	Assignment		14[6L+8P] Sessions

Topics:

Edge AI: Concepts and advantages, Lightweight ML frameworks: TensorFlow Lite, ONNX, OpenVINO, Model quantization and compression for deployment, Real-time data processing and event-based analytics, Case studies: object detection, audio classification, sensor fusion, Ethical considerations and security at the edge

Module 4	Edge-Cloud Integration and Applications			

Edge-to-cloud communication pipelines, AWS Greengrass, Azure IoT Edge, Google Edge TPU, Microservices and serverless architecture on the edge, Industrial edge computing with OPC-UA and Modbus, Building dashboards for edge data insights, Capstone: End-to-end edge system for real-world application.

Project work/Assignment:

Assignment 1: IoT Data Stream Processing at the Edge

Assignment 2: Edge AI Inference Deployment

Mini Project (Team-based): Real-World Edge Solution

List of Lab Tasks :

Setting up Raspberry Pi or Jetson Nano for edge deployment

Installing and configuring Docker on an edge device

Connecting sensors (camera, DHT11, ultrasonic) to edge devices

Building and running MQTT-based data pipeline

Collecting and visualizing data using Node-RED or Grafana

Edge inference using TensorFlow Lite object detection model

Deploying ONNX model for sensor-based classification

Streaming video analytics at the edge

Building a containerized AI service on the edge

Edge-to-cloud integration using AWS Greengrass or Azure IoT Edge

Monitoring resource usage on constrained devices

Detecting anomalies in time-series data at the edge

Designing a simple mobile dashboard to view edge insights

Security setup: HTTPS, authentication, and encryption

Capstone: Build a complete edge-to-cloud application prototype.

REFERENCE MATERIALS:

TEXTBOOKS

Perry Lea, Edge Computing: From Hype to Reality, Packt Publishing, 2020

Mahmoud Tawfik, Edge Computing and Internet of Things for Smart Agriculture, Springer, 2021

REFERENCES

Satyanarayanan M., The Emergence of Edge Computing, IEEE Computer, 2017

Flavio Bonomi et al., Fog Computing and Its Role in the Internet of Things, MCC Workshop, ACM 2012

OpenFog Consortium Architecture White Paper, 2017

JOURNALS/MAGAZINES

IEEE Internet of Things Journal

ACM Transactions on Internet Technology (TOIT)

IEEE Edge Computing Magazine

Elsevier Future Generation Computer Systems – Special Issues on Edge Computing

SWAYAM/NPTEL/MOOCs:

NPTEL – Cloud Computing and Distributed Systems (IIT Kharagpur)
https://onlinecourses.nptel.ac.in/noc22_cs62/preview

NPTEL – Internet of Things (IIT Kharagpur)
https://onlinecourses.nptel.ac.in/noc21_cs60/preview

Coursera – Edge AI and Computer Vision (Intel + OpenVINO)
https://www.coursera.org/learn/introduction-to-edge-ai

Course Code: CAI3417	Course Title: Cognitive Computing Type of Course: Integrated	L- T-P- C				

			2	0	2	3

Version No.	1.0
Course Pre-requisites	CSE2264
Anti-requisites	NIL
Course Description	This course explores the interdisciplinary domain of Cognitive Computing, inspired by the human brain's capability to reason, learn, and interact naturally. Students will study the fundamentals of cognitive systems, natural language processing, machine learning, and AI-driven decision-making, with a focus on building intelligent applications using IBM Watson, transformers, and cognitive APIs.
Course Objective	To understand the principles of cognitive systems and their architecture To explore the components of natural language understanding and reasoning To apply AI and ML models in cognitive tasks such as Q&A, dialogue, and speech To implement and evaluate real-world cognitive applications
Course Outcomes	Upon successful completion, students will be able to: Explain the structure and functioning of cognitive computing systems Apply NLP and ML techniques to build cognitive applications Use cognitive computing APIs for speech, vision, and language understanding Develop intelligent solutions using IBM Watson and other platforms

Course Content:

Module 1	Introduction to Cognitive Computing	Assignment		18[8L+10P] Sessions

Topics:

Definition and evolution of cognitive computing, Cognitive architecture: perception, reasoning, learning, decision-making, Differences between traditional AI and cognitive systems, Applications in healthcare, finance, education, and law.

Module 2	Machine Learning in Cognitive Systems	Assignment		14[7L+7P] Sessions

Topics:

Supervised, unsupervised, and reinforcement learning basics, Neural networks and deep learning, Introduction to cognitive frameworks (IBM Watson, Microsoft Azure AI, Google AI), Cognitive APIs for image, speech, and text processing

Module 3	Natural Language	Assignment		14[6L+8P]

<table>
<tr><td></td><td>Processing and Understanding</td><td></td><td></td><td>Sessions</td></tr>
<tr><td colspan="5">Topics:

Language modeling, tokenization, stemming, lemmatization, Sentiment analysis, named entity recognition (NER), and summarization, Conversational AI: chatbots and voice assistants, Transformer models: BERT, GPT, and question answering systems.</td></tr>
<tr><td>Module 4</td><td>Building Cognitive Applications</td><td>Assignment</td><td></td><td>14[6L+8P]

Sessions</td></tr>
<tr><td colspan="5">Topics:

Knowledge representation and reasoning, Integrating cognitive APIs (speech-to-text, text-to-speech, visual recognition), Ethical considerations and trust in cognitive systems, Cognitive services deployment and case studies.</td></tr>
<tr><td colspan="5">List of Lab Tasks

Lab 1: Introduction to Cognitive Computing Platforms
Objective: Explore IBM Watson and Azure Cognitive Services
Task: Register and configure accounts for cloud-based cognitive tools
Activity: Build a simple "Hello Cognitive World" app</td></tr>
<tr><td colspan="5">Lab 2: Sentiment Analysis using IBM Watson NLP API
Objective: Analyze emotional tone of user-generated content
Task: Use Watson’s NLP API to detect sentiment
Activity: Visualize sentiment trends in tweets or reviews</td></tr>
<tr><td colspan="5">Lab 3: Named Entity Recognition using spaCy
Objective: Extract key entities from text
Task: Identify names, places, and organizations
Activity: Highlight named entities using Python and spaCy</td></tr>
<tr><td colspan="5">Lab 4: Speech-to-Text using Google Cloud API
Objective: Convert speech input into text
Task: Use Google Cloud Speech API
Activity: Transcribe audio files with speaker diarization</td></tr>
<tr><td colspan="5">Lab 5: Text-to-Speech using IBM Watson TTS
Objective: Generate human-like speech from text
Task: Convert user input to spoken voice
Activity: Play synthesized speech in a web app</td></tr>
<tr><td colspan="5">Lab 6: Build a Visual Recognition App
Objective: Identify objects in images</td></tr>
</table>

Task: Use IBM Watson Visual Recognition API Activity: Upload image and detect labels or tags
Lab 7: Design a Conversational Chatbot with Dialogflow Objective: Implement intent-based conversation flow Task: Create intents, entities, and responses Activity: Deploy chatbot on a web interface
Lab 8: Question Answering with Transformers Objective: Use BERT to answer questions based on context Task: Load pre-trained model and context documents Activity: Ask and receive accurate answers using Hugging Face
Lab 9: Create a Knowledge Graph using Neo4j Objective: Represent relationships among entities Task: Build and query knowledge graphs Activity: Visualize connections in graph format
Lab 10: Sentiment Classification with LSTM Objective: Classify text as positive/negative Task: Train LSTM model for binary sentiment Activity: Evaluate with accuracy and confusion matrix
Lab 11: Image Captioning with CNN-RNN Architecture Objective: Generate captions for images Task: Integrate image features and text generation Activity: Display image and generate natural description
Lab 12: Facial Expression Recognition using OpenCV Objective: Detect and classify facial emotions Task: Use emotion classification models Activity: Real-time expression detection from webcam
Lab 13: Design a Voice Assistant using Python Objective: Enable basic voice interaction Task: Use speech recognition and TTS Activity: Query weather, date, and time via voice
Lab 14: Ethical Use of Cognitive Computing Tools Objective: Understand ethical AI deployment

Task: Analyze bias and fairness in models
Activity: Present case studies on responsible AI

Lab 15: Capstone Project – Build a Multi-Modal Cognitive App
Objective: Integrate speech, vision, and language
Task: Develop a chatbot with voice and visual recognition
Activity: Demonstrate and document full application pipeline

REFERENCE MATERIALS

TEXTBOOKS

Judith Hurwitz, Marcia Kaufman, Cognitive Computing and Big Data Analytics, Wiley, 2015

Rajiv Mathur, Cognitive Computing: Theory and Applications, CRC Press, 2022

REFERENCE BOOKS

Rob High, The Era of Cognitive Systems: An Inside Look at IBM Watson and How it Works, IBM Redbooks

Adnan Masood, Cognitive Computing Recipes: AI and Machine Learning Applications Using IBM Watson, Apress, 2019

Sebastian Raschka, Natural Language Processing with Transformers, O'Reilly, 2021

JOURNALS / MAGAZINES

IEEE Intelligent Systems

ACM Transactions on Interactive Intelligent Systems (TIIS)

Cognitive Computation (Springer)

Journal of Artificial Intelligence Research (JAIR)

SWAYAM / NPTEL / MOOCs

NPTEL – Deep Learning for Computer Vision (IIT Hyderabad)
https://nptel.ac.in/courses/106106231

Coursera – Introduction to IBM Watson (IBM)
https://www.coursera.org/learn/ai-watson

edX – IBM Applied AI: Cognitive Services
https://www.edx.org/professional-certificate/ibm-applied-artificial-intelligence

Course Code: CAI3418	Course Title: Geospatial Data Analytics Type of Course: Integrated	L- T-P- C				

			2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces the fundamentals of geospatial data and spatial analysis using modern analytical tools and technologies. It focuses on acquiring, visualizing, processing, and analyzing geographic data to extract meaningful patterns. Applications include urban planning, environmental monitoring, remote sensing, and location-based services.					
Course Objective	To understand the fundamentals of geospatial data and coordinate systems To perform spatial data processing and analysis using GIS tools To visualize geospatial data using mapping libraries and dashboards To apply machine learning and statistical models to spatial datasets					
Course Outcomes	Upon successful completion of this course, students will be able to: Work with different types of geospatial data and formats Perform spatial analysis and geoprocessing Build visualizations using GIS platforms and Python libraries Apply geospatial techniques for problem-solving in real-world scenarios					
Course Content:						

Module 1	Introduction to Geospatial Data and GIS	Assignment		18[8L+10P] Sessions
Topics: Basics of geospatial data: raster vs vector, Coordinate reference systems (CRS) and map projections, GIS architecture and components, Geospatial data sources: satellite, drone, GPS, open data.				
Module 2	Geospatial Data Handling and Visualization	Assignment		14[7L+7P] Sessions
Topics: Shapefiles, GeoJSON, and TIFF formats, Loading and manipulating geospatial data with GeoPandas, Map visualizations with Folium, Kepler.gl, and Plotly, Spatial joins, clipping, filtering, and reprojection				

Module 3	Spatial Analysis and Remote Sensing	Assignment		14[6L+8P] Sessions
Topics: Overlay operations, buffering, and geoprocessing, Raster analysis using rasterio, Remote sensing concepts and multispectral image analysis, NDVI, LST, and change detection from satellite images.				
Module 4	Applications and Machine Learning in Geospatial Analytics	Assignment		14[6L+8P] Sessions
Topics: Spatial clustering and hotspot analysis, Geospatial ML: land cover classification, object detection, Time series and spatiotemporal data analysis, Case studies in disaster management, urban planning, and climate monitoring.				

List of Lab Tasks

Lab 1: Introduction to QGIS and Map Projections
Objective: Understand GIS interface and coordinate systems
Tasks: Load vector data and explore CRS
Activity: Visualize administrative boundaries and reproject layers

Lab 2: Handle Vector Data using GeoPandas
Objective: Load and manipulate shapefiles in Python
Tasks: Read, filter, and plot shapefile data
Activity: Analyze India's state-level boundaries using GeoPandas

Lab 3: Perform Spatial Joins and Buffering
Objective: Learn spatial joins and geoprocessing
Tasks: Combine population and boundary datasets
Activity: Create buffer zones around city centers

Lab 4: Visualize Maps using Folium and Kepler.gl
Objective: Create interactive maps
Tasks: Generate heatmaps and choropleth maps
Activity: Visualize crime or COVID-19 data on an interactive map

Lab 5: Work with Raster Data using Rasterio
Objective: Read and manipulate satellite imagery
Tasks: Load and clip raster images
Activity: Display elevation or vegetation maps

Lab 6: Calculate NDVI from Satellite Images Objective: Perform vegetation index analysis Tasks: Use Red and NIR bands to compute NDVI Activity: Visualize vegetation cover changes
Lab 7: Geocoding and Reverse Geocoding Objective: Convert addresses to coordinates Tasks: Use Geopy and Google Maps API Activity: Geocode location list and map them
Lab 8: Perform Land Use Classification using K-Means Objective: Apply clustering to satellite images Tasks: Use unsupervised learning on raster data Activity: Classify urban vs green areas
Lab 9: Detect Change over Time in Remote Sensing Data Objective: Analyze temporal changes Tasks: Compare satellite images from different years Activity: Detect urban expansion or deforestation
Lab 10: Build Dashboard using Plotly and Dash Objective: Create an interactive geospatial dashboard Tasks: Combine charts and maps Activity: Display flood zones with demographic data
Lab 11: Perform Hotspot and Cluster Analysis Objective: Identify spatial patterns Tasks: Use DBSCAN or Getis-Ord Gi* statistic Activity: Detect crime or disease hotspots
Lab 12: Integrate GPS Data for Route Mapping Objective: Process and visualize GPS tracks Tasks: Load GPX/CSV files and plot paths Activity: Analyze cycling or delivery routes
Lab 13: Apply Spatial Regression Models Objective: Model spatial relationships Tasks: Fit spatial autoregression (SAR) or GWR Activity: Predict housing prices based on location

Lab 14: Use Google Earth Engine for Remote Sensing Analysis
Objective: Access cloud-based satellite processing
Tasks: Load and analyze Sentinel/Landsat data
Activity: Monitor water bodies or land surface temperature

Lab 15: Capstone – Geospatial Data Analytics Project
Objective: Apply geospatial techniques to a real dataset
Tasks: Perform end-to-end analysis
Activity: Present findings via dashboard or report

REFERENCE MATERIALS

TEXTBOOKS

Paul Longley et al., Geographic Information Systems and Science, Wiley, 4th Edition, 2015

Bolstad, Paul, GIS Fundamentals: A First Text on Geographic Information Systems, Eider Press, 6th Edition, 2019

REFERENCE BOOKS

Michael Dorman, Spatial Data Analysis in Python, Manning Publications, 2023

Andrew Cutts, Geospatial Analysis: A Comprehensive Guide, Winchelsea Press

Bonny P. McClain, Mastering Geospatial Analysis with Python, Packt Publishing, 2022

JOURNALS / MAGAZINES

International Journal of Geographical Information Science

Remote Sensing of Environment

Journal of Spatial Information Science

GIScience & Remote Sensing

SWAYAM / NPTEL / MOOCs

NPTEL – Introduction to GIS (IIT Roorkee)
https://nptel.ac.in/courses/105107120

Coursera – Geospatial and Environmental Analysis (UC Davis)
https://www.coursera.org/learn/environmental-analysis

edX – Geospatial Data Science and Applications (Tsinghua University)
https://www.edx.org/course/geospatial-data-science

Google Earth Engine Tutorials
https://developers.google.com/earth-engine/tutorials

Course Code: CAI3419	Course Title: AI for energy consumption optimization Type of Course: Integrated	L- T-P- C	2	0	2	3

Version No.	1.0			
Course Pre-requisites	CSE2264			
Anti-requisites	NIL			
Course Description	This course provides an in-depth study of how artificial intelligence can be leveraged to optimize energy consumption across various domains such as smart buildings, industrial systems, smart grids, and renewable energy. Students will learn how to use machine learning and deep learning models to analyze consumption data, predict future usage, and automate control for improved efficiency and sustainability.			
Course Objective	This course aims to impart practical knowledge in applying AI methods for optimizing energy usage, with a focus on reducing energy waste, maximizing efficiency, and integrating sustainable technologies through experiential learning.			
Course Outcomes	Course Outcomes On successful completion of this course, students will be able to: Understand the fundamentals of energy consumption systems and optimization methods. (Understand) Apply AI models to forecast and control energy usage. (Apply) Analyze and derive insights from energy data for efficient decision-making. (Analyze) Design intelligent energy optimization systems using modern AI tools. (Create)			
Course Content:				
Module 1	Introduction to Energy Systems and Optimization	Assignment		18[8L+10P] Sessions
Topics: Basics of energy generation, transmission, and consumption,Key challenges in energy optimization, Overview of smart energy systems and IoT integration,Fundamentals of optimization: cost, usage, scheduling				
Module 2	Machine Learning for Energy Forecasting	Assignment		14[7L+7P] Sessions
Topics: Energy datasets and data preprocessing, Regression techniques for load and usage prediction, Time-series modeling with ARIMA and LSTM, Evaluation metrics and model selection				
Module 3	Deep Learning and	Assignment		14[6L+8P]

	Reinforcement Learning for Energy Control			Sessions
Topics: Neural networks for pattern recognition in energy data, Deep learning for anomaly detection, Reinforcement learning for energy-efficient control systems, AI in smart HVAC and lighting systems				
Module 4	Applications and Emerging Trends	Assignment		14[6L+8P] Sessions
Topics: AI in smart homes and smart cities,Integration with renewable energy sources, Case studies: AI in smart grids, buildings, and industry, Future trends: Edge AI, Federated learning in energy networks				
Project work/Assignment:				
Develop a forecasting model for household energy optimization,Implement an RL-based agent to control energy consumption in a simulated environment, Design a smart energy dashboard with real-time analytics				
List of Lab Tasks: Lab 1: Load and explore energy consumption datasets (e.g., UCI, OpenEI) Lab 2: Clean and preprocess data for modeling Lab 3: Build a linear regression model for consumption forecasting Lab 4: Apply decision tree and random forest for energy classification Lab 5: Implement an ARIMA model for time-series analysis Lab 6: Develop a deep learning (LSTM) model for energy prediction Lab 7: Perform anomaly detection on smart meter data Lab 8: Develop a clustering model to group usage patterns Lab 9: Design a dashboard for visualizing real-time and historical energy data Lab 10: Build a rule-based control system for smart appliances Lab 11: Implement Q-learning for controlling a simulated thermostat Lab 12: Reinforcement learning for lighting system optimization Lab 13: Forecast solar energy generation using weather and usage data Lab 14: Combine IoT data with AI models for intelligent decision-making Lab 15: Final capstone: Smart energy optimization prototype using AI				

REFERENCE MATERIALS TEXTBOOKS Abhishek Kumar, Machine Learning and Data Science in the Energy Sector, Wiley, 2022. Peter Palensky et al., Energy Informatics: Fundamentals and Applications, Springer, 2021. REFERENCES Soteris Kalogirou, Artificial Intelligence in Energy and Renewable Energy Systems, Nova Science Publishers, 2013. Klaus-Dieter Thoben et al., AI Methods for Smart Energy Systems and Industry 4.0, Springer, 2020. Subramanian Vadari, Smart Grid Redefined: Transformation of the Electric Utility, CRC Press, 2020. JOURNALS / MAGAZINES IEEE Transactions on Smart Grid Energy and AI (Elsevier) Renewable & Sustainable Energy Reviews SWAYAM/NPTEL/MOOCs NPTEL – Smart Grid Technology by IIT Kharagpur Coursera – AI for Energy edX – Data Science and Machine Learning for Energy Systems

Course Code: CAI3420	Course Title: Bio Medical Informatics Type of Course: Integrated	L- P- T-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces students to Bio Medical Informatics. The focus is on understanding domain-specific data and AI methods applicable to healthcare. The course includes both theoretical and practical components that prepare students for real-world applications in the health sector.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.					

Course Out Comes	On successful completion of the course the students shall be able to: On successful completion of the course the students shall be able to: CO1: Describe the scope and importance of Bio Medical Informatics. [Understand] CO2: Identify and pre-process health-related data for analysis. [Apply] CO3: Build intelligent models to support medical diagnostics or analytics. [Apply] CO4: Evaluate AI models for performance and reliability in healthcare. [Analyze] CO5: Design ethical, efficient AI-based systems for healthcare applications. [Create]			
Course Content:				
Module 1	Introduction to Bio Medical Informatics	Assignment	Program activity	22 Hours
This module introduces the fundamental concepts of Bio Medical Informatics, outlining its scope and significance in modern healthcare. Students will learn about the different types of biomedical data including structured, semi-structured, and unstructured formats. The role of information systems such as Electronic Health Records (EHRs) and medical standards like ICD, SNOMED CT, and HL7 will be discussed. The application of data science and AI in areas such as diagnostics, treatment planning, and clinical workflows will be explored through real-world use cases. This module sets the foundation for understanding how informatics bridges technology and medicine.				
Module 2	Data collection, preprocessing techniques and AI model design	Assignment	Program activity	22 Hours s
In this module, the focus shifts to data acquisition and preprocessing techniques essential for biomedical data analysis. Students will explore various data collection methods used in healthcare, including clinical trials, IoT-based sensors, and surveys. Key topics include data cleaning, integration of heterogeneous sources, handling missing values, and feature engineering for biomedical signals and images. Privacy concerns and de-identification practices in patient data will also be addressed. Practical exposure to preprocessing tools and techniques will prepare students for effective data handling in real-world scenarios.				
Module 3	Model training, validation, interpretation, and performance metric	Assignment	Program activity	18 Hours
This module delves into the application of machine learning algorithms within the biomedical context. Students will implement supervised learning methods such as logistic regression, decision trees, and support vector machines, along with unsupervised techniques like clustering for patient stratification. Emphasis will be placed on performance evaluation using metrics tailored to healthcare (e.g., sensitivity, specificity, AUC). Techniques for improving model robustness, including cross-validation and model interpretability tools like SHAP and LIME, will be discussed. Real-life datasets will be used to build disease prediction models, offering insights into practical implementation challenges.				
Module 4	Deployment, ethics in AI for healthcare, and case studies	Assignment	Program activity	13 Hours

The final module focuses on deploying AI models in clinical environments and understanding the ethical, legal, and social implications of Bio Medical Informatics. Students will learn about lightweight deployment tools such as Flask and Streamlit for building user interfaces and dashboards. Case studies on clinical decision support systems (CDSS) will illustrate the integration of AI into healthcare systems. The module also explores recent trends such as personalized medicine, genomic data analysis, and the role of AI in epidemiology. Ethical dilemmas, bias mitigation, and fairness in AI applications are also critically examined to ensure responsible use of technology in healthcare.
List of Lab Tasks: Lab Sheet 1: Introduction to healthcare datasets using Python; Data visualization using matplotlib and seaborn Lab Sheet 2: Data cleaning techniques; Feature selection methods for health data Lab Sheet 3: Logistic regression for disease prediction; Evaluate with confusion matrix Lab Sheet 4: Decision trees and random forests; Cross-validation comparisons Lab Sheet 5: Clustering with K-means; Hierarchical clustering Lab Sheet 6: Time series forecasting with ARIMA; Anomaly detection Lab Sheet 7: Genomic sequence preprocessing; Feature extraction Lab Sheet 8: Medical image preprocessing; CNN classification (e.g., chest X-rays) Lab Sheet 9: NLP on clinical notes; Named Entity Recognition Lab Sheet 10: SHAP/LIME interpretability; Deployment with Flask/Streamlit Lab Sheet 11: Dashboard design; Integration with cloud or mobile apps Lab Sheet 12: Bias detection and mitigation Lab Sheet 13: COVID-19 case study; Real-time data visualizatio
Targeted Application & Tools that can be used Python, scikit-learn, pandas, matplotlib, seaborn, Jupyter, TensorFlow/PyTorch, Streamlit

Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Adam Bohr & Kaveh Memarzadeh – Artificial Intelligence in Healthcare, Academic Press, 2020 T2: Kevin Franks – Machine Learning for Healthcare, Apress, 2022
References R1: Recent journal articles from IEEE, Nature, and PubMed R2: Online materials from NPTEL, CourseraWeb resources:
Topics relevant to development of “Skill Development”: Health informatics, AI modeling, data analytics Topics relevant to development of “Environment and sustainability: Public health data analysis, epidemiology

Course Code: CAI3421	Course Title: Intelligent System for Disease Prediction and Drug Discovery Type of Course: Integrated	L- P- T-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course provides in-depth understanding and hands-on exposure to advanced techniques in Intelligent System for Disease Prediction and Drug Discovery. It aims to enhance technical skills for solving complex problems in healthcare using AI.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: On successful completion of the course the students shall be able to: CO1: Describe the scope and role of intelligent systems in disease prediction and drug discovery. [Understand]					

	CO2: Identify and prepare relevant clinical and molecular data for AI model development. [Apply] CO3: Build machine learning and deep learning models for disease prediction and drug target identification. [Apply] CO4: Evaluate the effectiveness of AI models using appropriate metrics in healthcare settings. [Analyze] CO5: Design and propose intelligent, ethical systems for real-world clinical and pharmaceutical applications. [Create]			
Course Content:				
Module 1	Fundamentals of Intelligent Systems in Healthcare	Assignment	Program activity	22 Hours
This module introduces students to the fundamentals of intelligent systems and their significance in disease prediction and drug discovery. It covers knowledge-based systems, expert systems, and decision support systems with examples from clinical settings. Students learn how AI mimics human reasoning for healthcare applications and the use of knowledge engineering in rule-based diagnosis.				
Module 2	Data-Driven Approaches in Disease Prediction	Assignment	Program activity	22 Hours s
The focus here is on data-driven intelligent systems using machine learning and deep learning. It covers data acquisition from clinical databases, molecular and drug databases, and preprocessing techniques suitable for biological data. Techniques for classifying disease patterns and identifying drug targets using AI are discussed.				
Module 3	AI in Computational Drug Discovery	Assignment	Program activity	18 Hours
This module delves into computational drug discovery, covering ligand-based and structure-based approaches. Students explore QSAR modeling, molecular docking, and neural networks for compound activity prediction. Ethical concerns and challenges in in-silico trials are also introduced.				
Module 4	Integration and Applications in Clinical Workflows	Assignment	Program activity	13 Hours
The final module addresses the integration of intelligent systems in clinical workflows and pharmaceutical research. Topics include AI-based platforms for precision medicine, clinical validation, regulatory compliance, and case studies on successful AI-driven drug discovery pipelines.				
List of Lab Tasks: Lab Sheet 1 Level 1: Introduction to healthcare and molecular datasets				

Level 2: Data loading and exploration using Python (pandas, NumPy)

Lab Sheet 2

Level 1: Data cleaning and preprocessing (missing values, normalization)

Level 2: Feature selection for clinical and drug datasets

Lab Sheet 3

Level 1: Implementation of classification models (Logistic Regression, Decision Trees)

Level 2: Model evaluation using confusion matrix and ROC-AUC

Lab Sheet 4

Level 1: Application of deep learning models for disease prediction

Level 2: Hyperparameter tuning and performance comparison

Lab Sheet 5

Level 1: Introduction to molecular representations (SMILES, fingerprints)

Level 2: Compound similarity calculation and clustering

Lab Sheet 6

Level 1: QSAR modeling using regression techniques

Level 2: Interpretation of chemical descriptors and activity prediction

Lab Sheet 7

Level 1: Structure-based drug discovery: basics of molecular docking

Level 2: Running docking simulations using open-source tools (e.g., AutoDock)

Lab Sheet 8

Level 1: Development of a basic rule-based expert system for disease diagnosis

Level 2: Knowledge base and inference engine simulation

Lab Sheet 9

Level 1: Data visualization with seaborn and matplotlib

Level 2: Creating dashboards to visualize model predictions

Lab Sheet 10

Level 1: Ethical case study analysis in AI-driven healthcare

Level 2: Design of fairness-aware AI models for drug discovery

Lab Sheet 11–15

Capstone mini-project development based on real-world data

Includes problem definition, data handling, model building, evaluation, and report writing

Targeted Application & Tools that can be used Python, scikit-learn, pandas, matplotlib, seaborn, Jupyter, TensorFlow/PyTorch, Streamlit
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Adam Bohr & Kaveh Memarzadeh – Artificial Intelligence in Healthcare, Academic Press, 2020 T2: Kevin Franks – Machine Learning for Healthcare, Apress, 2022
References R1: Krittanawong, C., Johnson, K.W., Rosenson, R.S., et al. Deep learning for cardiovascular medicine: A practical primer. European Heart Journal, 2020. R2: Ekins, S., Puhl, A.C., Zorn, K.M., et al. Exploiting machine learning for end-to-end drug discovery and development. Nature Materials, 2019. R3: Topol, E. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again. Basic Books, 2019. Web resources: R4: NPTEL Course – AI for Drug Discovery and Healthcare, https://nptel.ac.in R5: Coursera Specialization – AI in Healthcare Specialization, Stanford University, https://coursera.org
Topics relevant to development of “Skill Development”: Development of classification and regression models Topics relevant to development of “Environment and sustainability: Reduction of animal testing through AI-based drug screening and in-silico trials

Course Code: CAI3422	Course Title: AI for Medical Imaging Type of Course: Integrated	L- P- T- C	2	0	2	3
Version No.	1.0					

Course Pre-requisites	CSE2264			
Anti-requisites	NIL			
Course Description	This course focuses on applying artificial intelligence and deep learning to medical image analysis. Students will explore medical imaging modalities, preprocessing techniques, computer vision models, and deployment strategies. Emphasis is placed on real-world applications such as disease diagnosis, image segmentation, and anomaly detection.			
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques..			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe different medical imaging modalities and AI applications. [Understand] CO2: Preprocess and annotate medical images for AI pipelines. [Apply] CO3: Build and train computer vision models for disease detection. [Apply] CO4: Evaluate performance of AI models using imaging metrics. [Analyze] CO5: Design and deploy ethical and explainable AI solutions in medical imaging. [Create]			
Course Content:				
Module 1	Medical Imaging Modalities and Preprocessing	Assignment	Program activity	22 Hours
This module covers the foundations of medical imaging modalities such as X-rays, CT, MRI, and ultrasound. Students are introduced to DICOM formats, imaging physics, and image acquisition principles. The importance of image preprocessing for AI applications is emphasized.				
Module 2	Deep Learning for Image Analysis	Assignment	Program activity	22 Hours s
Focus is placed on computer vision and deep learning techniques in imaging. Key concepts include convolutional neural networks (CNNs), image segmentation, classification, and detection. Hands-on exercises include building image classification models for disease identification.				
Module 3	Advanced Imaging Techniques and Evaluation	Assignment	Program activity	18 Hours
Advanced topics such as 3D imaging, multi-modal fusion, and transfer learning are covered. Students also explore annotation tools, dataset creation, and model performance metrics like Dice coefficient and IoU.				

Module 4	Deployment and Real-world Applications	Assignment	Program activity	13 Hours
This module discusses AI deployment in radiology workflows, regulatory and ethical considerations, and real-world implementation. Use cases like tumor detection, fracture analysis, and pneumonia prediction are analyzed for impact and accuracy.				

List of Lab Tasks:

Lab Sheet 1

Level 1: Loading and visualizing medical images (DICOM, PNG, JPEG) using Python libraries (e.g., pydicom, OpenCV)

Level 2: Image enhancement techniques such as histogram equalization, denoising, and contrast adjustment

Lab Sheet 2

Level 1: Image annotation using tools like LabelImg or CVAT

Level 2: ROI (Region of Interest) extraction and mask creation for segmentation tasks

Lab Sheet 3

Level 1: Building a basic Convolutional Neural Network (CNN) for classifying binary medical images

Level 2: Fine-tuning pretrained models (e.g., VGG16, ResNet) on a labeled medical image dataset

Lab Sheet 4

Level 1: Semantic segmentation using U-Net architecture

Level 2: Evaluation using IoU and Dice coefficient

Lab Sheet 5

Level 1: Multi-class classification with medical datasets (e.g., chest X-ray with normal, pneumonia, COVID-19 labels)

Level 2: Performance evaluation using confusion matrix, sensitivity, specificity, and ROC-AUC

Lab Sheet 6

Level 1: Heatmap generation for explainability using Grad-CAM

Level 2: Visual interpretation of model decisions in medical diagnosis

Lab Sheet 7

Level 1: 3D image visualization using volumetric data (CT/MRI) with SimpleITK

Level 2: Slice-wise analysis and conversion between formats (e.g., NIfTI to PNG)

Lab Sheet 8

Level 1: Building a simple web interface using Streamlit for AI-based image diagnosis

Level 2: Deployment and testing of the model in the interface

Lab Sheet 9

Level 1: Comparative study of model performance with and without data augmentation Level 2: Real-world use case: early detection of breast cancer using mammography Lab Sheet 10 Capstone Project: End-to-end implementation of an AI model for a medical imaging problem (e.g., lung opacity classification, brain tumor segmentation, or fracture detection
Targeted Application & Tools that can be used Programming Language: Python Deep Learning Frameworks: TensorFlow, Keras, PyTorch Computer Vision Libraries: OpenCV, PIL (Python Imaging Library) Medical Image Processing: pydicom, nibabel, SimpleITK Annotation Tools: LabelImg, CVAT, VGG Image Annotator (VIA) Visualization: Matplotlib, Seaborn, Grad-CAM for explainability Model Deployment: Streamlit, Flask Datasets: NIH Chest X-ray, COVID-19 Radiography Dataset, BraTS for brain tumor segmentation, LIDC-IDRI
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Adam Bohr & Kaveh Memarzadeh, Artificial Intelligence in Healthcare, Academic Press, 2020. T2: S. Kevin Zhou, Hayit Greenspan, Dinggang Shen, Deep Learning for Medical Image Analysis, Academic Press, 2017.
References R1: M. A. Haidekker, Medical Imaging Technology, Springer, 2013. R2: Geert Litjens et al., A survey on deep learning in medical image analysis, Medical Image Analysis, Elsevier, 2017.

R3: Online resources including Coursera's AI for Medical Diagnosis, Stanford's CS231n: Convolutional Neural Networks for Visual Recognition, and NPTEL's Medical Image Computing

Web resources:

https://www.coursera.org/learn/ai-for-medical-diagnosis – AI for Medical Diagnosis by DeepLearning.AI

https://cs231n.stanford.edu/ – CS231n: Convolutional Neural Networks for Visual Recognition, Stanford University

https://nptel.ac.in/courses/106/106/106106213/ – Medical Image Computing, NPTEL

https://www.kaggle.com/datasets – Public datasets for medical image classification and segmentation

https://grand-challenge.org/ – AI challenges and annotated datasets for medical imaging research

Topics relevant to development of "Skill Development":

Image preprocessing and augmentation techniques

Design and training of deep learning models for medical image classification and segmentation

Evaluation of AI models using healthcare-specific metrics (e.g., sensitivity, specificity, IoU, Dice score)

Interpretation of model predictions using explainability tools (e.g., Grad-CAM)

Building and deploying real-time diagnostic tools using Python, Streamlit, and cloud platforms

Collaborative problem-solving through project-based learning with real medical datasets

Topics relevant to development of "Environment and sustainability:

Use of AI to reduce redundant imaging procedures, minimizing patient exposure to radiation and resource use

Energy-efficient model architectures and deployment practices to lower computational footprint in healthcare AI

Early detection and screening with AI to reduce the need for invasive follow-up procedures and hospital admissions

Cost-effective diagnostic solutions that support equitable access to healthcare in under-resourced or rural areas

Adoption of paperless workflows and digital tools to support green healthcare initiatives

Course Code: CAI3423	Course Title: Genomic Data Science Type of Course: Integrated	L- P- T- C	2	0	2	3

Version No.	1.0			
Course Pre-requisites	CSE2264			
Anti-requisites	NIL			
Course Description	This course provides an in-depth understanding of genomic data and the computational approaches used to analyze it. Students will explore genome structures, sequencing technologies, data preprocessing techniques, and the application of machine learning and statistical tools for interpreting genomic data. The course aims to equip students with the skills needed to extract meaningful insights from genomic datasets for biomedical and healthcare applications.			
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe fundamental genomic concepts and technologies. [Understand] CO2: Preprocess and manage large-scale genomic datasets. [Apply] CO3: Apply bioinformatics and ML techniques to genomic data. [Apply] CO4: Analyze and interpret patterns in gene expression and sequence data. [Analyze] CO5: Design solutions for personalized healthcare using genomic insights. [Create]			
Course Content:				
Module 1	Introduction to Genomics and Data Sources	Assignment	Program activity	22 Hours
An introduction to the field of genomics and its role in personalized medicine forms the basis of this module. Topics include genome structure, sequencing technologies, types of genomic data, and public genomic databases such as ENSEMBL, NCBI, and 1000 Genomes.				
Module 2	Genomic Data Preprocessing and Feature Engineering	Assignment	Program activity	22 Hours s
Students learn to handle large-scale genomic data, including sequence alignment (BLAST, BWA), variant calling (VCF), and gene expression analysis (microarray, RNA-seq). Focus is also given to quality control, normalization, and handling missing values.				
Module 3	Machine Learning in Genomic Analysis	Assignment	Program activity	18 Hours

Machine learning approaches are applied to tasks such as disease susceptibility prediction, biomarker discovery, and patient stratification. Techniques include classification, clustering, and feature selection using scikit-learn and bioinformatics tools like BioPython and Bioconductor.				
Module 4	Applications in Personalized Medicine	Assignment	Program activity	13 Hours
This module explores case studies in cancer genomics, pharmacogenomics, and population genomics. Ethical considerations, data privacy (e.g., HIPAA, GDPR), and the integration of genomic data into clinical workflows are discussed.				

List of Lab Tasks:

Lab Sheet 1

Level 1: Retrieve DNA and protein sequences from NCBI and Ensembl databases

Level 2: Visualize and annotate genomic regions using the UCSC Genome Browser

Lab Sheet 2

Level 1: Perform sequence alignment using BLAST (Basic Local Alignment Search Tool)

Level 2: Use BWA (Burrows-Wheeler Aligner) for short-read alignment; convert to SAM/BAM formats

Lab Sheet 3

Level 1: Variant calling from aligned reads using bcftools or GATK

Level 2: Annotate variants using tools like VEP (Variant Effect Predictor) or SnpEff

Lab Sheet 4

Level 1: Preprocess microarray gene expression data (normalization, filtering)

Level 2: Perform RNA-seq pipeline: FASTQ to aligned reads and read counts

Lab Sheet 5

Level 1: Feature engineering: convert genomic data into machine learning-ready formats

Level 2: Apply dimensionality reduction (PCA, t-SNE) on gene expression datasets

Lab Sheet 6

Level 1: Train a simple classifier (e.g., SVM, Decision Tree) to predict disease from gene expression

Level 2: Evaluate model performance using accuracy, precision, recall, and AUC

Lab Sheet 7

Level 1: Cluster genomic samples using k-means and hierarchical clustering

Level 2: Visualize clusters using heatmaps and dendrograms

Lab Sheet 8–10

Capstone Project: Use genomic datasets to identify candidate biomarkers or predict disease risk; includes full workflow from data preprocessing to model evaluation and report presentation

Targeted Application & Tools that can be used Data Repositories: NCBI, Ensembl, 1000 Genomes Project, UCSC Genome Browser Sequence Analysis: BLAST, BWA, SAMtools, FASTQC Variant Calling & Annotation: bcftools, GATK, VEP, SnpEff Gene Expression Analysis: DESeq2, edgeR (via R/Bioconductor), limma Machine Learning Libraries: scikit-learn, TensorFlow, XGBoost Bioinformatics Libraries: BioPython, Bioconductor (R), pyVCF Visualization: matplotlib, seaborn, pheatmap, genome browsers Web Platforms: Galaxy, EMBL-EBI Tools Environments: Jupyter Notebook, RStudio, Google Colab
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Michael C. Schatz et al., Genomic Data Science, Cold Spring Harbor Lab Press, 2022 T2: Jason H. Moore & Scott M. Williams, Bioinformatics for Geneticists, Wiley, 2020
References R1: R. Durbin et al., Biological Sequence Analysis, Cambridge University Press, 1998 R2: Online resources from Coursera (e.g., Genomic Data Science Specialization by Johns Hopkins), NPTEL, and EMBL-EBI Web resources: https://www.ncbi.nlm.nih.gov/ – NCBI Genomics Portal https://www.ensembl.org/ – Ensembl Genome Browser https://galaxyproject.org/ – Web-based bioinformatics analysis platform https://bioconductor.org/ – Open software for genomic data analysis
Topics relevant to development of “Skill Development”: Genome browsing and data retrieval Variant analysis and functional annotation Machine learning applications in genomics

Development of predictive models using omics data Project-based learning with publicly available datasets Topics relevant to development of “Environment and sustainability: Use of genomics to develop sustainable agriculture and precision nutrition Minimizing clinical trial waste through AI-based patient stratification Genetic screening for early disease detection to reduce long-term healthcare burden Efficient use of cloud computing for large-scale genomic data analysis

Course Code: CAI3424	Course Title: Clinical Data Science Type of Course: Integrated	L- P- T-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course introduces students to clinical data and the computational methods used for its analysis in healthcare. The curriculum covers electronic health records (EHR), clinical coding systems, data preprocessing, predictive modeling, and visualization. Students gain skills in transforming raw clinical data into meaningful insights for improving patient outcomes and supporting evidence-based decision-making.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe clinical data sources, structures, and standards. [Understand] CO2: Preprocess and integrate structured and unstructured clinical data. [Apply] CO3: Build analytical models for clinical decision support. [Apply] CO4: Evaluate model accuracy and interpret outputs using relevant metrics. [Analyze] CO5: Design data-driven solutions for real-world healthcare scenarios. [Create]					

Course Content:				
Module 1	Introduction to Clinical Data and Coding Systems	Assignment	Program activity	22 Hours
This module introduces electronic health records (EHRs), their components, and commonly used clinical coding systems like ICD, CPT, and LOINC. Students understand how structured and unstructured clinical data are generated and stored in hospitals and research environments.				
Module 2	Clinical Data Processing and Integration	Assignment	Program activity	22 Hours s
Focuses on data cleaning, missing value handling, temporal sequencing, and merging data from disparate hospital systems. Students explore preprocessing tools such as pandas and SQL, with real-world clinical datasets for practice.				
Module 3	Predictive Analytics and Risk Modeling	Assignment	Program activity	18 Hours
Students learn to develop and evaluate machine learning models for predicting hospital readmissions, disease progression, and patient risk scores. Survival analysis and calibration techniques are introduced.				
Module 4	Visualization and Deployment in Clinical Workflows	Assignment	Program activity	13 Hours
Covers best practices for visualizing clinical KPIs, creating dashboards for hospital use, and regulatory requirements like HIPAA and HL7 compliance. Students build real-time reporting tools for clinical insights.				

List of Lab Tasks:

Lab Sheet 1

Level 1: Explore the structure of synthetic electronic health records (EHRs)

Level 2: Extract and visualize demographic information using SQL or pandas

Lab Sheet 2

Level 1: Preprocess structured clinical data: handle missing values, outliers

Level 2: Transform unstructured clinical notes using basic NLP (e.g., tokenization, stemming)

Lab Sheet 3

Level 1: Join and merge multi-source clinical datasets (e.g., labs + diagnosis + medication)

Level 2: Time-based filtering and patient cohort generation using temporal queries

Lab Sheet 4

Level 1: Build a logistic regression model to predict hospital readmission

Level 2: Evaluate model performance using confusion matrix and ROC curve Lab Sheet 5 Level 1: Perform survival analysis using Kaplan-Meier estimator Level 2: Cox proportional hazards model to analyze patient survival risk Lab Sheet 6 Level 1: Create a visual dashboard of patient metrics using tools like matplotlib or seaborn Level 2: Build a real-time monitoring dashboard with Streamlit Lab Sheet 7–10 Capstone Project: End-to-end clinical analytics project: data preprocessing, modeling, evaluation, and reporting using real-world or simulated data
Targeted Application & Tools that can be used Data Repositories & Formats: MIMIC-III, eICU, FHIR, CSV, HL7 Programming & Data Handling: Python, SQL, pandas, NumPy Data Visualization: matplotlib, seaborn, Plotly, Streamlit Machine Learning Frameworks: scikit-learn, XGBoost Survival Analysis: Lifelines (Python), R survival package NLP for Clinical Text: spaCy, NLTK, SciSpacy Dashboards & Reporting: Power BI, Streamlit, Tableau (optional) Environment: Jupyter Notebook, Google Colab, Anaconda
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Mark L. Braunstein, Practitioner's Guide to Health Informatics, Springer, 2015. T2: Pradeep Menon, Applied Clinical Informatics: A Practical Guide for Healthcare Professionals, CRC Press, 2021.
References R1: J. D. Dalianis, Clinical Text Mining: Secondary Use of Electronic Patient Records, Springer, 2018. R2: Steinar Carlsen et al., Health Informatics: An Interprofessional Approach, Elsevier, 2020.

R3: Online resources including MIMIC-III tutorials (MIT-LCP), NPTEL Health Analytics courses, and Coursera's Data Science in Stratified Healthcare and Precision Medicine. Web resources: https://physionet.org/about/mimic/ – MIMIC-III: Medical Information Mart for Intensive Care https://www.hl7.org/ – Health Level Seven International (HL7 standards) https://nptel.ac.in/courses/106/106/106106213 – NPTEL: Health Informatics and Analytics https://www.coursera.org/learn/clinical-data-science – Coursera: Clinical Data Science Specialization https://streamlit.io/ – Streamlit: Rapid development of clinical data dashboards
Topics relevant to development of "Skill Development": Handling and preprocessing large-scale clinical datasets (structured and unstructured) Using SQL and Python for real-world healthcare data analysis Developing predictive models for risk scoring and clinical decision support Conducting survival analysis and time-to-event modeling Visualizing healthcare data using professional dashboard tools Building real-time, interactive applications for clinical reporting and monitoring Applying NLP techniques for extracting information from clinical notes Topics relevant to development of "Environment and sustainability: Promoting data-driven, paperless clinical workflows for sustainable healthcare management Reducing unnecessary diagnostic procedures through predictive analytics Enhancing resource optimization in hospitals via data-informed decision-making Supporting public health sustainability through early risk detection and preventive care models Minimizing environmental burden by deploying digital dashboards and remote monitoring systems

Course Code: CAI3425	Course Title: AI in Epidemiology and Public Health Analytics Type of Course: Integrated	L- P- T-C	2	0	2	3
Version No.	1.0					

Course Pre-requisites	CSE2264			
Anti-requisites	NIL			
Course Description	This course explores how artificial intelligence can be applied in epidemiology and public health to understand, predict, and manage health outcomes at a population level. Students will gain skills in analyzing health indicators, working with public datasets, and developing AI-based models for forecasting outbreaks and informing health policy decisions			
Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Explain the principles of epidemiology and population health data. [Understand] CO2: Preprocess and analyze large-scale public health datasets. [Apply] CO3: Develop AI models for outbreak prediction and risk estimation. [Apply] CO4: Evaluate model outcomes for public health decision-making. [Analyze] CO5: Design data-driven tools and dashboards for health policy and surveillance. [Create]			
Course Content:				
Module 1	Foundations of Epidemiology and Health Indicators	Assignment	Program activity	22 Hours
Introduces the core concepts of epidemiology including incidence, prevalence, mortality, morbidity, and health surveillance systems. Students learn about the structure and utility of public health datasets such as NHANES, DHS, and WHO databases.				
Module 2	Public Health Data Analytics	Assignment	Program activity	22 Hours s
Focuses on collecting, cleaning, and analyzing epidemiological data using statistical and AI tools. Students apply descriptive analytics and GIS-based visualizations to identify trends and disparities in population health.				

Module 3	AI Models for Population Health Forecasting	Assignment	Program activity	18 Hours

Students build predictive models for disease outbreak forecasting, disease burden estimation, and vaccination coverage prediction using machine learning algorithms like decision trees, SIR models, and ensemble methods.

Module 4	Visualization and Ethical Implications in Public Health AI	Assignment	Program activity	13 Hours

Students develop dashboards and visual reports to support public health decision-making. The module also explores privacy, fairness, and ethical issues in population-level AI applications.

List of Lab Tasks:

Lab Sheet 1

Level 1: Load and explore public health datasets (e.g., NHANES, DHS)

Level 2: Perform descriptive statistical analysis (mean, median, incidence rates)

Lab Sheet 2

Level 1: Clean and preprocess public health data using pandas

Level 2: Perform demographic segmentation and cohort analysis

Lab Sheet 3

Level 1: Visualize disease distribution geographically using plotly or geopandas

Level 2: Create choropleth maps and interactive visualizations

Lab Sheet 4

Level 1: Train a decision tree or logistic regression model to classify health risk groups

Level 2: Evaluate classification performance using ROC and precision-recall curves

Lab Sheet 5

Level 1: Apply time series forecasting (e.g., ARIMA) to model disease trends

Level 2: Compare model forecasts with actual data using RMSE

Lab Sheet 6

Level 1: Implement a simple SIR model to simulate disease spread

Level 2: Calibrate parameters to fit real-world outbreak data

Lab Sheet 7

Level 1: Build a public health dashboard using Streamlit

Level 2: Integrate multiple charts and summary statistics into an interactive interface

Lab Sheet 8–10 Capstone Project: Design an AI-based early warning system or policy dashboard using historical epidemic or immunization data
Targeted Application & Tools that can be used Public Health Datasets: NHANES, DHS, WHO Global Health Observatory, India NFHS Programming & Analysis: Python, pandas, NumPy, SciPy, statsmodels Visualization: matplotlib, seaborn, plotly, geopandas, folium AI/ML Frameworks: scikit-learn, XGBoost, Prophet, TensorFlow (optional) Epidemiological Modeling: SIR/SEIR models using custom Python functions Geospatial Mapping: QGIS (optional), plotly choropleths, mapbox Dashboards & Reporting: Streamlit, Tableau (optional), Power BI Environments: Jupyter Notebook, Google Colab, Anaconda
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Michael J. Paul & Mark Dredze, Social Monitoring for Public Health, Morgan & Claypool, 2017. T2: R. Bonita, R. Beaglehole & T. Kjellström, Basic Epidemiology, 2nd Edition, WHO Press, 2006.
References R1: David L. Streiner & Geoffrey R. Norman, Health Measurement Scales: A Practical Guide to Their Development and Use, Oxford University Press, 2015. R2: Online resources including CDC WONDER database, WHO Health Data Platform, and training modules from Johns Hopkins' Coursera series on Public Health Data Science R3: Tutorials and documentation for SIR/SEIR modeling, GIS-based health data visualization, and epidemiological surveillance dashboards Web resources: https://www.who.int/data – WHO Global Health Observatory (GHO) https://www.cdc.gov/datastatistics – CDC Data & Statistics https://www.coursera.org/specializations/public-health-data-science – Coursera: Public Health Data Science Specialization https://ourworldindata.org/coronavirus – COVID-19 data and public health analysis tools

https://www.healthdata.org/ – Institute for Health Metrics and Evaluation (IHME)
Topics relevant to development of “Skill Development”: Epidemiological data cleaning, exploration, and statistical summarization Application of machine learning for disease prediction and outbreak forecasting Use of geospatial tools for mapping and hotspot analysis Development of interactive public health dashboards using real datasets Deployment of AI models for real-time public health monitoring Communication of data-driven insights for policy formulation and community awareness Topics relevant to development of “Environment and sustainability: Early detection and mitigation of disease outbreaks to reduce public health burden AI-based models to track the impact of climate change on health outcomes Data-driven planning for sustainable healthcare infrastructure and resource allocation Monitoring of environmental hazards (e.g., air/water pollution) and their epidemiological impact Supporting sustainable development goals (SDGs) related to health and well-being (e.g., SDG 3, SDG 6, SDG 13)

Course Code: CAI3426	Course Title: Time Series Analysis for Patient Monitoring Type of Course: Integrated	L- P- T- C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
Anti-requisites	NIL					
Course Description	This course focuses on time series data generated from continuous patient monitoring systems such as ICU sensors, wearable devices, and medical records. Students will learn to preprocess, analyze, and forecast temporal data using classical and machine learning-based time series models to detect anomalies and predict patient conditions.					

Course Objective	The objective of the course is SKILL DEVELOPMENT of students using EXPERIENTIAL LEARNING techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Explain the nature and components of time series data in healthcare. [Understand] CO2: Preprocess and extract meaningful features from patient monitoring data. [Apply] CO3: Build forecasting and anomaly detection models using time series techniques. [Apply] CO4: Evaluate the performance of time series models for clinical applications. [Analyze] CO5: Design intelligent patient monitoring solutions using real-time data streams. [Create]			
Course Content:				
Module 1	Fundamentals of Healthcare Time Series Data	Assignment	Program activity	22 Hours
Introduces sources and structures of time series data in healthcare, such as vital signs, ECG, glucose levels, and ICU telemetry. Covers time series components (trend, seasonality, noise) and visualization techniques.				
Module 2	Time Series Preprocessing and Feature Engineering	Assignment	Program activity	22 Hours s
Focuses on handling missing data, irregular sampling, outliers, normalization, resampling, and windowing. Techniques for extracting rolling statistics and domain-specific temporal features are covered.				
Module 3	Forecasting and Anomaly Detection Models	Assignment	Program activity	18 Hours
Students implement statistical models like ARIMA, SARIMA, and exponential smoothing, as well as ML-based approaches such as LSTM, GRU, and hybrid models. Emphasis is placed on model selection, tuning, and interpretability.				
Module 4	Deployment and Real-time Monitoring Applications	Assignment	Program activity	13 Hours

Covers real-time patient monitoring frameworks, streaming data pipelines, alert systems, and dashboard integration using lightweight deployment tools (e.g., Streamlit, MQTT). Includes ethical and regulatory issues in monitoring.
List of Lab Tasks: Lab Sheet 1 Level 1: Load and visualize patient time series data (e.g., heart rate, ECG) Level 2: Decompose time series into trend, seasonality, and residuals Lab Sheet 2 Level 1: Handle missing data using interpolation and imputation techniques Level 2: Resample irregularly spaced data and smooth noisy signals Lab Sheet 3 Level 1: Extract rolling statistics (mean, std) and domain-specific features (e.g., HRV) Level 2: Apply time windowing techniques for model input preparation Lab Sheet 4 Level 1: Build an ARIMA model for forecasting a physiological signal Level 2: Evaluate model performance using MAE, RMSE, and residual plots Lab Sheet 5 Level 1: Train an LSTM model for predicting vital signs Level 2: Tune hyperparameters and visualize learning curves Lab Sheet 6 Level 1: Detect anomalies in ICU data using Z-score and Isolation Forest Level 2: Compare detection rates across different methods Lab Sheet 7 Level 1: Create a real-time streaming simulation using stored sensor data Level 2: Trigger alerts when predefined clinical thresholds are breached Lab Sheet 8–10 Capstone Project: Develop an end-to-end patient monitoring pipeline (data ingestion, processing, forecasting, alerting, and visualization)
Targeted Application & Tools that can be used Programming Languages & Libraries: Python, pandas, NumPy, matplotlib, seaborn, statsmodels

Time Series & Forecasting: ARIMA, SARIMA, Holt-Winters, Prophet, scikit-learn, pmdarima Deep Learning Models: TensorFlow, Keras, LSTM, GRU, Autoencoders Anomaly Detection: Isolation Forest, Z-score, One-Class SVM Data Visualization & Dashboards: Plotly, Streamlit, Dash Healthcare Datasets & Simulators: MIMIC-III Waveform Database, PhysioNet, openICPSR vital sign data Streaming & Real-time Tools (optional): MQTT, Apache Kafka (for advanced setups), Flask for alerting interfaces Development Environment: Jupyter Notebook, Google Colab, VS Code
Project work/Assignment:
Assignment: Assignments include module-wise exercises and real-world project implementation.
Text Book T1: Aileen Nielsen, Practical Time Series Analysis: Prediction with Statistics and Machine Learning, O'Reilly Media, 2019 T2: Paolo Emiliozzi, Time Series Forecasting in Python, Leanpub, 2021
References R1: Rob J. Hyndman & George Athanasopoulos, Forecasting: Principles and Practice, OTexts, 3rd edition (freely available online) R2: Online resources and datasets from https://physionet.org/ – MIMIC, eICU, and waveform databases R3: Tutorials from Coursera's Time Series Forecasting, NPTEL's Healthcare Analytics, and GitHub repositories for clinical time series modeling using LSTM and GRU Web resources: https://physionet.org/ – PhysioNet: Free access to physiological time series datasets (e.g., MIMIC, ECG, ICU signals) https://otexts.com/fpp3/ – Online book: Forecasting: Principles and Practice https://www.coursera.org/learn/time-series – Coursera: Time Series Forecasting Specialization https://github.com/awslabs/gluon-ts – GluonTS: Probabilistic time series modeling with deep learning

https://tensorflow.org/tutorials/structured_data/time_series – TensorFlow Time Series tutorials
Topics relevant to development of "Skill Development": Preprocessing and analyzing time series data from patient monitoring systems Building forecasting models using ARIMA, LSTM, and hybrid techniques Detecting anomalies in vital signs and physiological signals Designing end-to-end data pipelines for real-time health monitoring Developing interactive dashboards and alerting systems for clinical decision support Hands-on experience with publicly available ICU and wearable sensor datasets Topics relevant to development of "Environment and sustainability: Reducing unnecessary hospital visits through continuous remote monitoring of patients Promoting sustainable healthcare by enabling early detection and preventive interventions Minimizing resource usage (e.g., tests, ICU beds) through AI-based forecasting and anomaly alerts Supporting environmentally friendly healthcare models by integrating low-power wearable devices Enhancing public health outcomes with minimal ecological impact via digital monitoring platforms

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		CSE2258				
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:	Course Title: Java Full Stack Development	L- T-P- C	2		2	3

CSE3427	Course Type: Lab Integrated					0			
Version No.		1.0							
Course Pre-requisites		CSE2258							
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		CSE2258				
Anti-requisites						
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

<table>
<tr><td></td><td colspan="5">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#.</td></tr>
<tr><td>Module 2</td><td>Entity Framework Core 2.0</td><td>Project</td><td></td><td>Programming</td><td>06 Sessions</td></tr>
<tr><td></td><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>ASP.NET</td><td>Project</td><td></td><td>Programming</td><td>06 Sessions</td></tr>
<tr><td></td><td colspan="5">Topics:

ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts;

Assignment: Develop a web application to mark entry/exit of guests in a building.</td></tr>
<tr><td>Module 4</td><td>ASP.NET</td><td>Project</td><td></td><td>Programming</td><td>08 Sessions</td></tr>
<tr><td></td><td colspan="5">Topics:

Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp. Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application

Assignment: Develop a software tool to do inventory management in a warehouse.</td></tr>
<tr><td></td><td colspan="5">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.</td></tr>
</table>

	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: CAI3427	Course Title: Language Models for Text Mining Type of Course: Integrated	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE2264					
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: Process text data to derive information from text. [Apply] Apply insights from textual information to real-world business. [Apply]					

<table>
<tr><td></td><td colspan="4">Develop solutions for a particular NLP problem using different machine learning and deep learning techniques. [Apply]

Utilize different NLP tools and packages. [Apply]</td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td>Text Mining</td><td>Adversarial Quiz Tests</td><td>Module Tests</td><td>No. of
Sessions: 09</td></tr>
<tr><td colspan="5">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).</td></tr>
<tr><td>Module 2</td><td>Text Preprocessing</td><td>Adversarial Quiz Tests</td><td>Module Tests</td><td>No. of
sessions: 06</td></tr>
<tr><td colspan="5">Introduction to Preprocessing. Tokenization. Stop Words Removal. Lemmatization and Stemming. PoS Tagging. Integer Encoding. Padding. One-Hot Encoding.</td></tr>
<tr><td>Module 3</td><td>Text Representations</td><td>Adversarial Quiz Tests</td><td>Module Tests</td><td>No. of
sessions: 08</td></tr>
<tr><td colspan="5">Language Modeling. N-Gram Language Model. Bag-of-Words Model. Term-Document Matrix. Term Frequency. Inverse Document Frequency. TF-IDF. Cosine Similarity. Naive Bayes Classifier using Bag-of-Words. Topic Modeling. Latent Semantic Analysis. Singular Value Decomposition. Truncated SVD and Topic Vector. LDA Algorithm.</td></tr>
<tr><td>Module 4</td><td>Natural Language Processing with Keras</td><td>Adversarial Quiz Tests</td><td>Module Tests</td><td>No. of
Sessions: 06</td></tr>
<tr><td colspan="5">Word Embeddings vs. One-Hot Encoding. Contextual Bag of Words (CBOW). Skipgram. Deep Learning for Document Classification.</td></tr>
<tr><td colspan="5">List of Lab Tasks:

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</td></tr>
</table>

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: Google Colab Python IDEs like PyCharm
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course 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): Daniel Jurafsky, James H. Martin. "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech, Pearson Publication, 2025 (3rd Edition Draft). 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: 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	CSE2264					
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: Implement backpropagation and gradient descent techniques to train neural networks effectively. (Apply) Build and train deep learning models using Python libraries such as TensorFlow and Keras for real-world applications. (Apply) 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[7L+7P] Sessions
Topics: Introduction to TensorFlow, TensorFlow dataset, Machine Learning with TensorFlow				
Module 3	Deep Learning methods with Tensor Flow and Keras	Assignment		14[6L+8P] Sessions
Topics: Main Features of TensorFlow, Keras basics, AI with Keras.				
Project work/Assignment:				
Assignment 1 on (Module 1 and Module 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: Implement 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

François Chollet, "Deep Learning with Python", 2nd Edition, Manning Publications, 2022

Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.

REFERENCES

Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra , “Deep Learning”, Pearson Publication, 2021. David Foster, “Generative Deep Learning” O’Reilly Publishers, 2020. John D Kellehar, “Deep Learning”, MIT Press, 2020. JOURNALS/MAGAZINES IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385 IEEE Transactions on Pattern Analysis and Machine Intelligence https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x SWAYAM/NPTEL/MOOCs: Swayam Nptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview Coursera – Neural Networks and Deep Learning Andrew Ng Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Code: UG COURSE: CAI3429	Course Title: Deep Learning Techniques for Computer Vision Type of Course: Integrated	L-T- P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	MAT2402					
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: 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. 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. 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). 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

Read in the data and explore

Define a Sequential API model

Define the hyperparameters and optimizer

Train the model and visualize the history

Testing

Keras Functional API model:

Define a Functional API model

Train the model and visualize the history

Lab Sheet 2:

Softmax regression with Keras

Read in the data and prepare

Define a Sequential API model

Define the hyperparameters and optimizer

Train the model and visualize the history

Testing

Lab Sheet 3:

Convolutional Neural Network with Keras (grayscale images)

Read in the data:

Visualize the data:

Prepare the data:

Define a CNN model:

Define the hyperparameters and optimizer:

Train the model and visualize the history:

Testing:

Lab Sheet 4:

Convolutional Neural Network with Keras (color images):

Read in the data:

Visualize the data:

Prepare the data:

Define a CNN model:

Define the hyperparameters and optimizer:

Train the model and visualize the history:

Testing:

Lab Sheet 5:

Time series and prediction:

Read in the data and explore:

Apply the exponential smoothing method and predict

Recurrent neural network (RNN):

Pre-processing:

Do the necessary definitions: (Hyper parameters, Model,

Train the model:

Predict the future:

Lab Sheet 6:

Document classification with LSTM network:

Read in the data:

Explore the data:

Data preprocessing:

Define the model:

Define the optimizer and compile:

Train the model and visualize the history:

Testing:

Lab Sheet 7:

Document classification with LSTM network (Binary):

Read in the data:

Explore the data:

Data preprocessing:

Define the model:

Define the optimizer and compile:

Train the model and visualize the history:

Testing:

Lab Sheet 8:

Document classification with LSTM + CNN network (Binary):

Read in the data:

Explore the data:

Data preprocessing:

Define the model:

Define the optimizer and compile:

Train the model and visualize the history:

Testing:

Lab Sheet 9:

Softmax regression to recognize the handswritten digits:

Download the MNIST data:

Take a look at the dataset:

Do the necessary definitions:

Training and Testing:

Multi-layer neural network to recognize the handswritten digits:

Download the MNIST data:

Take a look at the dataset:

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)

Object Detection and Recognition:

Haar cascade object detection (e.g., face detection or object detection using pre-trained classifiers).

Feature-based object detection using techniques like Speeded-Up Robust Features (SURF) or Scale-Invariant Feature Transform (SIFT).

Deep learning-based object detection using Convolutional Neural Networks (CNNs) or You Only Look Once (YOLO) algorithm.

Optical Character Recognition (OCR):

Preprocessing of text images (e.g., binarization, noise removal, or skew correction).

Text localization using techniques like connected component analysis or Stroke Width Transform (SWT).

Character recognition using machine learning algorithms like Support Vector Machines (SVM) or Convolutional Neural Networks (CNNs).

Gesture Recognition:

Hand segmentation using techniques like background subtraction or skin color detection.

Feature extraction from hand regions (e.g., finger counting, hand shape descriptors).

Classification of gestures using machine learning algorithms (e.g., k-Nearest Neighbors or Support Vector Machines).

Tools/Software Required :

OpenCV 4

Python 3.7

MATLAB

Text Books

"Deep Learning for Computer Vision Image Classification, Object Detection and Face Recognition in Python" Jason Brownlee (2019)

"Deep Learning for Computer Vision with python" Adrian Rosebrock (2017)

References

Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.

A foundational book covering deep learning principles, including CNNs, optimization, and generative models.

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.

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.

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.

Chollet, F. (2021). Deep Learning with Python (2nd Edition). Manning Publications.

Explains deep learning fundamentals and applications with Keras, including image classification and segmentation.

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.