



SRI RAMAKRISHNA
INSTITUTE OF TECHNOLOGY

[Educational Service: SNR Sons Charitable Trust]

[Autonomous Institution reaccredited by NAAC with 'A' Grade, ISO 21001:2018 certified]

[Approved by AICTE New Delhi, Permanently affiliated to Anna University, Chennai]



Curriculum & Syllabus

R2025

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SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY

An Autonomous Institution | Educational Service of SNR Sons Charitable Trust



REGULATIONS 2025

For all B.E. / B.Tech. Full-Time Programs
Applicable to students admitted from the Academic Year 2025–2026
onwards

Sri Ramakrishna Institute of Technology
Coimbatore, Tamil Nadu

REGULATIONS 2025

Information on the minimum number of credits to be earned for successful completion of B.E./B.Tech. Programs

Regular candidates (4 Years): 162 credits

Lateral Entry candidates (3 Years): 120 credits

-Chairperson, Academic Council/Principal

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VISION AND MISSION OF THE INSTITUTION



VISION

Our vision is to develop into a world-class technological institute with centres of excellence in various disciplines by providing quality and value-based education with continuous upgradation of infrastructure, human resources, and the teaching-learning process.



MISSION

Our mission is to produce quality engineers, scientists, and managers equipped with unbounded technical skills, domain knowledge, and excellent moral values for the advancement of industry, business, and for the emancipation of society.



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Sri Ramakrishna Institute of Technology was established in 2002 by the SNR Sons Charitable Trust. It is an Autonomous Institution since 2017 and reaccredited by NAAC with 'A' Grade. The Institution offers 6 Undergraduate Programs and 3 Post Graduate Programs in Engineering and Technology. The B.E. Electronics and Communication Engineering and B.Tech. Information Technology Programs have been accredited by the NBA.

HIGHLIGHTS OF THE CURRICULUM

- Outcome-based education with student-centric learning through the Choice-Based Credit System
- Industry-driven learning with a multi-disciplinary approach
- Project-based learning
- Competency enhancement courses, including online learning
- Collaborations with Premier Institutions–National and International
- Certification courses in foreign languages
- One credit course offered by Industries and Research establishments
- Employability enhancement courses focusing on placements
- Industry Internship opportunities
- Inculcation of Innovation, startup culture, and Entrepreneurship development
- Syllabi development based on emerging technologies
- Implementation of active learning methods.
- Periodic program outcome review within the broad framework of the agreed-upon expected graduate attributes
- Provision for specialization and Minor certification

REGULATIONS 2025

For all B.E. / B.Tech. Full-Time Programs

(For the students admitted to B.E. / B.Tech. Program from the Academic year 2025-2026 and onwards)

1. PREAMBLE

Sri Ramakrishna Institute of Technology, with a focused vision and mission of imparting quality technical education in domain knowledge, both theory and practice application, is gearing up for several initiatives towards academic excellence and quality improvement. In view of this, Outcome-Based Education through the Choice-Based Credit System (CBCS) is being introduced from the Academic year 2025-2026 to strengthen an interdisciplinary and multidisciplinary approach, with advances in learner-centric programs and lifelong learning opportunities, with enriched and flexible content. The industry interaction initiative provides a meaningful linkage between the challenging professional world and academia. The programs are designed to integrate science, engineering, technology, and human values along with liberal arts for the graduates of the various programs to function efficiently and effectively in the technological society.

The proposed academic structure under Outcome-based education through the Choice-Based Credit System shall enable innovation, preparing students to work as a team and face professional challenges through additional courses as specialization/minor courses. The proposed system creates an ample environment for self-learning and innovation, leading to a startup culture and Entrepreneurship development.

SCOPE

The regulations provided herein shall apply to all Regular Undergraduate (UG) programs offered in SRIT. These regulations are comprehensive and include definitions of key terms, critical concepts, calculation mechanics, the role of various boards and committees, and the evaluation system.

PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise specifies:

1. **Program** means an undergraduate degree program. B.E. / B.Tech. Degree Program
2. **Discipline** means discipline of B.E. / B.Tech. Degree Program, like Mechanical Engineering, Information Technology, etc.
3. **Course** means a Theory / Integrated or Practical course that is studied in a semester, like Engineering Graphics, Fundamentals of Computing and Programming, etc...
4. **Head of the Institution** means the Principal of the College /Institution
5. **Head of the Department** refers to the Head of the Department concerned and
6. **University** means affiliated University, currently, Anna University Chennai

2. ADMISSION CRITERIA

The Admission Criteria for all Programs will be as per the norms prescribed by the Government of Tamil Nadu.

- Required to have a pass in Higher Secondary Course Examination (Academic 10 + 2) Curriculum or its equivalent examinations with Mathematics, Physics and Chemistry. Other eligibility criteria such as minimum marks in each of the above courses for different categories of communities, number of attempts and physical fitness shall be as prescribed by the Govt. of Tamil Nadu from time to time

Lateral Entry Candidates

Admission of students directly to second year (Lateral Entry) of B.E. / B.Tech. programs shall be as per the norms prescribed by the Government of Tamil Nadu as given below.

- The candidates who possess the Diploma in Engineering / Technology awarded by the Directorate of Technical Education, Tamil Nadu, or its equivalent are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. program. Other eligibility criteria such as discipline of Diploma, marks, number of attempts, and physical fitness shall be as prescribed by the Govt. of Tamil Nadu from time to time.

(OR)

- The candidates who possess a Bachelor of Science (B.Sc.) (10+2+3 stream) with Mathematics as a course at the B.Sc. level are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. program. Other eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Government of Tamil Nadu from time to time.

3. DURATION OF THE PROGRAM

The four academic years will be divided into eight semesters with two semesters per academic year. Each semester shall normally consist of 90 working days, including examination days.

Degree	Stipulated number of Semesters	Permitted number of Semesters
B.E. /B.Tech. (Regular)	8	14
B.E. /B.Tech. (Lateral)	6	12

The permitted number of Semesters can be increased on a case-to-case basis subject to the approval of the Academic Council and the affiliating university.

The total period for completing the Program is reckoned from the commencement of the first semester of the Program to which the candidate is admitted, and it shall not exceed the maximum period specified, irrespective of the period of break of study that he/she may be eligible for the award of the degree.

The ongoing degree programs in Bachelor of Engineering / Technology are given below: -

- **B.E. Computer Science and Engineering**
- **B.E. Electronics and Communication Engineering**
- **B.E. Electrical and Electronics Engineering**
- **B.E. Mechanical Engineering**
- **B.Tech. Information Technology**
- **B.Tech. Artificial Intelligence and Data Science**

The ongoing degree Postgraduate Programs of study

- **M.E. Communication Systems**
- **M.E. Computer Science and Engineering**
- **M.E. Power Systems Engineering**

4. STRUCTURE OF THE PROGRAM

The Curriculum and Syllabi under Regulations 2025 are implemented based on the recommendations of the Model Curriculum by **AICTE** and **UGC, New Delhi, and Anna University, Chennai**, with a view to achieving excellence in the quality of education by keeping the requirements of enhancing employability skills and producing well-rounded engineers for the benefit of Industry, Society, and Nation as a whole.

Outcome-based learning through CBCS enables students to earn credits across programs and provides flexibility for both slow and fast learners to register for the required number of credits in a semester. The CBCS facilitates the transfer of credits earned in different departments/Centers of other recognized/accredited universities or institutions of higher education in India and abroad, either through direct study or online.

The curriculum for every program is designed to require a minimum number of credits to be earned. To be eligible for the award of a degree, 162 credits (**120 credits** for lateral entry) must be completed.

5. CATEGORIZATION OF COURSES

Every B.E./B.Tech. Program will have a curriculum with syllabi consisting of theory/integrated and practical courses that shall be categorized as follows:

Category of Course	Description	Credits
Humanities and Social Sciences, including Management courses [HSMC]	Courses include Technical English, Employability Skills, Engineering Ethics and Human Values, Communication Skills, and Management courses	10-12
Basic Science courses [BSC]	Courses include Chemistry, Physics, Biology, and Mathematics	16-18
Engineering Science courses including workshop drawing, basics of electrical /mechanical/ computer, etc. [ESC]	Courses include Workshop, Drawing, Basics of Electrical / Electronics / Mechanical / Civil / Computer / Instrumentation Engineering	20-22
Professional core courses [PCC]	Courses include the core courses relevant to the chosen PROGRAM of study	56-60
Professional Elective courses relevant to chosen specialization/branch [PEC]	Courses include Elective courses relevant to the chosen PROGRAM of study.	18
Open subjects – Electives from other technical and /or emerging subjects [OPC]	Courses include interdisciplinary courses which are offered in other Engineering/Technology programs of study.	06
Internship cum Project work [IPW]	Courses include experiential learning courses such as Project, Seminar, and In-plant training / Internship to improve Employability Skills	12
Emerging Technology courses [ETC]	Courses include a wider perspective by integrating knowledge from various disciplines, fostering a more holistic understanding of complex issues. Computer science, data science, or even the arts and humanities.	06

Category of Course	Description	Credits
Ability Enhancement Courses [AEC]	Courses include Aptitude, Mindset, Soft Skills, Employment Readiness, and Entrepreneurship.	04
Skill Enhancement Courses / Skill Development Courses [SDC]	Courses include skill-development courses such as computational thinking, Design thinking, and Makerspace.	04
Liberal Arts Courses [LAC]	Courses help students develop essential soft skills such as communication, teamwork, and leadership, which are highly valued by employers.	04
Mandatory Courses [MC]	Courses include Personality and Character Development and courses recommended by regulatory bodies such as AICTE, UGC, etc.	Non-Credited
Total		162

- The Curriculum of a semester shall normally have a blend of theory /integrated and laboratory courses.
- Employability Enhancement Course(s) may also be included. Credit will be assigned to each course.
- However, the total number of courses per semester shall not exceed 8/9 (including EEC).
- The medium of instruction is English for all courses.

Each course is assigned a certain number of credits based on the following:

Contact period per week	Credits
1 Lecture Period/week	1
1 Tutorial Period/week	1
2/3 Practical Periods/week (Laboratory / Seminar / Project Work / etc.)	1

6. INDUCTION PROGRAM

- 6.1 All students shall undergo induction program in the first semester for duration as per the guidelines of All India Council for Technical Education (AICTE).
- 6.2 All students have to attend and complete the induction program.

7. COURSE ENROLLMENT AND REGISTRATION

- 7.1 Each student, on admission, shall be assigned to a student faculty advisor who shall advise and counsel the student about the details of the academic program and the choice of courses considering the student's academic background and career objectives.
- 7.2 Every student shall enroll for the course of the succeeding semester in the current semester. However, the student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the concerned semester.
- 7.3 No course shall be offered by a department unless a minimum of 15 students register for that course.
- 7.4 After registering for a course, a student shall attend the classes, satisfy the attendance requirements for that course, earn Continuous Assessment Marks and appear for the Semester-end examinations.
- 7.5 Each student on admission shall register for all the courses prescribed in the curriculum in the student's First Semester of study.
- 7.6 The enrollment for the courses of the semesters 2 to 8 will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the student's Faculty Advisor.
- 7.7 The curriculum for any semester except for the final semester usually carries credits between 21 and 25.

8. DIRECT SELF STUDY ELECTIVE COURSES

- 8.1 All B.E. / B.Tech. degree PROGRAM candidates who have earned a CGPA of 8.00 and above and who have no standing backlogs will be eligible to take one elective course as a Self-Study course, which may be either an Open Elective or a Professional Elective by getting prior approval from the HoD, who will nominate a faculty member for the periodic monitoring and continuous evaluation of the course.
- 8.2 Such candidates who successfully cleared the direct self-study elective course in the 4th /5th and 6th semesters of their PROGRAM of study will be eligible for project work/internship only during their final year of study if they complete all their coursework requirements.
- 8.3 The Direct Self-study elective course is limited to one course per semester from the 4th semester onwards. The candidate has to register with the office of the Controller

of Examinations through the Academic Coordinator & Head of the Department within the first 15 working days of the respective semesters.

8.4 The grade for the course will be based on the continuous assessment by the mentor and the performance of the candidate in the semester-end examinations.

8.5 **The maximum number of credits that can be earned as direct self-study is NINE.**

9. OPEN ELECTIVE COURSES

9.1 Open Elective courses include the elective courses relevant to the chosen discipline which a candidate can choose from the curriculum of other B.E./B.Tech. Programs and elective courses offered by the departments under the faculty of Science and Humanities.

9.2 Open elective courses generally will not require any prerequisite course of that program.

Please note the following when selecting your open elective/s:

- Some open elective courses may not be appropriate as an open course for a particular degree program. Example: Business Degree courses are not considered open for students in a business degree program.
- Some open elective courses may not be offered in the current academic semester or year.
- Some open elective courses may reach capacity early and therefore space may not be available for all interested students.
- Therefore, students who enroll early are most likely to get their choice.
- Students are responsible for ensuring that they successfully complete all courses as required by the program design to graduate.

10. GLOBAL INITIATIVE OF ACADEMIC NETWORKS (GIAN)

10.1 Two weeks/Ten days courses offered under the Global Initiative of Academic Networks (GIAN) program of MHRD conducted at premier institutes, can be **considered instead of one elective course.**

11. ONE CREDIT COURSES

11.1 Candidates can also opt for one credit industry-oriented courses of 15 to 20 hours duration, which will be offered by experts from industry/ other institution of eminence /faculty from premier institutions on specialized topics.

- 11.2 Candidates can complete such one credit courses during the semesters 3 to 7 as and when these courses are offered by different departments.
- 11.3 A candidate will also be permitted to register for the one credit courses of other departments provided the candidate has fulfilled the necessary pre-requisites (if any required) of the course being offered - subject to approval by both the Heads of the Departments.
- 11.4 One credit course will be evaluated by the course instructor/department faculty concerned. A total of 100 marks will be assessed by continuous assessment only, of which 75% weightage will be for final test to be scheduled by the course instructor/department faculty concerned.
- 11.5 The Head of the Department may identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, faculty handling the course (if available), coordinator and a senior faculty member nominated by the Head of the Department shall monitor the evaluation process.
- 11.6 The marks will be awarded to the candidate by the above committee based on their performance.
- 11.7 The additional grades earned by the candidates for the one credit courses which is not opted for conversion into an elective(s) will not be included in the computation of CGPA.

12.INDUSTRIAL TRAINING / INTERNSHIP

- 12.1 If Industrial Training is not prescribed in the curriculum, the student may undergo Industrial Training optionally, and the credits earned will be indicated in the Grade Sheet.
- 12.2 In case of Internship, the training needs to be undergone continuously from one organization preferably.
- 12.3 The student is allowed to undergo a maximum of 6 weeks Industrial Training for Internship during the entire duration of study.
- 12.4 At the end of the Internship training, the candidate should submit the report and certificate from the organization where he / she underwent the training.
- 12.5 Evaluation of the Industrial/Internship training will be done based on the report and Viva-Voce examination conducted internally by a department committee constituted by the Head of the department.
- 12.6 The institution shall monitor the student internship program. The internship report of each student shall be submitted to the Head of the Department of the college with the approval of the Guide.

12.7 One Week = 40 Internship Hours.

Duration of Training	Credits
2/3 Weeks	1
4/6 Weeks	2

13. TRANSFER OF CREDITS THROUGH ONLINE COURSES

13.1 Within the broad framework of the SRIT learning outcome based curriculum through choice based credit system Regulations 2025, and on the recommendation of the concerned Chair Person of the Board of studies and the Chairperson of the Academic Council, students may be permitted to earn part of the credit requirements for professional and open elective courses from other approved Institutes of repute and status in the country /abroad or online learning courses of SWAYAM* platform under UGC during their period of study(*Credit Frame work for online learning courses through SWAYAM Regulation 2016).

13.2 The Credits earned by such credit-transferred courses shall be limited to a maximum of nine credits for Professional and Open elective courses only.

For NPTEL/ SWAYAM courses, the corresponding range of marks for each grade is as follows:

O	A+	A	B+	B	C+	C	U
91-100	81-90	71-80	61-70	51-60	46-50	40-45	<40

THE GUIDELINES FOR THE TRANSFER OF CREDITS ARE AS FOLLOWS:

- The Online Course shall be a credited course and is taught for at least one semester.
- Students with consistent academic performance (having a **CGPA of 8.00** or above and no backlogs) shall opt for credit transfer courses through online mode of learning with the recommendation of the Chairperson of the Board of Studies and the approval of the Chairperson of the Academic Council.
- The Board of Studies of the department shall evaluate the credit transfer course with respect to the course contents, number of contact hours, course evaluation system, and approval or acceptance letter from the other institutions/Online courses and decide the Equivalent Elective Course(s) in their respective department curriculum and the number of equivalent credits the student earns for the course.
- The candidate undergoing online course needs to receive a certification for the earned credits.
- The Chairperson of the Board of Studies shall issue a Credit Transfer Certificate mentioning in it the details of equivalent Courses, corresponding credits, and

Equivalent Grades for the credit-transferred courses. The complete details will then be forwarded to the Chairperson, Academic Council for approval.

- Credits and the Grades earned by the student under this Credit Transfer scheme will be reflected in the corresponding Semester Grade Card and Consolidated Grade Card issued by the institution by entering the Equivalent Grades for the credit transferred courses.

Skill Enhancement Courses

Skill Enhancement Courses or Skill Development Courses (SDC) are the courses offered to enhance specific abilities and competencies of the students in both academic and professional contexts. These courses are designed to impart practical skills, including hands-on training, internships, and soft skills, to improve employability.

Ability Enhancement Courses:

Ability Enhancement Courses (AEC) are part of the curriculum and often include language courses and other analytical skill development programs to enhance employability and personal development.

Emerging Technology Courses:

A minor provides students with an opportunity to explore subjects outside their chosen major in emerging technologies, offering a more well-rounded education.

14.B.E. / B.TECH. WITH HONORS / DEGREE WITH A MINOR

- 14.1 Award of UG (Hons),UG with Minor will be implemented as approved by Anna University, Chennai for the UG students who have joined from the Academic Year 2021 – 2022 and onwards.
 - B.E. / B.Tech. (Honors)
 - B.E. / B.Tech. (Minor)
- 14.2 All branches of Engineering and Technology shall offer elective courses in the emerging areas like Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Robotics, Quantum Computing, Data Sciences, Cyber Security, 3D Printing and Design, and Augmented Reality/ Virtual Reality (AR/VR).
- 14.3 Additional courses in Emerging Areas shall be allowed from the same discipline of study is called specialization.
- 14.4 Additional Courses may be allowed where a student of another discipline of study is called a Minor.
- 14.5 The students' eligibility norms for taking up Honors/Minor degree courses will be as per the Anna University, Chennai guidelines.

- 14.6 The minimum number of Additional Credits to be earned for the award of Honors/Minor degree is 18 credits, over and above the credits required for the award of Undergraduate degree as suggested in the AICTE Model Curriculum and Anna University.
- 14.7 The candidate will be permitted to take up B.E/B.Tech. Honors/Minor degree courses from the IV/V semester onwards. The eligibility criteria will be the (N-1)th semester performance. **(CGPA 7.5 and above and cleared all courses in the first attempt).**
- 14.8 Six credits may be earned by the candidate through online mode (NPTEL platform) out of these 18 credits.
- 14.9 If a candidate decides not to opt for Honors, after completing a certain number of additional courses, the additional courses studied shall be considered in place of the professional elective courses which are part of the curriculum. If the candidate has studied more than the number of such courses than the number of professional elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA; the other courses shall be printed in the grade sheet; however, they will not be considered for the calculation of CGPA.
- 14.10 If a candidate decides not to opt for Minors, after completing a certain number of additional courses, the additional courses studied shall be considered in place of the open elective courses which are part of the curriculum. If the candidate has studied a more number of such courses with higher grades, these shall be considered for the calculation of CGPA; the other courses shall not be considered for the calculation of CGPA.
- 14.11 The course requirements for specialization/Minor degree are to be completed before the commencement of the final semester of study.

S.No.	Engineering Program of Study	Name of the Specialization	Permitted to Offer
1	Mechanical Engineering	Electric Vehicles	Specialization
2	Electrical & Electronics Engineering	Electric Vehicles	Specialization
3	Electronics & Communication Engineering	Internet of Things (IoT)	Specialization
4	Computer Science & Engineering	Virtual & Augmented Reality	Specialization
5	Information Technology	Cyber Security	Specialization
6	Artificial Intelligence & Data Science	Cloud Computing	Specialization

15.GAP YEAR - CONCEPT OF STUDENT ENTREPRENEURSHIP

- 15.1 The committee with the Principal as the chairman, an external member (preferably from industry), two internal members, and respective HODs as the member secretary, will evaluate the students who are involved in entrepreneurship activities.
- 15.2 A gap year is permitted to the students to take a year break to work on their start-ups and resume academics to complete the degree requirements.
- 15.3 The GAP year ranges from 8 months to a maximum period of one year.
- 15.4 The student who is interested in availing of a GAP year shall apply for the same after the publication of the results of IV/VI semester.
- 15.5 The committee shall ascertain the modalities and parameters to recognize a specific student as “Outstanding” for granting a gap period for the purpose of pursuing entrepreneurship in residence (or) working on a “Startup Idea” at the college level.
- 15.6 The Classification of the degree will not be affected for those students who have availed the gap year facility to pursue the entrepreneurship activities subject to the fulfillment of all conditions stipulated in the academic regulations for the award of the degree.
- 15.7 Candidates shall pursue entrepreneurship activities during their program of study with a break of one year.
- 15.8 After the gap year facility is given, and an appraisal process by an incubator where the student is attached, the student must ensure continuity of curriculum and syllabus at the time of joining back.
- 15.9 Student entrepreneurs working on a start-up idea during the gap year of the college may be permitted to convert their start-up project and submit the same as their final year project work towards the completion of the degree program.
- 15.10 **Eligibility Criteria:**
 - The student applying for GAP year should have secured a first class.
 - The student must have participated/won prizes in the national-level contests organized by Govt. agencies such as UGC, AICTE, MHRD, DRDO, etc.,/ leading corporates / Institution of Eminence (IITs/IIM/ IISC/NITs, etc.,) to secure the Institutional seed funding for Proof of Concept (PoC) setup.
 - The student must submit a basic PoC with minimal validation along with the application for the GAP year.
 - A review committee will be constituted comprising the Principal – Convenor, HOD of the Student Department, Internal Members from SRIT HIVE, NISP and EDC.
 - The decision will be taken by the committee as per the rubric tabulated below

Hackathons (Max.25)		MHRD IIC/EDC (Max.25)		Funding (Max.10)	
Phase	Points	Phase	Points	Phase	Points
Won	10	Won	5	Applied	2
Participation Final Round	10	Participation	5		
Participation	5	Ideation (In-house through MHRD-IIC)	5	Funds received	8
		B-Plan	10		

- Monthly Review will be conducted for the first six months. For the next six months, review will be conducted once in 45 working days.
- At the end of the Gap Year, the student must have converted the idea into a new product and ensure the validity for Commercialization/Technology Transfer.
- The student can be allowed to avail Gap Year in the Third/Fourth year of his/her study.
- If III Year is availed as Gap Year by the student, he/she may be permitted to sit with the juniors to study the Third-Year Courses and take the Final Year (Fourth Year) courses as Self–Study (if eligible).
- If IV Year is availed, he/she may be permitted to complete the Fourth-Year Courses as Self – Study during the III Year itself (if eligible).

16.LIVE-IN-LAB

- 16.1 It is an experiential learning program for the students to understand the problems of the population living in rural areas and to identify projects to address the problems, develop solutions, put them into practice, assess results, and provide innovative multidisciplinary solutions for the betterment of rural people and the rural economy.
- 16.2 The interested students shall go to the village adopted by the institution from the second year onwards, and they have to stay at least for two weeks continuously in that village.
- 16.3 During the stay, they can interact with the village population and identify the problems. Further, they have to provide a solution to the problems identified at the end of the period of study to be considered as an internship.
- 16.4 HIVE Convenor and Head of the department should ensure that all the necessary arrangements are made in this regard.
- 16.5 At the end of the study, students must report to the respective department, submit a report as a group consisting of a maximum of 6 students detailing the visit. The report should include the date of visit, questionnaires prepared for the problem identification,

justification, and the suggestions/solutions provided for the identified problem. Photo proof is essential for all activities.

16.6 The report will be evaluated by a committee constituted with the approval of the Principal as per the procedure formulated for the evaluation of the project.

16.7 All such projects will be considered as Internship/Field training.

ASSESSMENT FOR LIVE – IN – LAB

Review I

Assessment	Marks
Workshop (Group Participation) –Training	15
Village Visit- Reports	15
Problem Identification and Ideation	35
Poster Presentation	10
Paper Submission review/Report	25
Total	100

Review II

Assessment	Marks
Proposed Implementation with HIVE-SRIT Presentation	10
Proposal Submission + Review	10
Prototype Design	20
Implementation	35
Final Report and Proof of Concept	25
Research Paper Publications/ Product	10
Total	100 + 10

17.STUDENT EXCHANGE SCHEME IN APPROVED FOREIGN UNIVERSITIES

17.1 Students who complete a part of the academic program, either one or two semesters, under the student exchange scheme in approved foreign Universities, the transfer of credits of equivalent courses completed by them in the foreign university will be approved.

17.2 The remaining courses of the respective semester(s) which they have not studied in the respective regulation, they shall register for those courses within the next two or subsequent semesters on a self-study basis.

- 17.3 Such an appearance of the student in those courses will be treated as a first appearance for the purpose of classification.
- 17.4 The certificate of successful completion of International Mobility Program for a period of 2 weeks in an approved foreign university shall be considered as internship/industrial training under Internship Project work.

18.REAPPEARANCE REGISTRATION

- 18.1 The maximum number of credits the candidate can register in a particular semester cannot exceed 36 credits excluding laboratory courses.
- 18.2 Choice of reappearance course in registration will be permitted only for candidates who have more than 36 credits excluding practical courses in the current semester of study. A candidate who has to register for less than 36 credits excluding practical courses during the current semester of study shall appear for all courses.
- 18.3 If a candidate who fails to secure a pass/ is absent for the Semester-end Examination in a theory course (except electives), the student shall do reappearance registration for that course in the subsequent semester/when offered next.
- 18.4 If a candidate is prevented from writing the Semester-end Examination of a course due to lack of attendance, the candidate has to register for the course again in the subsequent semester/when offered next, attend the classes and fulfill the attendance requirements and earn continuous assessment marks for that course.
- 18.5 If the course, in which the student has failed/prevented from writing Semester-end Examination due to lack of attendance, is a professional elective or an open elective, the student may be permitted to do reappearance registration for that course in the subsequent semester. (OR) Register for any other professional elective or open elective course in the subsequent semesters, attend the classes and fulfill the attendance and continuous assessment requirements.
- 18.6 A student who, after having earned necessary attendance, has failed in any course like In-plant Training, Field training/Internship (or) in any course carrying only Continuous Assessment marks will register for the examinations when it is conducted next time and will be declared to have passed the examination if He/She secures 50% marks in the prescribed semester-end examinations alone.
- 18.7 A student who has earned necessary attendance in the course Project work/Mini Project but does not submit the report on Project work on or before the date specified by the department/college /whose project report is not accepted for reasons of incompleteness or other serious deficiencies/ could not appear for the Semester-end examinations on the scheduled date, or failed to secure a pass he/she shall be deemed

to have failed in the Project work and awarded grade U and will have to register for the same at the beginning of the subsequent semester, redo and submit the Mini Project/project report at the end of that semester and appear for the final examination, the Continuous Assessment mark earned afresh.

- 18.8 A student, after registering for a course, may withdraw his / her registration between the first and second Continuous Assessment Test on valid reasons and complete the registration process with the approval of the Faculty Advisor. The total number of credits of such dropped courses cannot exceed 6.

19. ATTENDANCE REQUIREMENTS FOR APPEARING FOR THE SEMESTER-END EXAMINATIONS OF A COURSE

A candidate who has fulfilled the following conditions shall be deemed to have satisfied the attendance requirements for the completion of a semester:

- 19.1 Every candidate is expected to attend all classes and secure 100% attendance.
- 19.2 Candidates who secure less than 65% of overall attendance will not be permitted to appear for the Semester-end examinations. The Candidate shall seek readmission to the same semester in the subsequent academic year.
- 19.3 A candidate must secure not less than 75% of attendance (after rounding off to the nearest integer), course-wise, taking into account the total number of periods required for that course as specified in the curriculum.
- 19.4 The maximum limit of duty leave exemption to a candidate during a semester shall be limited to 10% of the required attendance in that course. This duty leave is for representation in University/Inter University/ State / National/ sports events, Co-Curricular activities, paper and/or project presentation with prior permission from the head of the Institution based on the recommendation of the Head of the Department, provided the progress and conduct of the candidate is satisfactory.
- 19.5 If a candidate secures attendance between 65% and 75% in any course in the current semester due to medical reasons (hospitalization/accident/specific illness) he/she may be given an condonation (due to medical reasons only) to appear for the current semester examinations in that course, subject to the condition that the candidate should submit, the medical certificate approved by the Head of the Institution based on the recommendation of the Head of the Department on the day of resuming to college, after availing leave on medical reason.
- 19.6 Candidates who secure less than 65% of attendance in any course will not be permitted to appear for the Semester-end examinations of that course. The candidate

has to re-register and repeat that course in the subsequent semester/ when offered next.

- 19.7 Students maintaining a CGPA ≥ 9.00 and SGPA ≥ 9.00 in the latest completed semester may avail a waiver for attendance in the following semester in any course. Students who avail the attendance waiver will be awarded marks based on their performance in an advanced assignment specified by the course coordinator (in emerging topics related to the course). The candidate can appear in all assessments and evaluation components without being marked ineligible due to attendance-based regulations.

20.ASSESSMENT PROCEDURES FOR AWARDING MARKS

- All B.E./B.Tech. Programs consist of Theory Courses, Laboratory Courses, Theory integrated with laboratory, and Employability Enhancement Courses.
- Appearance in the Semester-end examinations is mandatory for all courses, including Theory, Laboratory, Theory integrated with laboratory and Project work.
- Performance in each course of study shall be evaluated based on
 - ✓ Continuous assessments throughout the semester
 - ✓ Semester-end examinations at the end of the semester

20.1 MARKS WEIGHTAGE FOR DIFFERENT COURSES:

S.No.	Category of course	Continuous Assessments Marks	Semester-end Examinations Marks
1	Theory Courses	40	60
2	Laboratory Courses	60	40
3	Theory cum Laboratory Course	50	50
4	Project Work	60	40
5	All other Courses	100	--

- The Semester-end examinations for theory courses will be of 3 hours duration and shall normally be conducted between October and December during the odd semesters and between April and June during the even semesters.
- Semester-end examinations are a mandatory requirement for passing the course having an external component, and every candidate should appear for the examination for theory, theory cum laboratory, laboratory courses and project work.
- In case a student is unable to attend the continuous assessment due to medical reasons (hospitalization/accident/ specific illness) or due to participation in the College / University / State / National / Sports events with prior permission from the Head of the Department, a Reassessment may be given at the end of the semester after getting approval from the Principal through the Head of the Department and the concerned course instructor.

20.2 CONTINUOUS ASSESSMENT FOR THEORY COURSE

Assessment	Continuous Assessment weightage 40%		Semester-end examinations weightage 60%
	Duration	Weightage	
Semester in Exam - I	120 min	12.5	
Semester in Exam - II	120 min	12.5	
Surprise Test/Open Book Test (A1)	-----	5	
Surprise Quiz(A2) (minimum 2 quizzes through Online mode)	-----	5	
Assessment by Course Instructor (A3)	-----	5	

20.3 CONTINUOUS ASSESSMENT FOR LABORATORY COURSES:

Assessment	Continuous Assessment Weightage 60%		End-Semester Practical Examinations 40%	
	Duration	Weightage		
Semester in Exam - I	90 min	20	Pre-Examination Viva	10
Semester in Exam - I	90 min	20	Exercise	20
Lab Weekly Exercise	---	15	Record	05
Mini/ Capstone Project	---	05	External Review	05

- Every laboratory exercise / experiment should be evaluated based on the candidate's performance during the laboratory class /examination, and the student's records should be maintained.

20.4 ASSESSMENT FOR LANGUAGE COURSES

Internal Assessment Marks

Test II	50 Marks (Reading & Writing)	Converts- 10 Marks
Speaking	2 Experiments	15 Marks
Listening	2 Experiments	15 Marks
Total		40 Marks

External Assessment Marks

End Semester Practical	Speaking (1 Experiment)	10 Marks
	Listening (1 Experiment)	10 Marks
Semester-end Examination	100 marks (Reading & Writing)	Converts- 40 Marks
Total		60 Marks

20.5 ASSESSMENT FOR THEORY CUM LABORATORY COURSES

Component	Assessment	Continuous Assessment Weightage 50 %	Semester-end Examination Weightage 50 %		
		Weightage	Assessment	Weightage	
LAB	Exam Cycle – I	10	Lab	Viva	5
	Lab Weekly Exercise	5	Examination (120 Min)	Experiment	10
THEORY	Semester in Exam I	12.5	End Semester Exam (Theory)	180 min	35
	Semester in Exam II	12.5			
	Surprise Quiz (min 2 – online open book test)	5			
	Assessment by course instructor	5			

20.6 ASSESSMENT FOR MINI PROJECT / PROJECT WORK

- Project work may be assigned to a single candidate or a group of candidates not exceeding 3 per group.
- There shall be a minimum of two assessments during the semester by a review committee. The student shall make a presentation to the committee on the progress made.
- The Head of the Department shall constitute a project review committee for each program.
- The project evaluation shall be carried out by a project committee comprising the Head of the Department or his/her Nominee (Chairperson), Project Coordinator (Professor/Associate Professor), and the Project Faculty Guide.
- The project work assessment shall be based on:
 - Conceptual understanding of Engineering Fundamentals
 - Ability to design and develop solutions and conduct investigations of complex problems
 - Ability to use modern engineering and IT tools
 - Decision-making ability

- Interdisciplinary approach
 - Initiative, leadership, and sense of responsibility
 - Ability to produce research information for the team
 - Ability to demonstrate understanding of team rules when assigned, and share in teamwork
 - Ability to demonstrate good communication skills
 - Completion of objectives
 - Presentation
 - Answer to queries
- The candidate(s) is expected to submit the project report on or before the last working day of the semester/ on the date specified by the department.
 - The semester-end examination for project work shall consist of an evaluation of the final project report submitted by the candidate or students of the project group by an external examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the guide of the project group, and an internal examiner.

Continuous Assessment weightage		End-semester examination weightage	
60%		40%	
Components	Weightage	Components	Weightage
Review I	15	Presentation	15
Review II	15	External Review	15
Review III	15	Report	10
		PLUS	
Report Review by Guide	15	Paper Publication	10

Ethics & Academic Integrity Requirements of Mini Project /Project work

Criteria for accepting similarity index (using Turnitin/Drillbit plagiarism check software), for the submission of UG Mini project/project work report:

- The overall similarity index should not exceed 25%, to be acceptable
- The highest similarity percentage from any one source should not exceed 4-6%.
- In case of self-plagiarism, the permissible percentage should not exceed, say, 7-10%.

20.7 ASSESSMENT OF CONTINUOUS ASSESSMENT COURSES

Continuous Assessment Weightage 100%		
Type of Course	Components	Weightage
ONE CREDIT	Quiz/ Assignment	25
	Test I	75
INDUSTRIAL TRAINING INTERNSHIP	Assessment by Industry	30
	Viva-voce	20
	Case Study / Report	20
	Presentation	30

20.8 ASSESSMENT OF VALUE-ADDED PROGRAMS

The department shall offer two one-credit courses or one two-credit course as a Value-added Program in collaboration with an industry partner. The assessment shall be of an internal mode for 100 marks. The evaluation scheme shall be approved by the Board of Studies before the course is offered to the students.

20.9 ASSESSMENT OF COMPREHENSIVE VIVA

Continuous Assessment weightage 50%		End-semester examination weightage 50%	
Test I (2 hours CBT – 120 questions)	12.5	End-semester Examination (2 hours CBT)	50
Test II (2 hours CBT – 120 questions)	12.5		
Unit Test (CBT) (5 tests)	25		

20.10 ASSESSMENT OF COMPREHENSIVE VIVA

Continuous Assessment Weightage 100%	
Computer-based Test	100

21.PASSING REQUIREMENTS

- 21.1 A candidate who has obtained a **minimum of 45% marks in the end-semester examination, in both Theory and Practical Courses** (including Project work), is declared to have passed in the end-semester examination for that course.
- 21.2 **A candidate who secures not less than 50% (Internal Assessment + Semester-end examinations marks) is declared to have passed in the examination for that course.**

- 21.3 A student is deemed to have passed in any course carrying only Continuous Assessment marks if the total mark secured by him/her **is at least 50% of the total marks**. (Including Project work).
- 21.4 If a candidate fails to secure a pass in a theory course/laboratory course (except electives), the student shall register and appear only for the end-of-semester examinations in the subsequent semester. In such case, the internal assessment marks obtained by the candidate in the first appearance shall be retained till the **third attempt**. However, from the fourth attempt onwards, if candidate fails to obtain pass mark (Internal Assessment + Semester-end examinations mark), then the candidate shall be declared to have passed the examination if s/he secures a minimum of 50% marks prescribed for the Semester-end Examination alone.
- 21.5 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades/marks.

22.AWARD OF LETTER GRADES

- 22.1 All assessments of a course will be done on the Uniform Evaluation Method of students based on Absolute Grading.
- 22.2 The same Ranges of Grades are applicable for the results of Revaluation/ Reappearance/ substitute /supplementary Examinations of that particular course.
- 22.3 Uniform Evaluation Method of students based on Absolute Grading as issued by Registrar, Anna University, Chennai, through Letter No. AU/CAC/ Absolute. Grading/ 02 / 2025-26 dated 27.03.2026 is followed for the awarding of Grades.
- 22.4 This uniform evaluation method consists of the norms to be followed for the award of marks for internal and Semester-end examinations of all types of courses, passing requirements, absolute grading, and award of letter grades and classification of degrees.
- 22.5 The award of letter grades will be decided based on the absolute grading principle. The absolute grading applies only to students who have passed the examination in accordance with the passing requirement, as set out in clause 21.
- 22.6 This is followed by the evaluation and passing of results for all the UG/PG students who joined from the academic year 2025-2026 onwards in the Autonomous Colleges affiliated to Anna University.
- 22.7 All candidates with failed marks will be awarded a U Grade.
- 22.8 There will be seven letter Grades for the passed candidates, such as O, A+, A, B+, B, C+ and C.

Letter Grade	Description	Grade Points
O	Outstanding	10
A+	Excellent	9
A	Very Good	8
B+	Good	7
B	Above Average	6.5
C+	Average	6
C	Satisfactory	5
U	Re-appearance	0
RA-SA	Shortage of Attendance	
RA-AB	Absent for the Semester-end Examination	
WD	Withdrawal in the Semester-end Examination	

The absolute grading system shall be followed for all categories of courses. The range of marks for corresponding grades is presented as follows:

O	A+	A	B+	B	C+	C	U
91-100	81-90	71-80	66-70	61-65	56-60	50-55	<50

23.GPA AND CGPA CALCULATION

All assessments of a course will be done on an absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying a certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course.

After the results are declared, grade sheets will be issued to each student, which will contain the following details:

- The list of courses enrolled during the semester and the grades scored.
- The Grade Point Average (GPA) for the semester, which is calculated as follows:

$$GPA = \frac{\sum_{i=1}^n (C_i \times GP_i)}{\sum_{i=1}^n C_i}$$

The Cumulative Grade Point Average (CGPA), which is calculated as follows:

$$GPA = \frac{\sum_{j=1}^n (C_j \times GP_j)}{\sum_{j=1}^n C_j}$$

Where C_i / C_j – is the credits assigned to the course

GP_i, GP_j - is the grade point corresponding to the letter grade obtained for each course

n - is the number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

24.ELIGIBILITY FOR THE AWARD OF DEGREE

- 24.1 A student shall be declared eligible for the award of the Degree if the candidate has
- 24.2 Successfully earned the required total credits as specified in the curriculum for his/her program of study within the allotted time.
- 24.3 Successfully completed the prescribed number of Value Added Courses* and mandatory courses if required by regulations.
- 24.4 Successfully completed any additional course assigned by the Head of the Institution when the candidate is readmitted under their regulations.
- 24.5 No disciplinary action is pending against him/her.

*Value-added courses (if any) are offered to facilitate the students to keep pace with the latest technologies pertaining to their chosen field of study. The students have the option to choose the course according to their interest and these courses will improve the employability of the students and assist them in exploring new opportunities.

25.CLASSIFICATION OF THE DEGREE AWARDED

I .FIRST CLASS WITH DISTINCTION

B.E./B.Tech. (Regular)

A candidate who satisfies the following conditions shall be declared to have passed the examination in **First Class with Distinction**:

- Who qualifies for the award of the Degree having passed the examination in all the courses prescribed for the PROGRAM of study with in the **stipulated number of Semester of study in first appearance plus one year (Two Semesters)** which includes authorized break of study of one year (if availed).
- The candidate should have secured a **CGPA of not less than 8.50** in all the courses prescribed for the PROGRAM of study.
- The candidate should NOT have been prevented from writing Semester-end examinations due to lack of attendance in any of the courses.

II. FIRST CLASS

B.E/B.Tech. (Regular)

- A candidate who satisfies the following conditions shall be declared to have passed the examination in First class:
- A candidate who qualifies for the award of the Degree having passed the examination in all the courses prescribed for the PROGRAM of study within the **stipulated number of semesters plus one year (Two Semesters)** reckoned from the commencement of study in the first Semester including authorized break of study (if availed) (or) Prevention from writing Semester-end examinations due to lack of attendance (if applicable).
- The candidate should have secured a **CGPA of not less than 6.50** in all the courses prescribed for the PROGRAM of Study.

III SECOND CLASS

- All other candidates not covered in clause 25(I) and 25(II) who qualify for the award of the Degree shall be declared to have passed the Examination in Second Class.
- A candidate who has earned an additional 18 credits as per clause 25(I& II) but does not satisfy the conditions mentioned in the above clause shall not be awarded B.E/B.Tech (Honors). In such cases, the grade sheet will show the additional courses studied, and those courses shall not be considered for CGPA computations.

Classification of B. E./B. Tech. (Honors):

- A Candidate is eligible for the B.E./ B.Tech. (Honors) degree if the following conditions are satisfied:
- The candidate who has completed additional courses from a specified group of professional electives (specialization) within the same PROGRAM and earned a minimum of 18 credits.
- The candidates who have passed all the courses prescribed in the curriculum as well as the additional courses on the first attempt.
- The candidates who have secured a minimum Cumulative Grade Point Average (CGPA) of 7.50, calculated based on all courses including the additional courses.
- A candidate who has passed all the prescribed and additional courses in the first attempt and has secured a CGPA of 8.50 or above is eligible for the award of B.E./ B.Tech. (Honors) Degree with First Class with Distinction.
- However, there may be candidates who have passed all the courses, including the additional ones, in the first attempt but have not obtained a CGPA of 8.50. They will be

awarded of B.E./ B. Tech. (Honors) Degree with First Class (CGPA less than 8.50, including additional courses).

- Some Candidates might have attained a CGPA of 8.50 when considering only the regular curriculum and benefiting from the grades obtained in the courses; such students will be awarded B.E/B. Tech. (Regular) Degree with First Class with Distinction, considering the improved CGPA due to good grades earned in the additional courses.
- The candidate should NOT have been prevented from writing Semester-end examinations due to lack of attendance in any of the courses.

Eligibility for B.E/B.Tech. (Minor):

A candidate is eligible for the B.E/ B.Tech. (Minor) degree if the following condition is satisfied:

- The Candidate has earned an additional minimum of 18 credits from the courses offered in any one of the following domains: Engineering, Science and Humanities, or Management.

Classification of B.E./ B.Tech.(Minor):

- A Candidate who has passed all the prescribed and additional courses in the first attempt and has secured a CGPA of 8.50 or above is eligible for the award of B.E./B.Tech. (Minor) Degree with First Class with Distinction.
- However, there may be candidates who have passed all the courses, including the additional ones, in the first attempt but have not obtained a CGPA less than 8.50 including additional courses.
- Some Candidates might have attained a CGPA of 8.50 when considering only the regular curriculum and due to strong performance in the additional courses, such students will be awarded of B.E./ B.Tech. (Regular) Degree with First Class with Distinction, considering the enhanced CGPA due to the grades in the additional courses.

26.RANK

- A student shall be eligible for award of ranking only if he/she has passed the examination in **First class with distinction or First class in having passed all the courses in first attempt.**
- Those who have availed the provision of break of study/withdrawal will not be eligible for rank.
- Ranks will be awarded only for a maximum of 5% of the Class strength.

27.PROCEDURE FOR COMPLETING THE COURSE

- 27.1 The academic year will be from June to May, in which the odd semester will be from the period of June to November/ December, and the even semester from December to May / June, respectively.
- 27.2 A candidate who has a break of study for some reason in any one of the semesters in the degree of study can rejoin the course in that semester only at the time of its normal commencement in the Institution for regular students upon satisfying the following conditions.
- 27.3 He/She should have obtained the approval from the DOTE and Affiliating University.
- 27.4 He /She should have completed the courses of study of the previous semesters.
- 27.5 He/She should have registered/appeared for all the Examinations of the previous semesters.
- 27.6 A candidate will be permitted to proceed from one semester to the next Semester only if he/she has satisfied the regulations for eligibility to appear for the Semester-end examinations in the semester concerned.
- 27.7 It is mandatory that a candidate has to complete the required number of value added courses during the duration of the program.
- 27.8 It is mandatory to successfully complete the required Employability Enhancement Course /other mandatory courses during the duration of the program.
- 27.9 No candidate will be enrolled in more than one Semester at any time. In the case of repeaters / Readmission, the earlier Internal Assessment in the respective courses will be disregarded.

28.SEMESTER-END EXAMINATIONS

- 28.1 There shall be a Semester-end examination of 3 hours' duration in each lecture/tutorial-based course.
- 28.2 The Semester-end examinations shall be conducted between October and December / January during the Odd semesters and between March and May/June in the Even Semesters.
- 28.3 If a student indulges in malpractice during examinations, the student shall be liable for punitive action as prescribed by the University from time to time.
- 28.4 A candidate who is absent for semester examination in a Course/Project Work after having enrolled for the same shall be considered to have attempted in that examination for the purpose of classification.

- 28.5 Supplementary Examinations may also be conducted at such times as may be decided by the Chairperson of the Academic Council/Principal subject to the approval of the Academic Council.
- 28.6 After the duration of the program (stipulated number of semesters), the passing requirement in the Semester-end examinations will be 50% marks in the Semester-end examinations for that course.

29.TRANSPARENCY IN EVALUATION

- 29.1 After the publication of End Semester results, the students are allowed to verify the answer scripts of all courses as per approved norms.
- 29.2 Subsequently, the application for revaluation of the answer scripts for those courses is permitted.
- 29.3 The verification of answer scripts or photocopies is not permitted for practical courses, one credit courses, seminars, practical training project work and other continuously assessed courses.

30.REVALUATION & REVIEW

The students are entitled to the following within fifteen days from the declaration of the results.

- 30.1 As per the regulations, there is only one valuation. However, a candidate after verification of their answer scripts, if not satisfied with the Grades allotted, then they can apply for Revaluation on payment of the prescribed fee. If the student is not satisfied with the Grades allotted after Revaluation, they can apply for a **Review of the answer script**.
- 30.2 Only a candidate who has applied for the verification of answer script or Photocopy and Revaluation of the answer script is eligible for applying for review of answer script.
- 30.3 The Revaluation of theory cum laboratory courses is not permitted.
- 30.4 The prescribed fee for the review of answer script should be paid. The refund of the fee will be made for the candidate who has failed originally and secured a pass mark after the review of the answer script.

31.ISSUE OF STATEMENT OF GRADES AND DEGREE CERTIFICATE

After the publication of the results in each semester, the Institution will issue the Statement of Grades. After the successful completion of the Degree program, the Academic Council of the Institution will recommend the list of candidates to the University for the award of the Degree Certificates.

32.PROVISION FOR WITHDRAWAL FROM EXAMINATION

- 32.1 A candidate may, for valid reasons and on prior application (medically unfit/Unexpected family situations/sports approved by the Head of the Institution), be granted permission to withdraw from appearing for the Semester-end examinations in any course or courses in only one semester examination **during the entire duration of the Degree Program.**
- 32.2 Withdrawal application shall be valid only if the candidate is eligible to appear for the Examination in that course and if it is made **prior to the commencement of the examination in that course(s)** duly recommended by the Head of Department and approved by the Head of the Institution.
- 32.3 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.
- 32.4 The candidate shall reappear for the withdrawn Course / Courses during the Examination conducted in the immediately subsequent Semester. Withdrawal is not permitted in the Semester-end examinations in the final semester of the period of study by the candidate.

33.BREAK OF STUDY FROM A PROGRAM

- 33.1 The candidates permitted to rejoin the program after a break of study shall be governed by the Curriculum and Regulations in force at the time of rejoining.
- 33.2 The students rejoined in any of the Semesters have to gain the stipulated number of credits to become eligible for the award of degree, under the regulations in vogue at the time of his/ her rejoining.
- 33.3 The total period for completion of the program reckoned from the commencement of the course for the first Semester to which the candidate was admitted shall not exceed the maximum period, irrespective of the period of break of study in order that he/she may be eligible for the award of the Degree.
- 33.4 If any student is detained for want of required attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study'.

34.FACULTY ADVISOR AND CLASS COMMITTEE

To help the students in planning their courses of study and for general advice on the Academic PROGRAM, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Faculty Advisor for those students throughout their

period of study. Such Faculty Advisor shall advise the students and monitor the courses taken by the students, check the attendance and progress of the students attached to him/her, and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress of their wards. An Academic Coordinator will monitor the Faculty Advisors.

The class committee consists of teachers who handle the class, student representatives, and a chairperson who is not handling the course for that class. It is like the 'Quality Circle' with the overall goal of improving the teaching-learning process.

The functions of the Class Committee include:

- Solving problems faced by students in the classroom and in the laboratories.
- Clarifying the regulations of the Degree PROGRAM and the details of rules therein.
- Informing the student representatives about the academic schedule dates and the syllabus coverage.
- Informing the student representatives about the regulations regarding weightage used for each assessment.
- In case of Practical Courses (Laboratory /Drawing / Project Work / Seminar etc.), the breakup of marks for each Experiment/exercise/module of work should be clearly discussed with the representatives in the Class Committee Meeting, who would inform the students.
- Analyzing the performance of the students of the class after each Test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional help or guidance or coaching for such weak students.

The Class Committee for a class under a particular program is constituted by the Head of the Department.

The Class Committee shall be constituted in the first week of the Semester. Two or three subsequent meetings may be held at suitable intervals. During these Meetings, the student members representing the entire class shall meaningfully interact and express their opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process. At least 10 student representatives (including girls) shall be included in the Class Committee.

The Chairperson of the Class Committee may invite the Academic Coordinator, Faculty advisor(s) and the Head of the Department to the meeting of the Class Committee.

The Chairperson has to prepare the minutes of every meeting, submit the same through the Head of the Department to the Head of the Institution within two days of the Class Committee meeting and arrange to circulate among the students and teachers concerned. If there are

some points in the minutes requiring action by the authorities concerned, the same shall be brought to the notice of the authority by the Head of the Institution.

35.MANDATORY COURSES (MAC)

- These courses include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc.
- The Tamil Courses and their syllabi as recommended by Anna University, Chennai, as per the circular letter No.618/CAC/TC/2023 dated 01.03.2023, are included as the Liberal Arts courses.
- Successful completion of the Tamil courses is essential for being eligible for the award of a degree.

Course Code	Title	Credits
20HS211	தமிழர் மரபு (Heritage of Tamils)	1
20HS212	தமிழரும் தொழில்நுட்பமும் (Tamils and Technology)	1

36.UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS COURSE

- A course on Universal Human Values and Professional Ethics is mandatory for all the candidates of the various B.E /B.Tech programs as per the recommendations of AICTE.
- The content will be delivered in three fifteen-hour courses.
- The first two contents of the fifteen-hour course will be common to all Programs of B.E/B.Tech. and in continuation to the Universal Human Values delivered during the first year Induction PROGRAM.
- The third fifteen-hour content is to be program-specific and to be delivered by the specific department.
- It is essential to complete the Universal Human Values and Professional Ethics course by all the candidates of B.E/B.Tech program.

37.DISCIPLINE

Every student shall maintain discipline both inside and outside the Institution and not to indulge in any activity that may spoil the name of the Institution. The Head of the Institution shall constitute a Disciplinary Committee which will enquire into the act and report to the Head of the Institution.

38. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The Institution may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi if demand is necessary, subject to the approval of the Academic Council and the affiliating University.



CURRICULUM & SYLLABUS



SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY

[Educational Service : SNR Sons Charitable Trust]

[Autonomous Institution, Reaccredited by NAAC with 'A' Grade, ISO 21001:2018 Certified]

[Approved by AICTE New Delhi, Permanently Affiliated to Anna University, Chennai]

Coimbatore - 641 010.



CURRICULUM STRUCTURE – R2025

HUMANITIES AND SOCIAL SCIENCES, INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI220	Social Impact of Artificial Intelligence	2	0	0	2	1,2,6,7,8,9,11	40	60	100
2	25CS212	Universal Human Values - III (Information Ethics and Digital Society)	1	0	0	1	1,2,3,6,7,11	40	60	100
3	25CS213	Software Development Standards (ISO)	1	0	0	1	1,2,3,4,5,9,10	40	60	100
4	25EC217	Universal Human Values III- Electronics and Society	1	0	0	1	7,11	40	60	100
5	25EC218	Intellectual Property Rights	1	0	0	1	2,6,8,11	40	60	100
6	25EE218	Product Development Economics	2	0	0	2	1, 2, 3, 4, 6, 8, 9, 10	40	60	100
7	25EE219	Product Innovation and IP Rights	2	0	0	2	6,7,9,10,11	40	60	100
8	25EE220	Entrepreneurship Development and Finance Management	1	0	0	1	8,9,10	40	60	100
9	25EE221	Universal Human Values – III (Professional Ethics)	1	0	0	1	2,6,7,8,9,10,11	40	60	100
10	25HS207	Environment, Sustainability, and Society	2	0	0	2	1,6,11	40	60	100
11	25HS251	Technical English	2	0	2	3	5,9,11	40	60	100
12	25HS270	Professional English	0	0	2	1	5,9,11	60	40	100
13	25HS271	Foreign Language	0	0	2	1	5,9,11	60	40	100
14	25IT210	Cybercrimes – Law, Practice and Procedures	2	0	0	2	2,6,8	40	60	100
15	25IT211	Universal Human Values - III (Cyber Ethics)	1	0	0	1	1,2,3,6,7,11	40	60	100
16	25IT212	Information Standards	1	0	0	1	1,2,3,4,5	40	60	100
17	25ME213	Quality Systems Engineering	3	0	0	3	1,2,3,4,5,7	40	60	100
18	25ME214	Innovation, Entrepreneurship and Engineering Society	2	0	0	2	2,3,6,10,11	40	60	100
19	25ME215	Professional Ethics and Engineering Economics	2	0	0	2	1,2,3,4,7,10,11	40	60	100

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CH201	Green Computing	2	0	0	2	1,6,11	40	60	100
2	25CH202	Electronic Material Sciences	2	0	0	2	1,2,11	40	60	100
3	25CH203	Environment and Sustainability	2	0	0	2	1,6,11	40	60	100
4	25CH204	Electrochemical Energy Systems	2	0	0	2	1,11	40	60	100
5	25IT201	Bio-inspired Computing	1	0	0	1	1,2,3	40	60	100
6	25MA201	Matrices and Calculus	3	1	0	4	1,2,5,8,9,11	40	60	100
7	25MA202	Linear Algebra and Number Theory	3	1	0	4	1,2,8,9,11	40	60	100
8	25MA203	Transforms & Complex Variables	3	1	0	4	1,2,5,11	40	60	100
9	25MA204	Transforms and Partial Differential Equations	3	1	0	4	1,2,5,11	40	60	100
10	25MA207	Probability and Statistics	3	1	0	4	1,2,5	40	60	100
11	25MA208	Probability, Statistics and Numerical Methods	3	1	0	4	1,2,5	40	60	100
12	25MA209	Probability and Random Processes	3	1	0	4	1,2,5	40	60	100
13	25PH251	Applied Physics	2	0	2	3	1,2,5,8,9	50	50	100
14	25PH252	Material Physics	2	0	2	3	1,2,5,8,9	50	50	100
15	25PH253	Engineering Physics	2	0	2	3	1,2,5,8,9	50	50	100

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI251	Excel Macros	1	0	2	2	1,2,3,4,5	50	50	100
2	25CS251	C Programming	2	0	4	4	1,2,3,5,9	50	50	100
3	25CS252	Data Structures	2	0	2	3	1,2,3, 5,9	50	50	100
4	25CS270	Computer Practices Workshop	0	0	2	1	1,2,3,4,5,9	60	40	100
5	25EC201	Semiconductor Devices	3	0	0	3	1,2,5,11	40	60	100
6	25EC202	Digital Principles and System Design	3	0	0	3	1,2,5,8	40	60	100
7	25EC270	Electronics Engineering Workshop	0	0	2	1	1,2,5,6,8,9,11	60	40	100
8	25EE201	Electric Circuit Analysis	3	1	0	4	1,2,5	40	60	100
9	25EE202	Applied Electrical and Electronics Systems	3	0	0	3	1,2,5,6	40	60	100
10	25EE256	Sensors and Instrumentation	1	0	2	2	1,2,3,4,5,8,9,11	50	50	100
11	25EE270	Electrical Workshop	0	0	2	1	1,2,6,8,9	60	40	100
12	25EE271	Electric Circuits and Electron Devices Laboratory	0	0	2	1	1,2,5,8,9	60	40	100
13	25IT205	Universal Acceptance	2	0	0	2	1,2,3,4,5	40	60	100
14	25IT251	Object Oriented Programming	2	0	4	4	1,2,3,4,5,9	50	50	100
15	25IT252	Python for Scientific Computing	2	0	2	3	1,2,3,4,5,6	50	50	100
16	25ME270	Engineering Graphics	0	0	4	2	1,2,5	60	40	100
17	25ME271	Digital Hardware Technologies	0	0	4	2	1,4,5,6	60	40	100
18	25EC251	Digital Circuits and Microcontrollers	2	0	2	3	1,2,3	50	50	100

EMERGING TECHNOLOGY COURSE (ETC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI203	Automated Intelligence	2	0	0	2	1, 2, 3, 4, 5, 6, 8, 9, 10, 11	40	60	100
2	25CS201	Data Science	2	0	0	2	1,2,3	40	60	100
3	25CS202	Artificial Intelligence	2	0	0	2	1,2,3,4	40	60	100
4	25EC219	Printed Circuit Board Design	2	0	0	2	1,2	40	60	100
5	25EE215	PLC Programming	2	0	0	2	1,2,3,4	40	60	100
6	25IT202	Modern Digital Technologies	2	0	0	2	1,2,3,4,5,6	40	60	100
7	25IT203	Prompt Engineering	2	0	0	2	1, 2, 3, 4, 5, 6, 8, 9, 10, 11	40	60	100
8	25IT204	Cybersecurity for Critical Infrastructure	2	0	0	2	1,2,3,4	40	60	100
9	25ME216	3D Printing	2	0	0	2	1,2,3,4,5,6	40	60	100

ABILITY ENHANCEMENT COURSE (AEC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25HS208	Aptitude, Verbal, Logical (CDPC-1)	1	0	0	1	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
2	25HS209	Problem Solving and Data Structures (CDPC-2)	1	0	0	1	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
3	25HS210	Lingua skill	1	0	0	1	5,9,11	40	60	100
4	25HS204	Design Thinking	1	0	0	1	2,3,4	100	-	100
5	25EE222	Introduction to Model Based Systems Engineering	2	0	0	2	1, 2, 3, 4, 5, 8, 9, 11	40	60	100

LIBERAL ARTS COURSE (LAC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC203	Evolution of Semiconductor Technologies	1	0	0	1	1, 2, 3, 11	100		100
2	25EE217	History of Science and Technology	1	0	0	1	6,7	100	-	100
3	25HS201	Heritage of Tamils	1	0	0	1	11	100	-	100
4	25HS202	Tamils and Technology	1	0	0	1	11	100	-	100
5	25HS203	Yoga	1	0	0	1	6	100	-	100
6	25HS211	Indian Knowledge System	1	0	0	1	1, 3	100	-	100
7	25MA205	Vedic Mathematics for Engineers	1	0	0	1	1,2,5,11	100	-	100
8	25MA206	Foundations of Problem Solving	1	0	0	1	1,2,4,9,11	100	-	100
9	25ME202	Industrial Revolutions & Emerging Trends in Manufacturing	2	0	0	2	1,2,5,6,10,11	40	60	100

SKILL DEVELOPMENT COURSE (SDC)

COMMON FOR ALL BRANCHES (except B.E. – MECHANICAL ENGINEERING)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC271	Think Build Innovate: Lab	0	0	2	1	1,2,3,4,8,9	60	40	100

B.E. – COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CS274	Value Added Program	0	0	4	2		100	-	100
2	25CS275	Comprehensive Viva	1	0	0	1	1, 2, 3, 4, 5, 9, 10, 11	50	50	100

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EE280	Value Added Program	0	0	4	2		100	-	100
2	25EE216	Comprehensive Viva	1	0	0	1	1, 2, 4, 6, 8, 9, 10, 11	50	50	100

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC280	Value Added Program	0	0	4	2		100	-	100
2	25EC281	Comprehensive Viva	1	0	0	1	1, 2, 3, 4, 5	50	50	100

B.E. – MECHANICAL ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25ME275	VAP Course - II Year	0	0	4	2		100		100
2	25ME276	VAP Course - III Year	0	0	2	1		100		100
3	25ME277	Comprehensive Viva	1	0	0	1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	50	50	100

B.Tech. – INFORMATION TECHNOLOGY

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25IT274	Value Added Program	0	0	4	2		100	-	100
2	25IT275	Comprehensive Viva	1	0	0	1	1, 2, 3, 9, 10	50	50	100

B.Tech. – ARTIFICIAL INTELLIGENCE

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI274	Value Added Program	0	0	4	2		100	-	100
2	25AI275	Comprehensive Viva	1	0	0	1	1, 2, 3, 4, 5, 9, 10, 11	50	50	100

MANDATORY COURSES (MC)

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25HS252	Universal Human Values: Understanding Harmony I	1	0	0	0	7,11	100	-	100
2	25HS253	Universal Human Values: Understanding Harmony II	1	0	0	0	7,11	100	-	100
3	25HS212	Constitution of India	1	0	0	0	6,8	100	-	100
4	25EC216	Electronic Standards	1	0	0	0	1,2,3,7,8	100	-	100

PROFESSIONAL CORE COURSES (PCC)

B.E. – COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CS203	Design and Analysis of Algorithms	3	0	0	3	1,2,3,4	40	60	100
2	25CS204	Computer Organisation and Architecture	3	0	0	3	1,2,3,4	40	60	100
3	25CS255	Database Management Systems	2	0	2	3	1,2,3,5	50	50	100
4	25IT253	Artificial Intelligence & Machine Learning	2	0	2	3	1,2,3,4,5	50	50	100
5	25CS254	Operating Systems	2	0	2	3	1,2,3,4,5	50	50	100
6	25CS205	Computational Theory and Automata	3	0	0	3	1,2,3,4	40	60	100
7	25CS206	LLM with Deep Learning	3	0	0	3	1,2,3,4,5,11	40	60	100
8	25CS257	Software Engineering and Project Management	3	0	0	3	1,2,3,4,5	40	60	100
9	25IT254	Programming in Java	2	0	2	3	1,2,3,4,5	50	50	100
10	25CS261	Data Communication and Networking	2	0	2	3	1,2,3,4,5,11	50	50	100
11	25CS258	Compiler Design and Program Translation	2	0	2	3	1,2,3,4,5	50	50	100
12	25CS260	Augmented, Virtual, & Mixed Reality (XR)	2	0	2	3	1,2,3,5,6	50	50	100
13	25IT257	Cloud Computing and Virtualization	2	0	2	3	1,2,3,4,5	50	50	100
14	25CS262	Cybersecurity Practices	2	0	2	3	1,2,3,4,5,6,7,9,11	50	50	100
15	25IT256	Web Technologies and Full Stack Development	2	0	2	3	1,2,3,4,5	50	50	100
16	25CS259	Internet of Things and Smart Systems	2	0	2	3	1,5	50	50	100
17	25CS211	Discrete Mathematics	2	1	0	3	1,2,5	40	60	100
18	25CS208	Quantum Algorithms and Computing Systems	2	0	0	2	1,2,5,6	40	60	100
19	25CS209	Mobile Computing and Wireless Technologies	2	0	0	2	1,3,5	40	60	100
20	25CS210	Blockchain Technologies	2	0	0	2	1,2,4,5,6	40	60	100
21	25CS214	Big Data Analytics	3	0	0	3	1,2,3	40	60	100

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EE203	DC Machines and Transformers	3	0	0	3	1,2,3	40	60	100
2	25EE251	Sensors and Transducers	2	0	2	3	1,2,3,4	50	50	100
3	25EE204	Digital Electronics	3	0	0	3	1,2,3,5	40	60	100
4	25EE272	DC Machines and Transformer Laboratory	0	0	2	1	1,2,4,5	60	40	100
5	25EE205	Analog Electronics and Applications	3	0	0	3	1,2,4	40	60	100
6	25EE206	Next-Gen Energy Generation	2	0	0	2	1,6	40	60	100
7	25EE252	Control Systems	3	0	2	4	1,2,3,4,5,8	50	50	100
8	25EE207	AC Machines	3	0	0	3	1,2,5	40	60	100
9	25EE208	Transmission and Distribution	2	1	0	3	1,2,3	40	60	100
10	25EC209	Signals and Systems	2	1	0	3	1,2,3,4,5	40	60	100
11	25EE273	AC Machines Laboratory	0	0	2	1	1, 2, 4, 5, 9	60	40	100
12	25EE274	Analog and Digital Laboratory	0	0	2	1	1, 2, 3, 4, 5	60	40	100
13	25EE209	Power Electronics	3	0	0	3	1,2,4	40	60	100
14	25EE210	Power System Analysis	2	1	0	3	1,2,3,4,5	40	60	100
15	25EE253	Embedded Systems	2	0	2	3	1,2,3,4,5	50	50	100
16	25EE211	Industrial IoT	3	0	0	3	1,2,3,4	40	60	100
17	25EE275	Power Electronics Laboratory	0	0	2	1	1,2,3,4,5	60	40	100
18	25EE254	Electric Drives and Control	2	0	2	3	1, 2, 3, 5, 6	50	50	100
19	25EE255	Power System Operation and Control	2	0	2	3	1, 2, 3, 4, 5, 11	50	50	100
20	25EE212	Intelligent Power Grid	2	0	0	2	1, 2, 3, 4	40	60	100
21	25EE213	Electric Vehicle	2	0	0	2	1, 2, 3	40	60	100
22	25EE214	Power System Protection	3	0	0	3	1, 2, 3, 4	40	60	100

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC205	Electromagnetic Fields and Transmission lines	3	0	0	3	1,2,8,9	40	60	100
2	25EC206	Analog Electronics	3	0	0	3	1,2	40	60	100
3	25EC207	Digital Circuits	3	0	0	3	1,2,8,9	40	60	100
4	25EC272	Digital Circuits laboratory	0	0	2	1	1,2,3,4,5,8,9,10,11	60	40	100
5	25EC273	Analog Electronics laboratory	0	0	2	1	1,2,3,4,5,8,9,10,11	60	40	100
6	25EC208	Computer Architecture	3	0	0	3	1,2,3,4,5,9,10,11	40	60	100
7	25EC209	Signals & Systems	3	0	0	3	1,2,3,4,5	40	60	100
8	25EC252	Linear integrated Circuits	3	0	2	4	1,2,5	50	50	100
9	25EC210	Communication Systems	3	0	0	3	1,2,3,4,5,9,10,11	40	60	100
10	25EC211	Control Engineering	3	0	0	3	1,2,3	40	60	100
11	25EC253	Smart Systems with Embedded & IOT	3	0	2	4	1,2,3,4,5	40	60	100
12	25EC254	Digital Signal Processing	3	0	2	4	1,2,3,4,5	50	50	100
13	25EC212	CMOS VLSI Design and Verification	3	0	0	3	1,2,3	40	60	100
14	25EC274	VLSI Design laboratory	0	0	2	1	1,2,3,4,5,8,9,10,11	60	40	100
15	25EC275	Communication Systems laboratory	0	0	2	1	1,2,3,4,5,8,9,10,11	60	40	100
16	25EC213	Machine Learning Techniques for 5G Communications	3	0	0	3	1,2,3,4,5	40	60	100
17	25EC214	ARM based embedded system design	3	0	0	3	1,2,3,4	40	60	100
18	25EC255	Computer Vision and Image Processing	3	0	2	4	1,2,3,4	50	50	100
19	25EC256	Microwave theory and Antenna	3	0	2	4	2,8,9	50	50	100
20	25EC215	System Verilog for Design and Verification	3	0	0	3	1,2,3,4,5,11	40	60	100
21	25EC276	ARM processor and programming Laboratory	0	0	2	1	1,2,3,4,5,8,9,10,11	40	60	100

B.E. – MECHANICAL ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25ME201	Engineering Mechanics	2	1	0	3	1,2	40	60	100
2	25ME203	Thermodynamics and Energy Systems	3	0	0	3	1,2,3	40	60	100
3	25ME251	Structural Behaviour and Deformation	2	0	2	3	1,2,3,4	50	50	100
4	25ME252	Production Processes and Fabrication	2	0	2	3	1,2,3	50	50	100
5	25ME204	Engineering Materials and Metallurgy	2	0	0	2	1,2,3,4	40	60	100
6	25ME205	Kinematics of Machinery	3	0	0	3	1,2,3,4,5,6,9,10	40	60	100
7	25ME206	Manufacturing and Sustainability Integration	2	0	0	2	1,2,3,4,6	40	60	100
8	25ME253	Thermal Engineering	2	0	2	3	1,2	50	50	100
9	25ME254	Engineering Metrology and Geometric Dimensioning	2	0	2	3	1,2,3,4,5	50	50	100
10	25ME255	Flow Dynamics and Hydraulic Systems	2	0	2	3	1,2,4	50	50	100
11	25ME207	Sensors and Actuators	2	0	0	2	1,2,3,4,5	40	60	100
12	25ME208	Design of Machine Elements	3	0	0	3	1,2,3,4	40	60	100
13	25ME256	Dynamics of Machinery	2	0	2	3	1,2,3,4,5,6,9,10,11	50	50	100
14	25ME257	Digital Design and Automated Production	2	0	2	3	1,2,3,4,5	50	50	100
15	25ME258	Heat Transfer	2	0	2	3	1,2,4	50	50	100
16	25ME209	Finite Element Analysis	3	0	0	3	1,2	40	60	100
17	25ME210	Additive Manufacturing	2	0	0	2	1, 2, 3, 4, 5, 6, 7, 11	40	60	100
18	25ME211	Design of Transmission Systems	3	0	0	3	1, 2, 3, 4, 6	40	60	100
19	25ME259	Computational Fluid Dynamics	2	0	2	3	1, 2, 3, 4, 5	50	50	100
20	25ME260	Industrial Automation and Mechatronics	2	0	2	3	1,2,3,5	50	50	100
21	25ME212	Vehicle Systems and Mobility Technology	3	0	0	3	1,2,3,4,5,6,11	40	60	100

B.Tech. – INFORMATION TECHNOLOGY

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CS203	Design and Analysis of Algorithms	3	0	0	3	1,2,3,4	40	60	100
2	25CS204	Computer Organization and Architecture	3	0	0	3	1,2,3,4	40	60	100
3	25CS254	Operating Systems	2	0	2	3	1,2,3,4,5	50	50	100
4	25CS255	Database Management Systems	2	0	2	3	1,2,3,5	50	50	100
5	25IT253	Artificial Intelligence and Machine Learning	2	0	2	3	1,2,3,4,5	50	50	100
6	25CS205	Computational Theory and Automata	3	0	0	3	1,2,3,4	40	60	100
7	25IT254	Programming in Java	2	0	2	3	1,2,3,4,5	50	50	100
8	25IT213	Discrete Structures	3	0	0	3	1,2,5	40	60	100
9	25IT255	Computer Networks and Communication	2	0	2	3	1,2,3,4,5	50	50	100
10	25IT206	Cyber Governance, Risk, and Compliance	2	0	0	2	1,2,3,5	40	60	100
11	25CS257	Software Engineering and Project Management	2	0	2	3	1,2,3,4,5	50	50	100
12	25IT256	Web Technologies and Full Stack Development	2	0	2	3	1,2,3,4,5	50	50	100
13	25CS258	Compiler Design and Program Translation	2	0	2	3	1,2,3,4,5	50	50	100
14	25IT257	Cloud Computing and Virtualization	2	0	2	3	1,2,3,4,5	50	50	100
15	25IT258	Penetration Testing and Vulnerability Assessment	2	0	2	3	1,2,3,4,5	50	50	100
16	25IT259	Cryptography and Cybersecurity	2	0	2	3	1,2,3,4,5	50	50	100
17	25IT207	Human Computer Interaction	3	0	0	3	1,2,3	40	60	100
18	25IT260	Realtime and Embedded Systems Development	2	0	2	3	1,2,3,4,5	50	50	100
19	25IT208	Information Security	2	0	0	2	1,2,3	40	60	100
20	25IT209	AI Safety	3	0	0	3	1,2,3, 4, 6, 8	40	60	100

B.Tech. – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI252	Neural Networks	2	0	2	3	1,2,3,4,5,11	50	50	100
2	25CS254	Operating Systems	2	0	2	3	1,2,3,4,5	50	50	100
3	25AI202	Data Science and Analysis	3	0	0	3	1,2,3,4,5,11	40	60	100
4	25CS255	Database Management Systems	2	0	2	3	1,2,3,5	50	50	100
5	25AI253	Computer Vision	2	0	2	3	1,2,3,4,5,11	50	50	100
6	25CS211	Discrete Mathematics	2	1	0	3	1,2,5	40	60	100
7	25AI254	Data Analytics	2	0	2	3	1,2,3,5,6,8,11	50	50	100
8	25IT256	Web Technologies And Full Stack Development	2	0	2	3	1,2,3,4,5	50	50	100
9	25AI255	Machine Learning Techniques	2	0	2	3	1,2,3,4,5,11	50	50	100
10	25AI256	Deep Learning	2	0	2	3	1,2,3,4,5,11	50	50	100
11	25IT257	Cloud Computing and Virtualization	2	0	2	3	1,2,3,4,5	50	50	100
12	25CS265	Devops Skills	2	0	2	3	1, 2, 3, 4, 5, 7, 8, 9, 10, 11	50	50	100
13	25CS259	Internet of Things and Smart Systems	2	0	2	3	1,5	50	50	100
14	25AI204	Reinforcement Learning	2	0	0	2	1,2,3,4,5	40	60	100
15	25AI257	Natural Language Processing	2	0	2	3	1, 2, 3, 4, 5, 6, 8, 11	50	50	100
16	25AI215	Algorithm Design And Performance	2	0	0	2	1, 3, 5	40	60	100
17	25AI207	Computer Networks	2	0	0	2	1, 2, 3, 4, 5, 10, 11	40	60	100
18	25AI258	Large Language Model	2	0	2	3	1, 2, 3, 4, 5, 6, 8, 11	50	50	100
19	25AI205	Predictive Analytics	2	0	0	2	1, 2, 3, 4, 5, 11	40	60	100
20	25AI206	Generative AI	2	0	0	2	1, 2, 3, 4, 5, 6, 8, 10, 11	40	60	100
21	25IT259	Cryptography and Cybersecurity	2	0	2	3	1,2,3,4,5	50	50	100

PROFESSIONAL ELECTIVE COURSES (PEC)

B.E. – COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CS2E01	Clean Coding and DevOps (IBM)	3	0	0	3	1,2,3	40	60	100
2	25CS2E02	Ethical Hacking and Penetration Testing	3	0	0	3	1, 2, 3, 4, 5, 6	40	60	100
3	25CS2E03	Robotics Operating System	3	0	0	3	1,2,4,5	40	60	100
4	25CS2E04	AI in Cybersecurity	3	0	0	3	1,2,3,4,5,11	40	60	100
5	25CS2E05	Immersive UI / UX Design	3	0	0	3	1,2,3,4,5	40	60	100
6	25CS2E06	Edge Computing	3	0	0	3	1,2,3	40	60	100
7	25CS2E07	Reinforcement Learning	3	0	0	3	1,2,3,4,5,6	40	60	100
8	25CS2E08	Virtual Reality Interaction Design	3	0	0	3	1,2,3,5,6,9	40	60	100
9	25CS2E09	Mixed Reality Systems	3	0	0	3	1,2,3,4,5	40	60	100
10	25CS2E10	Computer Graphics and Virtualization	3	0	0	3	1,2,3,4	40	60	100

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EE2E01	Energy Storage Systems	3	0	0	3	1,2,3,4,6	40	60	100
2	25EE2E07	Special Electrical Machines	3	0	0	3	1,2,3,4	40	60	100
3	25EE2E13	Battery Management System for EV	3	0	0	3	1,2,3,4	40	60	100
4	25EE2E19	PLC Programming and Industrial Automation	3	0	0	3	1,2,3,4,5	40	60	100

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC2E01	Smart And Advanced Sensors	3	0	0	3	1,2,3	40	60	100
2	25EC2E02	Wearable And Implantable Devices	3	0	0	3	1,2,3,4,5,7,11	40	60	100
3	25EC2E03	Cyber Security in Communication Networks	3	0	0	3	1,2,3,4,5	40	60	100
4	25EC2E04	Hybrid Intelligent Systems	3	0	0	3	1,2,5,11	40	60	100
5	25EC2E05	Multimedia Compression Techniques	3	0	0	3	1,2,3,4,5	40	60	100

B.E. – MECHANICAL ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25ME2E01	Non-destructive Evaluation Techniques	3	0	0	3	1,2,4,5	40	60	100
2	25ME2E02	Product Design and Development	3	0	0	3	1,2,3,4,5,10,11	40	60	100
3	25ME2E03	Energy Storage and Waste-to-Energy	3	0	0	3	1,2,3,5,6,7,11	40	60	100
4	25ME2E04	Industrial Robotics Technology	3	0	0	3	1,2,3,4,5,6,11	40	60	100

B.Tech. – INFORMATION TECHNOLOGY

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25IT2E01	Hardware Security	3	0	0	3	1, 2, 3, 4	40	60	100
2	25IT2E02	Usable Security	3	0	0	3	1, 2, 3	40	60	100
3	25IT2E03	Data Management	3	0	0	3	1,2,3,4	40	60	100
4	25IT2E04	Infrastructure Management	3	0	0	3	1,2,3,4	40	60	100
5	25IT2E05	Information and Technology Law	3	0	0	3	1,2,3,4	40	60	100
6	25IT2E06	Data Ethics	3	0	0	3	1,2,3,4	40	60	100
7	25IT2E07	Infrastructure Design and Operations	3	0	0	3	1,2,3,4	40	60	100
8	25IT2E08	Software Defined Networks	3	0	0	3	1, 2, 3, 4	40	60	100

B.Tech. – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI2E01	Feature Engineering For Machine Learning	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
2	25AI2E02	Information Retrieval And Search Engines	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
3	25AI2E03	Machine Translation Systems	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
4	25AI2E04	Natural Language Generation	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
5	25AI2E05	Natural Language Understanding	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
6	25AI2E06	Neural Network For Natural Language Processing	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100
7	25AI2E07	Retrieval Augmented Generation	3	0	0	3	1, 2, 3, 4, 5, 9, 10, 11	40	60	100

INNOVATION AND PROJECT WORK (IPW)
B.E. – COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25CS272	Mini Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
2	25CS271	Professional Practice	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
3	25CS273	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EE276	Professional Practices	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
2	25EE278	Mini Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
3	25EE279	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25EC277	Professional Practice	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
2	25EC278	Mini Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
3	25EC279	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

B.E. – MECHANICAL ENGINEERING

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25ME272	Industrial In Plant Training	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
2	25ME273	Design and Fabrication Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
3	25ME274	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

B.Tech. – INFORMATION TECHNOLOGY

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25IT271	Mini Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
2	25IT272	Professional Practice	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
3	25IT273	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

B.Tech. – ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI272	Mini Project	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	60	40	100
2	25AI271	Professional Practice	0	0	4	2	1,2,3,4,5,6,7,8,9,10,11	100	-	100
3	25AI273	Project Work	0	0	16	8	1,2,3,4,5,6,7,8,9,10,11	60	40	100

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course	L	T	P	C	POs	CA	ES	TOTAL
1	25AI2E51	Fundamentals Of Artificial Intelligence	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	40	60	100
2	25AI2E52	Introduction To Machine Learning	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8, 9	40	60	100
3	25AI2E53	Deep Learning Foundations	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8, 9	40	60	100
4	25AI2E54	Applications Of Generative Ai	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8, 9	40	60	100
5	25AI2E55	AI Tools	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8, 9	40	60	100
6	25EE2E51	Electric Vehicle Technology	3	0	0	3	1, 2, 3, 4, 5	40	60	100
7	25EE2E52	Renewable Energy Sources	3	0	0	3	1, 2, 3, 4, 5	40	60	100
8	25CS2E51	Introduction to Augmented and Virtual Reality	3	0	0	3	1, 2, 3, 4, 5	40	60	100
9	25CS2E52	Introduction to Cybersecurity	3	0	0	3	1, 2, 3, 4, 5	40	60	100
10	25EC2E51	Next Gen Communications	3	0	0	3	1, 2, 3, 4, 5, 6, 7, 8	40	60	100
11	25EC2E52	Visual Intelligence Systems	3	0	0	3	1, 2, 3, 6, 11	40	60	100
12	25IT2E51	Principles of Universal Acceptance	3	0	0	3	1,2,3	40	60	100
13	25IT2E52	Digital Privacy	3	0	0	3	1, 2, 3, 4, 6	40	60	100
14	25IT2E53	Data Science and AI Foundation	3	0	0	3		40	60	100

SYLLABUS

**HUMANITIES AND SOCIAL SCIENCES, INCLUDING
MANAGEMENT COURSES (HSMC)**

25AI220	SOCIAL IMPACT OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of Artificial Intelligence, its societal impacts, and the importance of ethics in AI systems	1,6,8,11	3
CO2	Analyse key ethical issues and legal considerations related to AI technologies.	2,6,8	3
CO3	Examine concepts such as fairness, transparency, accountability, and responsibility in AI systems.	2,8,11	2,3
CO4	Evaluate interdisciplinary perspectives on AI ethics and the concept of trustworthy AI.	6,8,9,11	3
CO5	Assess ethical challenges in real-world AI applications through case studies in domains such as healthcare, law, and smart cities.	2,6,8,11	1,2

COURSE CONTENT:

INTRODUCTION

[6]

Introduction – Introduction to Artificial Intelligence – Overview for Law and Regulations – Impacts of AI – Ethics of AI – Approaches in AI Ethics.

RISE OF AI ETHICS

[6]

AI Ethics – Common Themes and Varieties of Questions – Ethical Questions in AI – AI Ethics Now – AI Ethics Law – Case study: An Indigenous AI Report.

CONCEPTS AND ISSUES

[6]

Moral frameworks of Justice in AI – Accountability in Computer Systems – Transparency – Responsibility – Concept of Handoff as a Model – Race and Gender – Autonomy – Troubleshooting AI.

PERSPECTIVES AND APPROACHES

[6]

Perspectives on Ethics of AI – Computer Science - Engineering – Cognitive Science – Economics – Humanities – Philosophy – Anthropology – Trustworthy AI – Case study of AI for Social Good.

CASE STUDIES AND APPLICATIONS

[6]

Ethics of AI – Transport – Military – Biomedical research – Patient care and Public health – Law – Robot teaching – Algorithms and the Social Organization of work – Smart city Ethics.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXTBOOKS:

- [1] Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook Of Ethics Of AI, Oxford University Press, 2021, ISBN: 019006739X
- [2] Paula Boddington, AI Ethics: A Textbook, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer, 2023, ISBN: 9811993815

REFERENCE BOOKS:

- [1] Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge, The MIT Press, 2020, ISBN: 0262538199

WEB REFERENCES:

- [1] “The Ethical and Societal Impact of AI Assistants by Google DeepMind”
<https://www.youtube.com/watch?v=xy2B52ZO3X0>

25CS212	INFORMATION ETHICS AND DIGITAL SOCIETY	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational ethical theories, normative principles, and the complex architecture of the internet that shape moral dilemmas in cyberspace.	1, 2, 7	1,3
CO2	Identify contemporary issues involving free speech, intellectual property, and privacy in digital contexts by applying ethical frameworks and relevant legal concepts.	2, 7	3
CO3	Interpret the societal, security, and environmental impacts of networked technologies and cybersecurity measures from the perspective of sustainable and ethical engineering practice.	3, 6	1,2,3
CO4	Propose ethical and legal strategies for protecting personal data, securing digital infrastructure, and managing online content, considering principles from statutes.	3, 7	1,3
CO5	Describe the professional and ethical responsibilities of engineers in promoting inclusive, secure, and rights-respecting digital ecosystems, and commit to the need for continuous learning in this evolving field.	7, 11	3

Foundations of Digital Ethics and Internet Society

[3]

Introduction to ethics and moral reasoning in the digital era – Ethical decision-making models – Values and responsibilities in online environments – Evolution of internet technologies – Digital communication platforms – Information access and dissemination – Governance of digital spaces – Emerging challenges in interconnected societies – Illustrative case studies.

Communication Rights and Digital Expression

[3]

Freedom of expression in online environments – Digital communication and public discourse – Challenges in regulating online content – Responsible online behaviour – Misinformation and disinformation – Digital citizenship – Balancing individual rights and societal interests – Selected case studies.

Knowledge Ownership and Digital Resources

[3]

Concepts of ownership and creativity in digital environments – Protection of intellectual creations – Sharing and reuse of digital content – Open access and collaborative knowledge development – Ethical use of information resources – Emerging issues in digital publishing and content distribution – Relevant case studies.

Personal Data and Digital Well-being**[3]**

Digital identity and personal information management – Data collection and usage practices – Privacy concerns in connected environments – Data protection mechanisms – Rights and responsibilities of individuals and organizations – Digital well-being and responsible technology use – Contemporary legal perspectives – Case studies.

Trust, Security, and Responsible Technology Development**[3]**

Fundamentals of secure digital ecosystems – Risks and challenges in networked environments – Safe and responsible use of technology – Cyber resilience and risk management – Ethical aspects of security technologies – Professional responsibilities in technology development – Sustainable and inclusive digital futures – Case studies

Total Notional Hours: 30

L	T	P	TW&SL	C
15	-	-	15	1

TEXT BOOK:

- [1] Richard A. Spinello. Cyberethics: Morality and Law in Cyberspace, 7/E. Jones & Bartlett Learning, 2021.

REFERENCE BOOKS:

- [1] Sanjana Singh. Digital Ethics and Cyber Security. Yking Books, 2024.
[2] Mary Manjikian. Cybersecurity Ethics: An Introduction. Routledge, 2022.
[3] Mark Grabowski and Eric P. Robinson. Cyber Law and Ethics: Regulation of the Connected World. Routledge, 2021.
[4] Joseph Migga Kizza. Computer Network Security and Cyber Ethics, 4/E. McFarland & Company, Inc., 2014.
[5] Terry Halbert, Elaine Ingulli. Cyberethics. CBS Publishers & Distributors Pvt. Ltd, 2004.

WEB REFERENCES:

- [1] Government of India, *The Digital Personal Data Protection Act, 2023*, [Online]. Available: <https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

25CS213	SOFTWARE DEVELOPMENT STANDARDS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the scope, terminology, conformance requirements, and information management processes defined in ISO/IEC/IEEE 26514 for user documentation.	1, 2, 10	1
CO2	Apply information architecture principles, audience analysis, content development, review, and change management techniques for creating user information.	1, 2, 3, 5, 10	1, 3
CO3	Analyze information quality attributes and organize conceptual, instructional, and reference information using appropriate structures.	1, 2, 3, 4, 10	1
CO4	Design user-oriented information formats, interfaces, navigation features, visual elements, and accessibility mechanisms following the standard guidelines.	1, 2, 3, 4, 5, 10	1, 2, 3
CO5	Evaluate and implement modern documentation practices including APIs, FAQs, chatbots, multimedia content, and interactive user support systems.	1, 2, 3, 4, 5, 9, 10	1, 2, 3

Software Development standards

[15]

Introduction to ISO/IEC/IEEE 26514:2022, Scope, Terms and Definitions, Conformance Requirements – Information Management Process: Planning and Managing Information-Development Projects – Information Architecture and Development: Project Requirements, Objectives and Constraints, Audience and Task Analysis, Development, Review, Prototypes and Drafts, Content Management, Version Control and Change Control – Information Quality Characteristics: Correctness, Consistency, Comprehensibility, Conciseness, Minimalism and Accessibility – Structure of Information for Users: Overall Structure, Modularity, Functional Structuring and Information Models – Structure of Conceptual, Instructional and Reference Information, Commands, Troubleshooting Information, Error Messages and Glossaries – Structure of Printed and Online Information, User-Generated Content, Application Programming Interfaces (API), Frequently Asked Questions (FAQ), Chatbots and Voice Response Systems – Format of Information for Users: Consistent Format, Selection of Appropriate Media and Format, Context-Sensitive Information and Accessibility – Layout of Screens and Pages, Legibility, Representation of User Interface Elements, Use of Colour and Navigation Features – Formats for Danger, Warning and Caution Indications, Instruction Formats, User-Supplied Annotations, Illustrations, Icons and Other Visualizations, Video Tutorials, Animations and Interactive Content.

Total Notional Hours: 30

L	T	P	TW&SL	C
15	-	-	15	1

TEXT BOOK:

- [1] ISO/IEC/IEEE 26514:2022 - Systems and software engineering — Design and development of information for users. ISO/IEC/IEEE, 2022

25EC217	ELECTRONICS AND SOCIETY	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Explain the significance of universal human values and self-awareness.	7, 11	-
CO2	Apply ethical values and discipline in academic and professional activities.	7, 11	-
CO3	Demonstrate interpersonal skills and teamwork in engineering tasks.	7, 11	-
CO4	Apply ethical issues in communication technologies.	7, 11	-
CO5	Apply professional ethics and sustainability principles in engineering practice.	7, 11	-

HUMAN VALUES AND SELF-DEVELOPMENT

[5]

Need for Universal Human Values – Self-exploration – Basic human aspirations (happiness and prosperity) – Harmony of self and body – Stress management and self-discipline for engineering students.

INTERPERSONAL VALUES AND TEAMWORK

[5]

Values in relationships (trust, respect, responsibility) – Effective communication – Classroom and laboratory values (punctuality, honesty, accuracy, safety).

ETHICAL TECHNOLOGY AND PROFESSIONAL RESPONSIBILITY

[5]

Ethical use of communication systems – Role of engineers in sustainable development– Sustainable electronics and e-waste management - Ethics in professional bodies.

Case studies: Sustainable E-Waste Management, Semiconductor Manufacturing and Environmental Sustainability, Green Energy Practices in ECE Laboratories.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

[1] R R Gaur, R Asthana, G P Bagaria A Foundation Course in Human Values and Professional Ethics, 2nd Rev. ed., Excel Books, New Delhi, 2019.

REFERENCE BOOKS:

[1] Dr.Kuldeep S Sharma, Dr. Sarveen Kaur Sachdeva Universal Human values, Books clinic Publisher, 2023.

[2] Dr. Anand Vyas, Universal Human Values and Professional Ethics, Anandvyas publisher, 2023.

WEB REFERENCES

- [1] "Ethics in Engineering Practice," <https://nptel.ac.in/courses/110105097>
- [2] "Ethics in Engineering Practice," https://onlinecourses.nptel.ac.in/noc26_mg42/
- [3] "Electronic Waste Management - Issues and Challenges," https://onlinecourses.nptel.ac.in/noc25_ce15/
- [4] "Sustainable Engineering Concepts And Life Cycle Analysis," https://onlinecourses-archive.nptel.ac.in/noc18_ce08/
- [5] "Ecology and Environment," https://onlinecourses.nptel.ac.in/noc19_ge23/

25EC218	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Explain the fundamentals of Intellectual Property Rights, various forms of IPR, and the regulatory framework governing intellectual property at national and international levels.	6,8,11	-
CO2	Apply the principles of patents, copyrights, trademarks, industrial designs, and geographical indications to identify and protect innovations and creative works.	6,8	-
CO3	Analyze intellectual property issues in engineering research, technology transfer, entrepreneurship, and commercialization of innovations.	2,11	-
CO4	Evaluate emerging IPR challenges related to AI, IoT, Industry 4.0, open-source technologies, and ethical aspects of innovation management.	2,8	-
CO5	Interpret real-world IPR case studies and apply legal, technical, and ethical considerations to solve innovation-related problems.	6,11	-

INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS

[5]

Concepts and types of Intellectual Property Rights - Role of IPR in innovation and economic development. Overview of WIPO, WTO, TRIPS Agreement, and the Indian IPR framework.

Case Study: Patent-driven innovation in the Indian startup ecosystem.

PATENTS AND PATENT FILING

[5]

Patentability criteria, patentable and non-patentable inventions, and components of a patent specification, Patent filing procedure, patent search basics, technology transfer, and commercialization.

Case Study: Apple vs Samsung patent dispute.

COPYRIGHTS, TRADEMARKS AND INDUSTRIAL DESIGNS

[5]

Copyright protection for software and digital content; trademarks, industrial designs, and geographical indications. Trade secrets, brand protection, and intellectual asset management.

Case Study: Trademark protection strategies of Tata and Infosys.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, 1st ed., 2001, McGraw-Hill Education.
- [2] Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, 1st ed., 2014, PHI Learning Pvt. Ltd.
- [3] B. L. Wadhera, Law Relating to Intellectual Property Rights, 5th ed., 2016, Universal Law Publishing.

REFERENCE BOOKS:

- [1] William Cornish, David Llewelyn, and Tanya Aplin, Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights, Sweet & Maxwell, 9th ed., 2019
- [2] Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 5th ed., Cengage Learning, 2017.

WEB REFERENCES

- [1] “Ethics in Engineering Practice” https://onlinecourses.swayam2.ac.in/e-learning/preview/cec20_hs18
- [2] “Intellectual Property” https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs84

25EE218	PRODUCT DEVELOPMENT ECONOMICS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the stages of product development, innovation, and technology adoption in the context of EEE products.	-	-
CO2	Analyze market requirements and customer needs to define product requirement specifications.	1,2,4,9,10	1,2,3
CO3	Apply cost estimation and financial evaluation techniques to assess the economic feasibility of EEE products.	1,2,3,4,9	1,2,3
CO4	Develop strategies for product commercialization, intellectual property protection, and startup ecosystem engagement.	3,6,8,9,10	1,2,3
CO5	Evaluate techno-economic proposals for sustainable and market-ready EEE products	1,2,3,9,10	1,2,3

PRODUCT DEVELOPMENT AND MARKET ANALYSIS

[10]

Introduction to Product Development Process. Innovation and Design Thinking. Product Life Cycle and Technology Adoption Curve. Identification of customer needs and market opportunities. Market research, Voice of Customer (VoC), and Product Requirement Specification (PRS). Competitive benchmarking and demand forecasting.

ECONOMIC FEASIBILITY AND PRODUCT COMMERCIALIZATION

[10]

Cost components in product development, Cost estimation techniques, Break-even analysis, Payback Period, Return on Investment (ROI), and Cost-Benefit Analysis. Product pricing strategies. Intellectual Property Rights (IPR), patents, and technology transfer. Startup ecosystem, incubation support, and funding opportunities.

TECHNO-ECONOMIC ANALYSIS OF EEE PRODUCTS

[10]

Techno-economic assessment framework, Sustainability considerations in product development, Product commercialization strategies. Case studies: Smart Energy Meter Solar PV Systems, EV Charging Infrastructure Smart Home Automation Systems, IoT-Based Energy Monitoring Solutions.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Karl T. Ulrich, Steven D. Eppinger and Maria C. Yang, Product Design and Development, McGraw-Hill, 7th ed., 2020.
- [2] Leland Blank and Anthony Tarquin, Engineering Economy, McGraw-Hill, 9th ed., 2024.

REFERENCE BOOKS:

- [1] Chan S. Park, Contemporary Engineering Economics, Pearson, 7th ed., 2023.
- [2] Karl Ulrich, The Innovation Tournament Handbook: A Step-by-Step Guide to Finding Exceptional Solutions to Any Challenge, Wharton School Press, 1st ed., 2023.
- [3] George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw-Hill, 6th ed., 2021.
- [4] Chan S. Park, Fundamentals of Engineering Economics, Pearson Education, Global ed., 2021.
- [5] Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business, 1st ed., 2011.

WEB REFERENCES

- [1] "Product Design and Development," https://onlinecourses.nptel.ac.in/noc25_me121/preview
- [2] "Engineering Economic Analysis," https://onlinecourses.nptel.ac.in/noc25_me98/preview
- [3] "Innovation, Business Models And Entrepreneurship"
https://onlinecourses.nptel.ac.in/noc23_mg116/preview
- [4] "Entrepreneurship" https://onlinecourses.nptel.ac.in/noc24_mg93/preview

25EE219	PRODUCT INNOVATION AND IP RIGHTS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the principles of engineering innovation and design thinking frameworks in Indian and global contexts.	6,7	1
CO2	Apply ideation and systematic design methods to develop engineering solutions.	6,7,9,10	1
CO3	Apply the types of intellectual property rights and the Indian patent filing process for protecting engineering innovations.	7,10	1
CO4	Develop commercialization and entrepreneurship strategies for innovative products.	6,7,9,10	1
CO5	Prepare an innovation-to-market plan integrating product design, IP protection, and startup fundamentals.	6,7,9,10,11	1

INNOVATION FUNDAMENTALS

[10]

Introduction to Engineering Innovation, Indian and Global Innovation Ecosystems, Design Thinking Methodology, Empathy in Engineering, Engineering Innovation, Human-Centered Design, Creative Problem Solving, Ideation Techniques, Innovation Management, Frugal Innovation, Sustainability in Innovation.

PRODUCT DESIGN

[10]

Engineering Design Process, Systematic Design Approaches, Design Briefs, Requirements Gathering, Technical Constraints, Quality Function Deployment, Concept Generation, Morphological Analysis, Decision Matrices, Pugh Charts, Feasibility Assessment, Risk Analysis, Prototyping Methodologies, Low-fidelity Prototyping, Digital Prototyping, CAD Fundamentals, Testing, Iterative Refinement, Design for Manufacturing, Material Selection, Manufacturing Process Selection, Design for Assembly, Cost Estimation, Product Testing, Validation, Failure Modes Analysis, User Testing, Design Refinement.

INTELLECTUAL PROPERTY RIGHTS AND COMMERCIALIZATION

[10]

Types of IP, Patent Basics, Indian Patent Process, Patent Searching, Copyrights, Trademarks, Trade Secrets, IP Management, Technology Licensing, IP Enforcement. Market Assessment, Business Models, Startup Ecosystem, Product Standards, Entrepreneurship Basics, Funding Options, Pitch Development, Industry-Academia Collaboration.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Karl T. Ulrich, Steven D. Eppinger and Maria C. Yang, Product Design and Development, McGraw-Hill, 7th ed., 2020.
- [2] Kalyan Vaidyanathan and Pramod Karnad, Design Thinking: Integrating Innovation, Customer Experience, and Brand Value, LID Publishing, 2nd ed., 2020
- [3] P. Narayanan, Intellectual Property Rights, Excel Books, 3rd ed., 2019

REFERENCE BOOKS:

- [1] Chakrabarti, A. and Blessing, L., An Anthology of Theories and Models of Design: Philosophy, Approaches and Empirical Explorations, Springer, 2015.
- [2] Kumar, V., 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Wiley, 2012.
- [3] Krishnan, V. and Ulrich, K.T., Product Development Decisions: A Review of the Literature, Management Science, 2001.
- [4] Nair, P., Patent Law for Engineers and Scientists, Universities Press, India, 2014.
- [5] Brown, T., Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business, 2009.

WEB REFERENCES

- [1] "Intellectual Property India," <https://ipindia.gov.in>
- [2] "Innovation, Business Models And Entrepreneurship," https://onlinecourses.nptel.ac.in/noc23_mg116/preview
- [3] "Startup India," <https://www.startupindia.gov.in>

25EE220	ENTREPRENEURSHIP DEVELOPMENT AND FINANCE MANAGEMENT	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the concepts and characteristics of entrepreneurship and its role in economic development.	9,10	-
CO2	Identify business opportunities and develop entrepreneurial ventures using government and startup ecosystem support.	9,10	-
CO3	Prepare business plans using Business Model Canvas and validate business ideas through market feasibility studies.	8,9,10	-
CO4	Analyze sources of finance and institutional support structures for startup ventures.	9,10	-
CO5	Apply budgeting, break-even analysis and financial statements to evaluate business performance.	9,10	-

ENTREPRENEURSHIP AND ENTREPRENEURIAL ECOSYSTEM

[10]

Concept, characteristics, and importance of entrepreneurship, Types of entrepreneurs and entrepreneurial competencies, Role of entrepreneurship in economic development. Innovation, creativity, and opportunity recognition. Startup ecosystem in India. Government initiatives for entrepreneurship and innovation. Challenges and opportunities for entrepreneurs.

BUSINESS PLANNING AND FINANCING OF ENTERPRISES

[10]

Business Planning: Business idea generation and validation, Market analysis and feasibility study, Business Model Canvas, Preparation of business plans. Financing of Enterprises: Sources of finance, Equity, debt, venture capital, angel investors, crowd funding, and government schemes. Institutional support for startups. Working capital and fixed capital requirements. Financial planning for startups.

FINANCIAL MANAGEMENT FOR ENTREPRENEURS

[10]

Fundamentals of financial management, Budgeting and cash flow management, Cost estimation and pricing strategies, Break-even analysis, Profitability analysis, Financial statements: Income Statement, Balance Sheet, and Cash Flow Statement. Financial performance indicators. Risk management and sustainability in business.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, New Delhi, 2nd ed., 2013.
- [2] S.S. Khanka, Entrepreneurial Development, S. Chand Publishing, New Delhi, Rev. ed. (5th ed.), 2026

- [3] Prasanna Chandra, Financial Management: Theory and Practice, McGraw Hill Education (India), 11th ed., 2022

REFERENCE BOOKS:

- [1] Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, Entrepreneurship, McGraw-Hill Education, 10th ed., 2017.
- [2] I.M. Pandey, Financial Management, Vikas Publishing House, 11th ed., 2015.
- [3] Donald F. Kuratko, Entrepreneurship: Theory, Process, and Practice, Cengage Learning, 10th ed., 2017.
- [4] Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business, 1st ed., 2011.
- [5] Government of India, Startup India and MSME Policy Documents, Ministry of Commerce and Industry, 2023.

WEB REFERENCES

- [1] “Innovation, Business Models And Entrepreneurship”
https://onlinecourses.nptel.ac.in/noc23_mg116/preview
- [2] "Entrepreneurship," https://onlinecourses.nptel.ac.in/noc24_mg93/preview
- [3] "Startup India," <https://www.startupindia.gov.in>
- [4] "Ministry of Micro, Small & Medium Enterprises," <https://www.msme.gov.in>

25EE221	PROFESSIONAL ETHICS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Outline the principles of professional ethics and responsibilities of engineers.	6,7,8,9,10	-
CO2	Identify ethical issues related to engineering practice, digital technologies, and societal development.	6,7,9,11	-
CO3	Analyze the impact of emerging technologies on society, privacy, security, and human welfare.	6,7	-
CO4	Apply ethical reasoning to address challenges related to sustainability, digital citizenship, and social responsibility.	2,6,7,9,11	-
CO5	Demonstrate professional integrity, ethical leadership, and responsible use of technology for societal benefit.	6,7,8,9,11	-

FOUNDATIONS OF PROFESSIONAL ETHICS

[5]

Significance of ethics, Engineering ethics and professional responsibility. Integrity, honesty, accountability, transparency, and fairness. Rights and responsibilities of engineers. Professional codes of ethics. Ethical decision-making frameworks. Ethical responsibilities towards society, employers, clients, and colleagues.

ETHICAL ISSUES IN ENGINEERING PRACTICE, SOCIETY, AND DIGITAL ETHICS

[5]

Public safety and welfare. Risk, reliability, and engineering judgment. Engineering solutions and societal impact. Environmental sustainability and responsible technology development. Data privacy, data protection, and cybersecurity ethics. Artificial Intelligence, Machine Learning, and algorithmic bias. Social responsibility of engineers in the digital era. Case studies on engineering failures, cybersecurity breaches, and ethical issues in digital technologies.

PROFESSIONAL EXCELLENCE, DIGITAL CITIZENSHIP, AND ETHICAL LEADERSHIP

[5]

Sustainable development and social responsibility, Workplace ethics and professional relationships. Teamwork, communication, and leadership. Responsible innovation and emerging technologies. Ethical leadership in technology-driven organizations. Digital citizenship and responsible online behavior. Technology for societal welfare and inclusive development. Lifelong learning and professional competence.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Mike W. Martin and Roland Schinzinger, Ethics in Engineering McGraw-Hill Education,4th ed., 2005
- [2] Charles E. Harris, Michael S. Pritchard, and Michael J. Rabins,Engineering Ethics: Concepts and Cases, Cengage Learning,5th ed., 2013
- [3] Herman T. Tavani, Ethics and Technology: Controversies, Questions and Strategies for Ethical Computing, Wiley, 4th ed., 2012

REFERENCE BOOKS:

- [1] Govindarajan M., Natarajan S., and Senthil Kumar V.S., Professional Ethics and Human Values, PHI Learning Pvt. Ltd., 2nd ed., 2013
- [2] Caroline Whitbeck, Ethics in Engineering Practice and Research, Cambridge University Press, 2nd ed., 2011
- [3] Luciano Floridi, The Ethics of Information, Oxford University Press, 1st ed., 2013
- [4] Shannon Vallor, Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting, Oxford University Press, 1st ed., 2016

WEB REFERENCES

- [1] "Ethics in Engineering Practice," <https://nptel.ac.in/courses/110105097>
- [2] "Emotional Intelligence," https://onlinecourses.nptel.ac.in/noc21_hs55/preview
- [3] "Ethics, Technology and Engineering," <https://www.coursera.org/learn/ethics-technology-engineering>

25HS207	ENVIRONMENT, SUSTAINABILITY AND SOCIETY	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Recall the fundamental concepts of environment and sustainability.	1	-
CO2	Understand the over-exploitation of our natural resources and the need for sustainability.	1	-
CO3	Describe the importance of sustainable development.	1	-
CO4	Use different approaches for attaining environmental sustainability.	1	-
CO5	Apply sustainable practices to real-world environmental management scenarios.	1,6,11	-

ENVIRONMENT

[6]

Components of environment - Atmosphere, lithosphere, hydrosphere and biosphere - types of environments – Natural – man – made - Environmental education- objectives, importance and scope - Need for public awareness.

CONCEPTS OF SUSTAINABILITY

[7]

Sustainability- concept, needs and challenges-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas. Concept of Carbon Credit, Carbon Footprint.

SUSTAINABLE PRACTICES

[7]

Zero waste and R concept, ISO 14000 Series-Sustainable habitat-Sustainable transport. Energy Cycles carbon cycle, emission and sequestration, electronic waste recycling- Spent batteries and recovery of valuable materials from waste electrodes.

ENVIRONMENT AND SOCIETY

[10]

State, corporate, civil society, community, and individual-level initiatives to ensure sustainable development; case studies of environmental movements (Appiko Movement, Chipko Movement, Silent Valley movement); corporate responsibility movement; role played by NGOs.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXTBOOKS:

- [1] Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2020.
- [2] Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 2018.

REFERENCE BOOKS:

- [1] Martin J Ossewaarde., Introduction to Sustainable Development, Sage Publications India Pvt. Ltd, 2018.
- [2] Gilbert M Masters and Wendell P Ela, Introduction to Environmental Engineering and Science, Pearson, 2022.
- [3] Tyler Miller, G and Scott E Spoolman, Environmental Science, Cengage learning, 2019.
- [4] Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning, 2016.

WEB REFERENCES:

- [1] "Introduction to Environmental Engineering and Science - Fundamental and Sustainability,"
https://onlinecourses.nptel.ac.in/noc25_ge17/preview
- [2] https://onlinecourses.nptel.ac.in/noc25_hs86/preview
- [3] https://onlinecourses.nptel.ac.in/noc25_mm57/preview

25HS251	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
D1	Understand the foundational rules of English grammar, including parts of speech, tenses, and subject-verb agreement, to ensure accuracy in both written and spoken communication.	9	-
D2	Describe the various strategies for effective reading and listening, such as skimming, scanning, and extracting specific information from a range of texts and audio sources.	9	-
D3	Identify key strategies for improving presentation skills, group discussions, and technical sales talks, along with their grammatical and structural requirements.	9,11	-
D4	Apply appropriate writing strategies to compose professional documents, including formal letters, emails, resumes, and technical reports.	9,11	-
D5	Demonstrate effective oral communication skills by delivering a self-introduction, participating in group discussions, and giving a formal presentation on a technical topic.	5,9,11	-
D6	Interpret visual graphics and respond appropriately in professional scenarios such as a sales talk, a product description, or an interview.	5,9,11	-

IMPORTANCE OF COMMUNICATION

[6]

Reading: Reading Comprehension, Skimming and Scanning

Speaking: Self-introduction

Writing: Grammar- Parts of Speech, Tense, Subject-Verb Agreement

Listening: Listening to documentaries and interviews with celebrities.

FORMAL COMMUNICATION

[6]

Reading: Reading Newspaper and Articles, Reading for specific information.

Speaking: Describing a product/place, Conversation practice

Writing: Grammar- Present Tense, Compound Nouns, Question types: Wh./Yes or No and Tags, Paragraph Writing, Email writing.

Listening: Listening to motivational talks / TED talks

WRITING STRATEGIES

[6]

Reading: Cloze reading

Speaking: Role-Play, Picture description.

Writing: Grammar- Past Tense, Gerunds and Infinitives, Articles, Modal Verbs, Recommendations, Checklist.

Listening: Listening to stories and event narration.

PRESENTATION SKILLS

[6]

Reading: Interpreting pictures of visual graphics.

Speaking: Group Discussion

Writing: Grammar- Future Tense, If Conditional Clause, Voices, Formal Letters (Quotations, Clarification, Placing orders & Complaint letter), SOP for conducting an event

Listening: Listening to Group Discussion and Interview Skills.

TECHNICAL COMMUNICATION

[6]

Reading: Reading advertisements and company profiles.

Speaking: Presentation on the technical topic, Sales talk.

Writing: Grammar-Purpose and Function, Prefix and Suffix, Reported Speech, Resume Writing, Report (Industrial visit reports, Accident report, Feasibility Reports).

Listening: Listening to Product description and Process

LIST OF LABORATORY EXERCISES

READING

[6]

1. Understanding short, real-world notices, messages. (Notices, messages, adverts)
2. Detailed comprehension of factual material: Skimming and scanning skills (Longer text, business reports, Product description)
3. Interpreting visual information (Graphs, Charts, Tables, etc.)

SPEAKING

[8]

4. General Conversation on Business Context
5. Giving product information and expressing opinions
6. Technical Presentation (PPT)

WRITING

[8]

7. Arranging appointments, asking for permission, giving instructions
8. Apologizing and offering compensation, dealing with requests, giving information about a product. (e mail writing, letter writing, notices)

LISTENING

[8]

9. Listening for specific information (short conversations)
10. Listening for specific information (telephonic conversation, interview discussion)

Total Notional Hours : 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

[1] Technical English 2nd Edition Level2 Course Book and eBook, David Bonamy, 2022

[2] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).

REFERENCE BOOKS:

[1] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).

[2] Cambridge BEC4 Preliminary (BEC Practice Tests), Cambridge university press, 2021.

WEB REFERENCES

[1] "NPTEL," https://www.youtube.com/playlist?list=PLzf4HHlsQFwIQUeZq_ykEVB6qZrTRnJZn

[2] https://www.youtube.com/playlist?list=PL3qvHcrYGy1sU_1nMMVrfFEhYROpQtVXV

25HS270	PROFESSIONAL ENGLISH	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Identify the process of improving specific skills to be more efficient and effective to perform a task.	9	-
CO2	Understand the concept of email writing, structures of grammar and to interpret advance listening skills	5,9,11	-
CO3	Infer the strategies of academic writing using advanced grammar mechanics.	5,9,11	-
CO4	Apply different styles and techniques of communication in professional context.	5,9,11	-
CO5	Develop the skills to perform tasks more efficiently, adapt to new challenges, and achieve goals faster.	5,9,11	-

RESUME / REPORT PREPARATION / LETTER WRITING

[6]

Structuring the Resume / Report – Letter Writing / E-mail Communication – Samples.

PRESENTATION SKILLS

[6]

Elements of an Effective Presentation – Structure of a Presentation –Presentation Tools – Voice Modulation – Audience Analysis – Body Language.

SOFT SKILLS

[6]

Time Management – Articulateness – Assertiveness – Innovation and Creativity – Stress Management & Poise.

GROUP DISCUSSION

[6]

Why is GD Part of the Selection Process? – Structure of a GD- Moderator-led and Other GDs – Strategies in GD – Team Work – Body Language –Mock GD.

INTERVIEW SKILLS

[6]

Kinds of Interviews –Required Key Skills – Corporate Culture- Mock Interviews

Total Notional Hours : 30

L	T	P	TW+SL	C
30	0	0	0	1

TEXT BOOKS:

- [1] E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2020
- [2] Sheetal Desarda Master the Group Discussion & Personal Interview Notion Press: Delhi, 2020.

REFERENCE BOOKS:

- [1] Butterfield, Jeff Soft Skills of Everyone. Cengage Learning: New Delhi, 2019
- [2] Effective Communication Skills, Khanna Publishing house, ISBN 10-82609-94-6, 2024
- [3] Cambridge BEC resource (Web): Cambridge English Exams IELTS Resources
- [4] Jack C. Richards. Cambridge Fifth Edition Interchange (with CD), 5 nd Edition, Cambridge University Press, 2021.

WEB REFERENCES

- [1] <https://www.youtube.com/playlist?list=PLUP07JBWJm8preRogkAN3TT0YGJVdPJuu>
- [2] https://www.youtube.com/playlist?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ

25IT210	CYBERCRIMES - LAW, PRACTICE AND PROCEDURES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the jurisprudential basis, scope, and classification of cybercrimes under Indian law.	2, 6, 8	-
CO2	Explain the key provisions of the Information Technology Act, 2000, and the Digital Personal Data Protection Act, 2023.	6, 8	-
CO3	Recall the procedural framework for cybercrime investigation.	6	-
CO4	Identify the legal principles governing the admissibility and evidentiary value of electronic records in court.	6	-
CO5	Apply legal principles to real-world cybercrime scenarios.	2, 6, 8	-

Foundations of Cyber Law and Jurisdiction

[6]

Introduction to Cyberspace and Cyber Law - Definition, evolution, and need for cyber laws - Jurisprudence of Cyber Law: Challenges of regulating the borderless digital world - Overview of the Indian legal framework: Constitution of India, IPC/BNS, Evidence Act/BSA, and the IT Act - The Information Technology Act, 2000 - Objectives, scope, and salient features - Key amendments via the IT (Amendment) Act, 2008 - Legal recognition of electronic records and digital/electronic signatures - Jurisdictional Issues in Cyberspace - Theories of cyber jurisdiction - Issues in cross-border data flow and investigation - Provisions for extra-territorial application under the IT Act.

Cyber Offenses and Legal Provisions

[6]

Offenses under the Information Technology Act, 2000 - Section 43: Penalty and compensation for damage to computer systems - Section 66: Computer-related offenses (Hacking, data alteration, virus dissemination) - Section 66B: Punishment for dishonestly receiving stolen computer resource - Section 66C: Punishment for identity theft - Section 66D: Punishment for cheating by personation by using computer resource - Section 66E: Punishment for violation of privacy - Section 66F: Punishment for cyber terrorism - Analysis of Specific Cybercrimes: Against Persons: Cyber stalking, cyber bullying, cyber defamation, online harassment, morphing, and publishing obscene content (Section 67, 67A, 67B) - Against Property: Phishing, vishing, online fraud, credit/debit card frauds, Intellectual Property (IP) crimes, and cybersquatting - Against Government: Cyber terrorism and espionage - Overlap with Traditional Laws: - Applicability of the Bharatiya Nyaya Sanhita (BNS), 2023 (and IPC) to cybercrimes - Mapping between IT Act offenses and BNS offenses (cheating, forgery, defamation, stalking) - Case studies.

Cybercrime Investigation and Procedure

[6]

The Investigation Framework: Role and powers of the Investigating Officer (IO) - Procedure for registration of cybercrime complaints (FIR vs. NCR) - Issues of territorial and subject-matter jurisdiction for investigation - Search, Seizure, and Arrest: Procedural requirements for search and seizure of computer resources - Handling of digital evidence at the crime scene: Do's and Don'ts - Arrest of an accused in a cybercrime case - Intermediary Liability and Data Disclosure - Definition and role of intermediaries (ISPs, social media platforms) - Safe harbor provisions and due diligence requirements

(Rules under IT Act) - Procedures for lawful interception, monitoring, and decryption (Section 69) - Obligations to preserve and retain user information (Section 67C).

Electronic Evidence and Courtroom Procedure

[6]

Electronic Evidence under the Indian Evidence Act, 1872 / Bharatiya Sakshya Adhiniyam (BSA), 2023 - Concept of primary and secondary evidence for electronic records - Admissibility of electronic evidence (Section 65B of Evidence Act / corresponding provisions in BSA) - The "Certificate under Section 65B" – requirements and judicial interpretation - Forensic Analysis and Reporting - Trial of Cybercrime Cases - Pre-trial procedures (cognizance of offenses, taking of evidence) - Role of key players: Judge, Prosecutor, Defense Counsel, Expert Witness - Preparation of case materials for court: Chronology, evidence log, and presentation.

Emerging Issues, Ethics, and Case Laws

[6]

Data Protection and Privacy: Overview of the Digital Personal Data Protection (DPDP) Act, 2023 - Rights and duties of data principals (citizens) and obligations of data fiduciaries - Interface between the DPDP Act and the IT Act - Specialized Cybercrimes: Legal issues in E-Banking and Mobile Payments - Social media-related crimes and platform accountability - Cryptocurrency and blockchain-related frauds.

60 Notional Hours

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] R.P. Kataria & S.K.P. Srinivas. Cyber Crimes: Law, Practice and Procedure, 2/E. Orient Publishing Company, 2025.

REFERENCE BOOKS:

[1] Dr Gupta & Agrawal. Cyberlaws. Premier Publication Company, 2024.

[2] D.P. Mittal. Law Relating to Information Technology, E-Commerce, E-Governance & Cyber Crimes. Orient Publishing Company, 2025.

WEB REFERENCES:

[1] "The Information Technology Act, 2000," https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf

[2] "The Digital Personal Data Protection Act, 2023," <https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

25IT211	CYBER ETHICS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational ethical theories, normative principles, and the complex architecture of the internet that shape moral dilemmas in cyberspace.	1, 2, 7	1
CO2	Identify contemporary issues involving free speech, intellectual property, and privacy in digital contexts by applying ethical frameworks and relevant legal concepts.	2, 7	1
CO3	Interpret the societal, security, and environmental impacts of networked technologies and cybersecurity measures from the perspective of sustainable and ethical engineering practice.	3, 6	1
CO4	Propose ethical and legal strategies for protecting personal data, securing digital infrastructure, and managing online content, considering principles from statutes.	3, 7	1
CO5	Describe the professional and ethical responsibilities of engineers in promoting inclusive, secure, and rights-respecting digital ecosystems, and commit to the need for continuous learning in this evolving field.	7, 11	1

The Internet and Ethical Values

[3]

Cyberethics and Code – Ethical Values and the digital frontier – Postscript on Moral Theory – Floridi’s Macroethics – Normative Principles – Early history of the internet – The Internet’s architecture – Net neutrality – The World Wide Web – Gatekeepers and Search Engines – Social Networking – Internet Governance – Contested Sovereignty in Cyberspace – Internet Monopolies – Case Studies.

Free Speech and Censorship

[3]

Speech and Internet Architecture – Pornography – Hate Speech – Online Threats – Anonymous speech – Government censorship and the fate of political speech – Case Studies.

Intellectual Property

[3]

Background on Intellectual Property – Issues for the internet and networking technologies – Digital Books and E-books – Case studies.

Privacy Rights in the Age of Surveillance

[3]

Definition and Theory of Privacy – Personal Information on the Internet – Consumer Privacy on the Internet – Privacy Protection – Privacy in the Workplace - Digital Personal Data Protection Act, 2023 – Case Studies.

Securing the Digital Infrastructure

[3]

Vulnerabilities of Networked Technologies – Cybercrime – Anti-Piracy Architectures – Trespass, Hackers and Hacktivism - Security Measures in Cyberspace – Cybersecurity as a Moral Obligation – The Encryption Controversy – New Encryption Disputes and Challenges – Encryption code, Privacy and Free Speech – Case Studies.

30 Notional Hours

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOK:

- [1] Richard A. Spinello. Cyberethics: Morality and Law in Cyberspace, 7/E. Jones & Bartlett Learning, 2021.

REFERENCE BOOKS:

- [1] Terry Halbert, Elaine Ingulli. Cyberethics. CBS Publishers & Distributors Pvt. Ltd, 2004.
[2] Sanjana Singh. Digital Ethics and Cyber Security. Yking Books, 2024.
[3] Joseph Migga Kizza. Computer Network Security and Cyber Ethics, 4/E. McFarland & Company, Inc., 2014.

WEB REFERENCES:

- [1] "The Digital Personal Data Protection Act, 2023,"
<https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>
[2] "Ethics of Technology," <https://ocw.mit.edu/courses/24-131-ethics-of-technology-spring-2023/>

25IT212	INFORMATION STANDARDS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental concepts of information security as defined by the ISO 27k series of standards.	1	1
CO2	Understand the organizational context requirements for establishing an ISMS.	1	1
CO3	Describe the complete ISMS lifecycle.	1	1
CO4	Apply risk assessment methodologies to identify, analyze, and evaluate information security risks based on organizational risk appetite and tolerance	1, 2, 3, 4, 5	1
CO5	Apply the ISO 27001 control framework across various domains to establish comprehensive information security controls.	1, 2, 3, 4, 5	1

Information Security Management Systems

[15]

The CIA Triad (Confidentiality, Integrity, Availability) - Introduction to Management Systems - The ISO 27k Series - The Plan-Do-Check-Act (PDCA) Model - Business Benefits of an ISMS - Understanding the organization, interested parties, and defining the ISMS scope - Leadership & commitment, Policy, Roles - Addressing risks/opportunities, setting security objectives - Resources, Competence, Awareness, Communication, Documented Information - Operational Planning & Control - Risk Identification, Analysis, and Evaluation - Risk Assessment Methodologies (Qualitative vs. Quantitative) - Risk Appetite and Tolerance - The risk assessment process - Risk treatment options (Modify, Retain, Avoid, Share) - The Statement of Applicability (SoA) and Risk Treatment Plan (RTP) - Policies, Roles, Segregation of Duties, Asset Management, Access Control concepts - Supplier Relationships, Information Security Incident Management, Business Continuity, Compliance - HR Security, Training, Remote Work - Physical Perimeter, Secure Areas, Clear Desk/Screen - Endpoint Security, Privileged Access, Malware Protection, Vulnerability Management, Backup - Network Security, Cryptography, Secure Development Lifecycle (SDLC), Logging & Monitoring - Monitoring, Measurement, and Analysis - Conducting Internal Audits (Principles, Planning, Execution); Management Review - Nonconformity and Corrective Action; Continual Improvement - The 2-stage certification audit process; Maintaining certification - Review of the complete ISMS lifecycle - Integration with other frameworks (NIST, COBIT) - Future trends in information security management.

30 Notional Hours

L	T	P	TW+SL	C
15	0	0	15	2

TEXT BOOK:

- [1] ISO/IEC 27001:2022 - Information security, cybersecurity and privacy protection — Information security management systems — Requirements. ISO, 2022.

25ME213	QUALITY SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Understand the basic concepts and principles of Total Quality Management (TQM).	1,2	3
CO2	Explain leadership, customer satisfaction, teamwork, and continuous improvement in TQM.	2,4,5	3
CO3	Apply quality tools and techniques such as PDCA, 5S, Kaizen, Six Sigma, and FMEA.	3,5,7	1,3
CO4	Analyze process quality and use quality improvement methods in industries.	1,2	1,3
CO5	Understand ISO 9000 and ISO 14000 standards and their applications in quality and environmental management systems.	3,5,7	3

INTRODUCTION

[9]

Definition of Quality – Dimensions of Quality - Product quality and service quality – Evolution of Quality – Total Quality Management – Definition – Benefits and Barriers of TQM.

PRINCIPLES OF TQM

[9]

Leadership - Deming Philosophy, Quality Council, Quality statements - Strategic planning- Customer Satisfaction – Feedback – Employee involvement – Motivation - Empowerment, Team – Teamwork - Recognition - Reward - Continuous process improvement.

QUALITY TOOLS & TECHNIQUES

[15]

PDCA cycle - 5S – Kaizen - Seven Basic Quality Tools - Six-sigma Process Capability- Bench marking - Planning, Pitfalls - FMEA - Design FMEA and Process FMEA.

QUALITY MANAGEMENT SYSTEMS

[12]

Introduction - Benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements - Environmental Management System - Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001-Benefits of EMS.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] P. N. Mukherjee, Total Quality Management, 2nd ed., PHI Learning, 2024..
- [2] M. P. Poonia, Total Quality Management and Reliability, 2nd ed., Khanna Publishing House, 2025.
- [3] P. M. Charantimath, Total Quality Management, 4th ed., Pearson Education India, 2022.

REFERENCE BOOKS:

- [1] D. D. Sharma, Total Quality Management: Principles, Practice and Cases, 2nd rev. ed., Sultan Chand & Sons.
- [2] P. L. Jain, Quality Control & Total Quality Management, McGraw Hill Education
- [3] N. V. S. Raju, Total Quality Management, 1st ed., Cengage Learning India.

WEB REFERENCES

- [1] “Total Quality Management – I” <https://nptel.ac.in/courses/110104080>
- [2] “Total Quality Management – II” <https://nptel.ac.in/courses/110104085>

25ME214	INNOVATION, ENTREPRENEURSHIP AND ENGINEERING SOCIETY	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Identify viable mechanical engineering problems and market gaps using observation and empathy mapping techniques.	2	1,3
CO2	Apply Design Thinking and TRIZ principles to generate innovative solutions for hardware-based challenges.	3	1
CO3	Validate product assumptions through direct customer discovery and low-fidelity prototyping (MVP).	3	1
CO4	Analyze the financial viability of a hardware product by calculating Unit Economics, Bill of Materials (BOM), and Break-even points.	11	3
CO5	Develop a Business Model Canvas and Intellectual Property strategy suitable for mechanical innovations.	6,11	3
CO6	Construct and deliver a persuasive investor pitch deck demonstrating technical and commercial feasibility.	10	3

THE INNOVATOR'S LENS & OPPORTUNITY IDENTIFICATION [6]

Introduction to "Effectuation" vs. "Causation." Differentiating between an engineering hobby and a scalable business.

SOLUTION ARCHITECTURE & PROTOTYPING STRATEGY [6]

Creative Problem Solving using TRIZ (Theory of Inventive Problem Solving) basics. Understanding the Minimum Viable Product (MVP) in a hardware context (Pretotype vs. Prototype).

CUSTOMER DISCOVERY & MARKET VALIDATION [6]

The "Get Out of the Building" methodology. Distinguishing between user needs (functional) and customer wants (emotional/financial).

HARDWARE ECONOMICS & BUSINESS MODELLING [6]

The fatal trap of hardware startups: Unit Economics. Understanding COGS (Cost of Goods Sold), BOM (Bill of Materials), Tooling costs, and Margins. Introduction to the Business Model Canvas (BMC).

IP STRATEGY, FUNDING & PITCHING [6]

Protecting mechanical innovations: Patents vs. Industrial Design vs. Trade Secrets. The Funding Ladder: Bootstrapping vs. Grants (BIRAC/SISFS) vs. Angels.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Aulet, Bill. Disciplined Entrepreneurship: 24 Steps to a Successful Startup. John Wiley & Sons, 2013. (The Bible for rigorous academic entrepreneurship)
- [2] Ries, Eric. The Lean Startup. Crown Business, 2011.

REFERENCE BOOKS:

- [1] Fitzpatrick, Rob. The Mom Test: How to talk to customers & learn if your business is a good idea when everyone is lying to you. Founder Centric, 2013. (Essential for validation).
- [2] Kawasaki, Guy. The Art of the Start 2.0. Portfolio, 2015.
- [3] Thiel, Peter. Zero to One: Notes on Startups, or How to Build the Future. Crown Bu

WEB REFERENCES

- [1] “Startup School” [Online]. Available, <https://www.startupschool.org/>
- [2] “Entrepreneurship” <https://nptel.ac.in/courses/110106141>
- [3] “Innovation by Design”<https://nptel.ac.in/courses/107101086>

25ME215	PROFESSIONAL ETHICS AND ENGINEERING ECONOMICS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the principles of professional ethics and responsibilities of engineers.	1,7	3
CO2	Illustrate ethical issues, social responsibilities, and sustainable practices in engineering applications.	2,7,10	3
CO3	Apply engineering economics principles for cost estimation and economic decision-making	3,10	2,3
CO4	Examine project evaluation techniques and economic feasibility methods in industries.	4,10	3
CO5	Recognize the importance of ethical conduct and economic decision-making in professional engineering.	7,10,11	3

FUNDAMENTALS OF PROFESSIONAL ETHICS

[8]

Introduction to professional ethics – Engineering ethics and moral values – Ethics in engineering practice – Code of Ethics by NSPE – Rights and responsibilities of engineers – Ethical decision-making – Case studies on professional ethics.

ENGINEERING ETHICS AND SOCIAL RESPONSIBILITY

[7]

Safety, risk, and reliability in engineering – Environmental ethics – Sustainable development – Intellectual property rights and cyber ethics – Conflict of interest – Ethical issues in modern technology – Responsibilities towards society and profession.

FUNDAMENTALS OF ENGINEERING ECONOMICS

[8]

Introduction to engineering economics – Time value of money – Interest calculations – Economic decision-making – Cost concepts and estimation – Break-even analysis – Depreciation methods.

ECONOMIC ANALYSIS AND INDUSTRIAL APPLICATIONS

[7]

Capital budgeting techniques – Economic comparison of alternatives – Project evaluation methods – Inflation and taxation concepts – Economic analysis in industrial engineering projects – Case studies in engineering economics.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Engineering Ethics, Cengage Learning, 6th ed., 2021.
- [2] Engineering Economics and Costing, PHI Learning, 1st ed., 2021.
- [3] Professional Ethics and Human Values, New Age International Publishers, Rev. ed., 2022.

REFERENCE BOOKS:

- [1] Contemporary Engineering Economics, Pearson Education, 7th ed., 2022.
- [2] Engineering Ethics: Concepts and Cases, Cengage Learning, Latest ed., 2021.
- [3] Principles of Engineering Economy, Wiley India, 9th ed., 2021.
- [4] Ethics in Engineering Practice and Research, Cambridge University Press, Latest ed., 2021.

WEB REFERENCES

- [1] "Principles of Management," <https://nptel.ac.in/courses/110105146>
- [2] "Ethics in Engineering Practice," <https://nptel.ac.in/courses/110105097>
- [3] "Ethics in Engineering," <https://www.coursera.org/learn/ethics-in-engineering>

BASIC SCIENCE COURSES (BSC)

25CH201	GREEN COMPUTING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamentals and importance of green computing in reducing environmental impact.	1, 6	*
CO2	Compare traditional and green alternatives in computing practices.	1, 6	*
CO3	Use different methods for reducing energy consumption and carbon emissions in computing environment.	1, 6	*
CO4	Apply green computing practices in hardware selection, software development, and system design to minimize ecological footprints.	1, 6	*
CO5	Practice the e-waste management measures proposed under national and global legislations.	1, 6,11	*

GREEN COMPUTING FUNDAMENTALS

[6]

Definition: Personal Computers, Data Centre, Client/Server Architecture - Power consumption of Personal Computers – Power consumption in data centres – Cloud Services - computing and climate change – correlation between energy and data transfer - Case Study.

ENERGY CONSERVATION IN COMPUTING

[8]

Basic cooling mechanism of a personal computer – CPU vs GPU – Performance of Data Centres – Carbon Footprint – Conventional Cooling – Data Centre Cooling – Air Cooling – Rear door heat exchangers – Liquid-to-chip – Single-phase immersion cooling – Advantages of immersion cooling – Case Studies: Zelendata Centar, U.S. Air Force.

E-WASTE MANAGEMENT

[8]

Types of Contamination – Treatment Strategies: Recycling, Landfill disposal, Biological Treatment – Urban mining e-waste for metals – extraction of nanometals – Lifecycle of various elements – Toxicity (Cu, Cr, Pb and Hg) – Plastics in electronics and Electrical Items.

E-WASTE MANAGEMENT PRACTICES

[8]

Practices in India – Policy comparison between developed and developing countries – Impact of e-waste on ecosystem – Phytoremediation – Electro-kinetic remediation – Classification of E-waste – Legislations for e-waste management in India.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

[1] Sapna Jain & Hena Parveen M. Afshar Alam, "Green Computing Approach Towards Sustainable Development", I.K. International Publishing House, 2019.

- [2] Majeti Narasimha Vara Prasad, Meththika Vithanage, Anwesha Borthakur, "Handbook of Electronic Waste Management: International Best Practices and Case Studies", Butterworth-Heinemann, 2020.

REFERENCE BOOKS:

- [1] Bud. E. Smith, Green Computing: Tools and Techniques for Saving Energy, Money, and Resources, CRC Press, 1st ed., 2014 (2024 reprint).

WEB REFERENCES:

- [1] "What is Green Computing? via," <https://www.ibm.com/think/topics/green-computing>
[2] The definitive guide to Immersion Cooling, Green Revolution Cooling (Open ebook)
[3] The State of Sustainability Readiness 2024, IBM think report (Open E-resource)
[4] PC Energy Report 2009, 1E, Alliance to Save Energy (Open E-resource)
[5] "E-waste Management Rules, Central Pollution Control Board, Ministry of Environment, Forest and Climate Change, Government of India," <https://cpcb.nic.in/rules-6/>

25CH202	ELECTRONIC MATERIAL SCIENCES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the primary concerns of substrate materials used in electronics industry.	1	-
CO2	Understand the chemical aspects of industrially important substrates and advanced materials.	1, 2	-
CO3	Identify the nature of substrate materials present in the electronic component.	1, 2	-
CO4	Select the relevant coating techniques for producing various electronic components.	1, 11	-
CO5	Choose an appropriate substrate material for the manufacture of electronic devices.	1, 11	-

CHEMISTRY OF ELECTRONIC MATERIALS

[10]

Substrates-Introduction-common substrate materials used in electronics industry-Key Considerations for Substrate Materials-Compatibility with Molecules, Electrical Conductivity, Mechanical Properties, Thermal Stability, Cost and Scalability. Industrially important Flexible Substrates-Polyethylene Terephthalate, Conducting polymers, Polyimide-Graphene Oxide-Preparation, properties and applications. Advanced Materials- Silicon carbide, Aluminium nitride, Gallium nitride, Tin (IV) oxide-Preparation, properties and applications.

SEMICONDUCTOR FABRICATION TECHNIQUES

[10]

Introduction-production of electronic grade silicon-Czochralski process (CZ), Float Zone(FZ) methods and Bridgman techniques, Purification of Si and Ge for semiconductor applications. Lithography-Types of Lithography, Applications of Lithography, Thin Film Deposition Techniques-Pulsed Laser Deposition (PLD) and Atomic Layer Deposition (ALD). Epitaxy: Vapor Phase Epitaxy- Liquid Phase Epitaxy – Molecular Beam Epitaxy.

CHEMICAL PROCESS IN PCB FABRICATION

[10]

PCB substrates-Introduction-Electrical, mechanical, thermal and chemical properties-Types of PCB substrates- FR-4, Flex PCB substrates, Rigid PCB substrates and Flex-Rigid PCB substrates-Photoresists-Chemistry-types-applications. Chemical Processes in PCB Fabrication-Photolithography-Etching techniques-Ammoniacal etching, etch factor. Plating-Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB. Advanced PCBs-HDI PCBs, Microelectronic PCBs, Aerospace and Defense PCBs, controlled impedance PCBs, RF and Microwave PCBs, PCB mass production.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Andrew R Barron, Chemistry of Electronic Materials, Midas Green Innovations, 2021.
- [2] Otto Hutzinger, Stephen Safe, and Vladimir Zitko ,The chemistry of PCB's, CRC Pr I Llc, 2017.

REFERENCE BOOKS:

- [1] Lesley E.Smart, Elaine A.Moore Solid State Chemistry - an Introduction, 5th ed. , CRC Press., London, 2021.
- [2] Hartmut Frey and Hamid R Khan, Handbook of Thin-Film Technology, Springer., 2015.
- [3] Peter Van Zant Microchip Fabrication: A Practical Guide to Semiconductor Processing,6th ed., Mc Graw Hill., 2014.

WEB REFERENCES:

- [1] "Materials Science for Advanced Technological Applications,"
<https://www.coursera.org/specializations/materials-science-for-advanced-technological-applications>
- [2] https://onlinecourses.nptel.ac.in/noc25_ge74/preview
- [3] "Electrical Properties and Semiconductors," <https://www.coursera.org/learn/electrical-properties-and-semiconductors>
- [4] https://onlinecourses.nptel.ac.in/noc25_cy71/preview

25CH203	ENVIRONMENT AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of environment and sustainability.	1	-
CO2	Understand the over-exploitation of our natural resources and the need for sustainability.	1	-
CO3	Describe the importance of sustainable development.	1	-
CO4	Use different approaches for attaining environmental sustainability.	1	-
CO5	Apply sustainable practices to real-world environmental management scenarios.	1,6,11	-

ENVIRONMENT

[10]

Definition, scope and importance of environment – Components of environment - Atmosphere, lithosphere, hydrosphere and biosphere - types of environment – Natural – man – made - Environmental education- objectives, importance and scope - Need for public awareness.

CONCEPTS OF SUSTAINABILITY

[10]

Sustainability- concept, needs and challenges-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint.

SUSTAINABLE PRACTICES

[10]

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Energy Cycles carbon cycle, emission and sequestration, Electronic waste recycling : Waste Printed Circuit Board, delamination and metal recovery- Spent batteries and recovery of valuable materials from waste electrodes.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2016.
- [2] Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 2018..

REFERENCE BOOKS:

- [1] Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
- [2] Martin J Ossewaarde., Introduction to Sustainable Development, Sage Publications India Pvt. Ltd, 2018.

- [3] Gilbert M Masters and Wendell P Ela, Introduction to Environmental Engineering and Science, Pearson, 2022.
- [4] Tyler Miller, G and Scott E Spoolman, Environmental Science, Cengage learning, 2019.
- [5] Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning, 2016.

WEB REFERENCES:

- [1] "Introduction to Environmental Engineering and Science - Fundamental and Sustainability,"
https://onlinecourses.nptel.ac.in/noc25_ge17/preview
- [2] https://onlinecourses.nptel.ac.in/noc25_hs86/preview
- [3] https://onlinecourses.nptel.ac.in/noc25_mm57/preview

25CH204	ELECTROCHEMICAL ENERGY SYSTEMS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of various electrochemical energy systems.	1	-
CO2	Identify the key parts of electrochemical energy devices.	1	-
CO3	Understand the applications of various energy conversion technologies.	1	-
CO4	Demonstrate the working of batteries, super capacitors and fuel cells.	1, 11	-
CO5	Choose the relevant components for the fabrication of energy devices for industrial applications.	1, 11	-

BATTERIES

[12]

Fundamental concept of batteries – Characteristics-classification– primary batteries (Leclanche cell, alkaline battery and lithium battery) – secondary batteries (lead acid, Ni-Cd, Ni-metal hydride, lithium ion and sodium ion)-fabrication and working- Drone batteries-LiPo-Electric vehicles – working principle. Forms of corrosion- uniform, pitting, crevice, intergranular and stress corrosion-Corrosion protection by design, anodic and cathodic protection, corrosion inhibitors - types and applications.

SUPERCAPACITORS

[8]

Introduction-Definition-Supercapacitors-Storage principle- types of supercapacitors, cycling and performance characteristics-difference between battery and supercapacitors-Introduction-Principle and applications-Hybrid electrochemical supercapacitors.

FUEL CELLS

[10]

Fundamentals and Electrochemistry of fuel Cell- Electrode kinetics, over potential and cell polarization curve –Types – Hydrogen – Oxygen, Hydrogen air cell-Hydrocarbon air cell-Alkaline fuel cell, direct methanol-solid oxide and biofuel cells- construction, working and applications.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Sharma, R. K. Electrochemistry for energy systems (1st ed.). Narosa Publishing House, 2022.
- [2] Vladimir S. Bagotsky, Alexander M. Skundin, Yuriy VM. Volfkovich., Electrochemical power sources: Batteries, fuel cells and supercapacitors, John Wiley & Sons, Inc.,2015.

REFERENCE BOOKS:

- [1] Beard, K.W., Linden's handbook of batteries. McGraw-Hill Education, 2019.
- [2] Petrovic, S., Battery Technology Crash Course, Springer International Publishing, 2021.
- [3] Ma, J., Battery Technologies: Materials and Components., John Wiley & Sons, 2021.
- [4] Electrochemical Energy Systems - Foundations, Energy Storage and Conversion, Braun, A., de Gruyter, 2018.
- [5] Singh, G., Advanced battery technology for energy storage applications (1st ed.). New Age International Publishers, 2019.

WEB REFERENCES:

- [1] "Primary and Secondary Batteries," <https://www.coursera.org/learn/primary-and-secondary-batteries>
- [2] "Lithium-Based Batteries," <https://www.coursera.org/learn/lithium-based-batteries>
- [3] "Battery Technologies," <https://www.coursera.org/specializations/battery-technologies>
- [4] "Next-Gen Energy Storage: Battery and Hydrogen Technology,"
<https://www.coursera.org/learn/next-gen-energy-storage---battery-and-hydrogen-technology>

25IT201	BIO-INSPIRED COMPUTING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review the basic concepts of bio-inspired optimization techniques.	1,2	*
CO2	Identify the main components of human biological systems and explain their respective functions.	1,2	*
CO3	Describe Mendel's laws of inheritance, gene mapping, and the impact of mutations on genetic abnormalities.	1,2	*
CO4	Compare biological neural networks with artificial neural networks.	1,2	*
CO5	Use bio-inspired optimization algorithms for addressing engineering optimization problems.	2,3	*
CO6	Develop artificial immune system models for network security, using biological principles.	2,3	*

BIO-INSPIRATION

[3]

Optimization and Bio-inspiration – Ant Colony – Bee colony – Particle Swarm Optimization principles – Modern Optimization techniques: Ant Lion – Dragonfly – Grey Wolf – Grasshopper – Advances in Swarm Intelligence.

GENETICS

[4]

Modern and Future Genetics – Heredity and Principles of Heredity – Mendel's law of inheritance – Dominance – Independent Assortment – Segregation – Allele – Gene mapping – Gene interaction – Mitosis and Meiosis – Phenotype Mapping – Mutation and abnormalities.

NERVOUS SYSTEM

[4]

Components of Human Nervous System – human neural network and its function – inspiration towards artificial neural networks – comparison – Perceptron model.

IMMUNE SYSTEM

[4]

Human immune system – organs, cells, immunity - functionalities – artificial immune system – network security applications.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Annamma Odaneth, *Biology for Engineers*, All India Council for Technical Education, 2023.
 [2] Bibekanand Mallick, *Biology for Engineers*, McGraw-Hill, 1st ed., 2021.

REFERENCE BOOKS:

- [1] Seyedali Mirjalili, Jin Song Dong, Andrew Lewis, *Nature-inspired Optimizers: Theories, Literature Reviews and Applications*, Springer: Studies in Computational Intelligence, 2020.

- [2] Seyedali Mirjalili, *Evolutionary Algorithms and Neural Networks: Theory and Applications*, Springer: Studies in Computational Intelligence, 2019.
- [3] S. N. Sivanandam, S. N. Deepa, *Principles of Soft Computing*, Wiley, 2018 (2019 Reprint).

25MA201	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamental concepts expressed as matrix algebra, multivariable calculus and the solution techniques for ordinary differential equations.	1,2	*
CO2	Recall the definitions of eigenvalues and eigenvectors, notations of partial and total derivatives of vector field and standard form of second and higher order ODE.	1,2	*
CO3	Apply mathematical techniques from matrix theory, calculus and differential equations to solve interdisciplinary problems.	1,11	*
CO4	Examine multivariable functions, vector fields, differential equations and real-world dynamic systems, like elastic membranes and vibrating systems.	1,2,8,9,11	*
CO5	Integrate mathematical tools from matrices, multivariable calculus, vector calculus and differential equations to solve real- world physical systems.	1,2,5,8,9,11	*

MATRICES

[12]

Introduction – Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem (without proof)– Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Stretching of an Elastic Membrane – Vibrating System of two masses on two springs.

MULTIVARIABLE CALCULUS

[12]

Partial derivatives – Total derivative – Differentiation of implicit functions – Change of variables – Jacobian – 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.

MULTIPLE INTEGRALS

[12]

Double integrals – Change the order of integration - Double integrals in polar coordinates – Triple integrals – Rectangular Coordinate System – Cylindrical and Spherical Polar coordinates.

VECTOR CALCULUS

[12]

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Gauss divergence theorem and Stoke's theorems (without proofs)– Verification and application in evaluating line, surface and volume integrals.

ORDINARY DIFFERENTIAL EQUATIONS

[12]

Solution of second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear differential equations - Simultaneous first order linear differential equations with constant coefficients.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF MATLAB PROGRAMS

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Subtraction, Multiplication, Transpose and Inverse.
3. Finding Eigenvalues and Eigenvectors of Higher Order Matrices.
4. Finding Maxima and Minima of functions of two variables.
5. Applications of Taylor's series expansion to find continuity equation in bipolar transistors.
6. Solution of second and higher order ordinary differential equations with constant coefficients
7. Analysis of Dynamic characteristics of Biosensors using ordinary differential equations
8. Evaluating double and triple integral with constant and variable limits.
9. Finding area as double integral.
10. Finding volume as triple integral.

TEXT BOOKS:

- [1] Grewal. B.S, *Higher Engineering Mathematics*, 44th ed., Khanna Publications, Delhi, 2022.
- [2] Erwin Kreyszig, *Advanced Engineering Mathematics*, 11th ed., Wiley India, 2025.
- [3] T. Veerarajan, *Engineering Mathematics I & II*, 3rd ed., McGraw Hill Education India, 2018 (Reprint).

REFERENCE BOOKS:

- [1] James Stewart, *Calculus, Early Transcendental*, 9th ed., Cengage learning, New Delhi, 2020.
- [2] Joel Hass, Christopher Heil and Maurice D.Weir, *Thomas Calculus*, Pearson, 14th ed., New Delhi, 2018.
- [3] B.V. Ramana, *Higher Engineering Mathematics*, McGraw Hill Education, New Delhi, 2017.

WEB REFERENCES

- [1] "Mathematical Methods and its Applications," https://onlinecourses.nptel.ac.in/noc25_ma79/
- [2] "algebra-introduction-to-eigenvalues-and-eigenvectors," <https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear->

25MA202	LINEAR ALGEBRA AND NUMBER THEORY	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the concepts of linear algebra and number theory, including the structure of vector spaces, orthogonality, and congruences.	1,2	*
CO2	Recall the definitions, notations, and fundamental theorems related to vector spaces, linear transformations, inner product spaces, and number theory.	1,2	*
CO3	Use linear algebra techniques and number theory tools to solve computational and theoretical problems.	1,11	*
CO4	Analyze the properties of linear mappings, orthogonality conditions, and congruences in number theory.	1,2,8,9,11	*
CO5	Construct solutions using concepts from linear algebra and number theory to solve complex and non-standard problems.	1,2,8,9,11	*

LINEAR SPACE

[12]

Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.

LINEAR TRANSFORMATIONS

[12]

Introduction, Linear Mappings, Geometric linear transformation of $\mathbb{R}^2$, Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem (without proof), Singular and Nonsingular linear transformations, Invertible linear transformations.

INNER PRODUCT SPACES

[12]

Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram- Schmidt process, QR-factorization, least squares problem and least square error.

CONGRUENCES

[12]

Introduction, Congruences and Equivalence Relations, Linear Congruences, Linear Diophantine Equations and the Chinese Remainder Theorem, Modular Arithmetic: Fermat's Theorem, Wilson's Theorem and Fermat Numbers. Polynomial Congruences, Pythagorean equations, Legendre symbol, Quadratic reciprocity, the Jacobi symbol.

NONLINEAR DIOPHANTINE EQUATIONS

[12]

Pythagorean triangles, Fermat's last theorem, Sum of Squares, Pell's equation, Mordell's equation.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF EXPERIMENTS (MATLAB)

1. Finding bases and dimensions for the vector spaces and subspaces.
2. Finding the matrix representation of a linear transformation.

3. Data Transmission and processing of digital signals using vector spaces.
4. Prime number checker
5. Euclidean Algorithm
6. Extended Euclidean Algorithm
7. Modular inverse
8. Fermat's Little theorem

TEXT BOOKS:

- [1] Richard Bronson, Gabriel B.Costa, *Linear Algebra*, 6th ed., Academic Press Publications 2023.
- [2] Erwin Kreyszig, *Advanced Engineering Mathematics*, 11th ed., Wiley India, 2025.
- [3] Thomas Koshy, *Elementary number theory with Applications*, Academic Press Inc, 2nd ed.- 2009.

REFERENCE BOOKS:

- [1] Davis C Lay, Stephen R, *Linear Algebra and its Applications*, 6th ed., Pearson, 2020
- [2] Neville Robbins, *Beginning Number Theory*, 2nd ed.-Jones and Barlett Publications, 2006.
- [3] David M Burton, *Elementary Number Theory*, Tata McGraw Hill Publ.-1st ed. 2010.
- [4] Gareth A. Jones and Josephine Mary Jones, *Elementary Number Theory*, Springer 1998.

WEB REFERENCES

- [1] "Linear Algebra," https://onlinecourses.nptel.ac.in/noc25_ma114/preview
- [2] "A Basic Course in Number Theory," https://onlinecourses.nptel.ac.in/noc25_ma102/preview
- [3] "MathWorks," <https://www.mathworks.com>

25MA203	TRANSFORMS AND COMPLEX VARIABLES	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the underlying principles and theorems of transforms and complex functions.	-	-
CO2	Recall the fundamental concepts and properties of Laplace, Fourier, Z-transforms and techniques of analytic functions and complex integration.	-	-
CO3	Use Laplace, Fourier and Z-transforms to solve ordinary differential equations and difference equations in engineering contexts.	1,11	-
CO4	Examine continuous and discrete domain methods, analytic functions and complex integrals in engineering field.	1,2,11	-
CO5	Construct solutions by combining transform methods and complex variable techniques to solve engineering problems.	1,2,5,11	-

LAPLACE TRANSFORMS

[12]

Transform of elementary functions -Properties - Transform of derivatives and integrals - Transform of unit step function, Unit impulse function - Transform of Periodic functions - Inverse Laplace transforms – Convolution theorem - Initial and Final value theorems - Solution of linear second order ordinary differential equations with constant coefficients.

FOURIER TRANSFORMS

[12]

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Finite Fourier sine and cosine transforms.

Z TRANSFORMS

[12]

Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - Transform.

ANALYTIC FUNCTIONS

[12]

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, $w = kz$, $w = 1/z$ and bilinear transformation.

COMPLEX INTEGRATION

[12]

Complex integration – Statement of Cauchy's integral theorem - Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF MATLAB PROGRAMS

1. Solution of Differential equations using Laplace Transform techniques
2. Solution of Difference equations using Z-transform techniques
3. Rate of change of output signals with respect to input signals using Laplace transform
4. Image analysis using Fourier transforms
5. Analysis of discrete signals using Z-transforms
6. Evaluating a complex integral.
7. Comparison of Taylor's series approximation with actual function.
8. CT Image based Reconstruction Techniques using analytic functions.
9. Analysis of Biosignals using Cauchy's contour integral technique.
10. Find solution for Maxwell's Equation.

TEXT BOOKS:

- [1] Grewal. B.S, *Higher Engineering Mathematics*, 44th ed., Khanna Publications, Delhi, 2022.
- [2] Erwin Kreyszig, *Advanced Engineering Mathematics*, 11th ed., Wiley India, 2025.
- [3] T. Veerarajan, *Transforms and Partial Differential Equations*, 3rd ed., McGraw Hill Education India, 2016

REFERENCE BOOKS:

- [1] Ravish R Singh and Mukul Bhatt, *Engineering Mathematics*, 1st ed., Tata McGraw Hill Education, New Delhi, 2020.
- [2] Srimanta Paul and Subodh C. Bhunia, *Engineering Mathematics*, Oxford University Press, 1st ed., 2015.
- [3] Peter V. O'Neil, *Advanced Engineering Mathematics*, Cengage Learning India Pvt. Ltd., New Delhi, 8th ed., 2017.

WEB REFERENCES

- [1] "Advanced Engineering Mathematics," https://onlinecourses.nptel.ac.in/noc25_ma85/preview
- [2] "Laplace Transform," <https://www.khanacademy.org/math/differential-equations/laplace-transform>
- [3] "MathWorks," <https://www.mathworks.com>

25MA204	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the underlying principles and theorems of transforms and complex functions.	-	-
CO2	Recall the fundamental concepts and properties of Laplace, Fourier, Z-transforms and techniques of analytic functions and complex integration.	-	-
CO3	Use Laplace, Fourier and Z-transforms to solve ordinary differential equations and difference equations in engineering contexts.	1,11	-
CO4	Examine continuous and discrete domain methods, analytic functions and complex integrals in engineering field.	1,2,11	-
CO5	Construct solutions by combining transform methods and complex variable techniques to solve engineering problems.	1,2,5,11	-

LAPLACE TRANSFORMS

[12]

Transform of elementary functions - Properties - Transform of derivatives and integrals - Transform of unit step function, Unit impulse function - Transform of Periodic functions - Inverse Laplace transforms – Convolution theorem - Initial and Final value theorems - Solution of linear second order ordinary differential equations with constant coefficients.

PARTIAL DIFFERENTIAL EQUATIONS

[12]

Formation of PDE by elimination of arbitrary constants and functions – Solutions of first order equations – Standard types and Equations reducible to standard types (Type I to 4 only) – Singular solutions – Lagrange's linear equation – Solution of second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

FOURIER SERIES

[12]

Dirichlet's conditions – Expansion of periodic functions into Fourier series – Change of interval – Fourier series for even and odd functions – Half-range expansions – Root mean square value of a function – Parseval's identity – Harmonic analysis.

FOURIER TRANSFORM

[12]

Statement of Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Z - TRANSFORM

[12]

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues)- Initial and final value theorem– Convolution theorem – Formation of difference equations – Solution of difference equations using Z - transform.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF MATLAB PROGRAMS

1. Solution of Differential equations using Laplace Transform techniques
2. Rate of change of output signals with respect to input signals using Laplace transform
3. Time response of RLC circuit using Laplace transformation in MATLAB
4. Analysis of RLC circuit for different conditions using Laplace Transforms.
5. Solution of Difference equations using Z-transform techniques
6. Image analysis using Fourier transforms
7. Analysis of discrete signals using Z-transforms

TEXT BOOKS:

- [1] Grewal. B.S, *Higher Engineering Mathematics*, 44th ed., Khanna Publications, Delhi, 2022.
- [2] Erwin Kreyszig, *Advanced Engineering Mathematics*, 11th ed., Wiley India, 2025.
- [3] T. Veerarajan, *Transforms and Partial Differential Equations*, 3rd ed., McGraw Hill Education India, 2016

REFERENCE BOOKS:

- [1] Ravish R Singh and Mukul Bhatt, *Engineering Mathematics*, 1st ed., Tata McGraw Hill Education, New Delhi, 2020.
- [2] Srimanta Paul and Subodh C. Bhunia, *Engineering Mathematics*, Oxford University Press, 1st ed., 2015.
- [3] Peter V. O'Neil, *Advanced Engineering Mathematics*, Cengage Learning India Pvt. Ltd., New Delhi, 8th ed., 2017.

WEB REFERENCES

- [1] "Advanced Engineering Mathematics," https://onlinecourses.nptel.ac.in/noc25_ma85/preview
- [2] "Laplace Transform," <https://www.khanacademy.org/math/differential-equations/laplace-transform>
- [3] "MathWorks," <https://www.mathworks.com>

25MA207	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply the basic concepts of probability and probability distributions (discrete and continuous) in analyzing engineering-related uncertainties.	1,2,5	1
CO2	Apply the concepts of probability distributions to solve problems in the engineering field.	1,2,5	1.2
CO3	Apply statistical sampling methods and hypothesis testing procedures to draw inferences from data using standard distributions.	1,2,5	1,2
CO4	Apply the principles of experimental design and perform analysis of variance (ANOVA) to interpret experimental data.	1,2,5	1,2
CO5	Apply the methods of statistical process control in the engineering field.	1,2,5	1,2,3

PROBABILITY AND STATISTICAL DISTRIBUTIONS

[12]

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES

[12]

Joint probability distribution – Marginal probability distribution – Conditional probability distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

SAMPLING THEORY

[12]

Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on normal distribution for single mean and difference of means – Tests based on t, Chi-square and F distributions for mean, variance and proportion – Contingency table (test for independent) – Goodness of fit.

DESIGN OF EXPERIMENTS

[12]

Analysis of Variance – One way classification – Two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial designs.

STATISTICAL QUALITY CONTROL

[12]

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF EXPERIMENTS USING MATLAB

1. Verification of axioms of probability and Bayes' theorem
2. Computation of moments for discrete random variables
3. Moment generating function for continuous random variables
4. Simulation of Binomial, Poisson and Geometric distributions
5. Simulation of Uniform, Exponential and Normal distributions
6. Joint, marginal and conditional probability distributions
7. Covariance, correlation and linear regression analysis
8. Verification of Central Limit Theorem using simulation
9. Hypothesis testing using t, Chi-square and F tests
10. Statistical Quality Control charts and acceptance sampling

TEXT BOOKS:

- [1] E. Kreyszig, Advanced Engineering Mathematics, 11th ed., Indian Adaptation. New Delhi, India: Wiley India Pvt. Ltd., 2025.
- [2] R. A. Johnson, I. Miller, and J. E. Freund, Miller & Freund's Probability and Statistics for Engineers, 9th ed. New Delhi, India: Pearson Education, 2020/2023.

REFERENCE BOOKS:

- [1] Papoulis and S. Unnikrishnapillai, Probability, Random Variables and Stochastic Processes, 4th ed. New Delhi, India: McGraw-Hill Education India Pvt. Ltd., 2017.

25MA208	PROBABILITY, STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply the basic concepts of probability and probability distributions (discrete and continuous) in analyzing engineering-related uncertainties	1,2,5	2
CO2	Ability to use the concepts of probability distributions to solve problems in the engineering field	1,2,5	2
CO3	Apply statistical sampling methods and hypothesis testing procedures to draw inferences from data using standard distributions.	1,2,5	2
CO4	Determine the numerical solutions of algebraic, transcendental and system of simultaneous linear equations.	1,2,5	2
CO5	Demonstrate the concept of interpolation with empirical datasets	1,2,5	2

PROBABILITY AND STATISTICAL DISTRIBUTIONS

[12]

Probability – The axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

SAMPLING THEORY

[12]

Sampling distributions – Estimation of parameters – Statistical hypothesis – Large sample tests based on normal distribution for single mean and difference of means – Tests based on t, Chi-square and F distributions for mean, variance and proportion – Contingency table (test for independent) – Goodness of fit.

DESIGN OF EXPERIMENTS

[12]

Analysis of Variance – One way classification – Two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial designs.

SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

[12]

Solution of algebraic and transcendental equations - Newton - Raphson Method- Method of false position - Solutions of Linear system by Gauss Jordan method, Iterative method– Gauss Seidel Method.

INTERPOLATION AND APPROXIMATION

[12]

Interpolation – Lagrangian Polynomials – Newton’s divided difference formula -Newton Forward and Backward difference formula.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF EXPERIMENTS USING MATLAB

1. Verification of Axioms of Probability and Bayes' Theorem
2. Simulation of Discrete and Continuous Random Variables and Statistical Distributions
3. Computation of Moments and Moment Generating Functions
4. Sampling Distributions and Estimation of Parameters
5. Statistical Hypothesis Testing using Z, t, Chi-square and F Tests
6. Tests for Independence and Goodness of Fit using Contingency Tables
7. Analysis of Variance (One-Way and Two-Way ANOVA)
8. Solution of Algebraic and Transcendental Equations using Newton–Raphson and False Position Methods
9. Solution of System of Linear Equations using Gauss–Jordan and Gauss–Seidel Methods
10. Interpolation using Lagrange Polynomial and Newton's Forward & Backward Difference Methods

TEXT BOOKS:

- [1] R. A. Johnson, I. Miller, and J. E. Freund, Miller & Freund's Probability and Statistics for Engineers, 9th ed. New Delhi, India: Pearson Education, 2023.
- [2] P. Kandasamy, K. Thilagavathy, and K. Gunavathy, Numerical Methods. New Delhi, India: S. Chand & Company Ltd., 2015.

REFERENCES:

- [1] R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Probability and Statistics for Engineers and Scientists, 10th ed. Harlow, UK: Pearson Education, 2023.
- [2] J. D. Hoffman, Numerical Methods for Engineers and Scientists, 2nd ed. Hoboken, NJ, USA: Wiley, 2015.
- [3] S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, 7th ed. New York, NY, USA: McGraw-Hill Education, 2020.
- [4] T. Veerarajan, Numerical Methods, 2nd ed. New Delhi, India: Tata McGraw-Hill Education, 2016.

WEB RESOURCES:

- [1] "Probability and Statistics," <https://nptel.ac.in/courses/111105090>
- [2] "Introduction to Data Analytics," <https://nptel.ac.in/courses/110106064>
- [3] "<https://nptel.ac.in/courses/111103070>," nptel.ac.in/courses/111103070
- [4] "Finite Element Analysis," <https://nptel.ac.in/courses/105105041>
- [5] "Khan Academy," <https://www.khanacademy.org>
- [6] <https://www.coursera.org/learn/probability-statistics-data>

25MA209	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Apply probability laws and standard statistical distributions to model uncertainty in systems.	1,2,5	1
CO2	Analyze joint and conditional distributions of two random variables and apply correlation and regression techniques.	1,2,5	1
CO3	Understand the classification of random processes and apply Poisson and Markov models to engineering problems.	1,2,5	1
CO4	Interpret correlation functions and spectral densities for signal analysis.	1,2,5	1
CO5	Apply correlation and spectral techniques to evaluate the response of LTI systems with random inputs.	1,2,5	1

PROBABILITY AND STATISTICAL DISTRIBUTIONS

[12]

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES

[12]

Joint probability distribution – Marginal probability distribution – Conditional probability distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

RANDOM PROCESSES

[12]

Classification – Stationary Processes – Markov process – Markov chain – Poisson process – Random telegraph process.

CORRELATION AND SPECTRAL DENSITIES

[12]

Auto correlation – Cross correlation – Properties – Power spectral density – Cross spectral density – Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function.

LINEAR SYSTEMS WITH RANDOM INPUTS

[12]

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

Total Notional Hours : 120

L	T	P	TW+SL	C
45	15	0	60	4

LIST OF MATLAB PROGRAMMES

1. Verification of Axioms of Probability using MATLAB
2. Computation of Conditional Probability and Verification of Bayes' Theorem
3. Simulation and Analysis of Discrete Random Variables (Binomial, Poisson, Geometric Distributions)
4. Simulation and Analysis of Continuous Random Variables (Uniform, Exponential, Normal Distributions)
5. Computation of Moments and Moment Generating Functions of Random Variables
6. Joint, Marginal and Conditional Probability Distributions of Two Random Variables
7. Computation of Covariance, Correlation Coefficient and Linear Regression
8. Simulation of Random Processes: Markov Chain and Poisson Process
9. Computation of Autocorrelation, Cross-Correlation and Power Spectral Density
10. Analysis of Linear Time-Invariant System with Random Input Signals

TEXT BOOKS:

- [1] Oliver C. Ibe *Fundamentals of Applied Probability and Random Processes*, Elsevier, 2nd ed., 2014.
- [2] Peyton Z. Peebles, *Probability, Random Variables and Random Signal Principles*, Tata Mc Graw-Hill, 4th ed., 2017.
- [3] Grinstead & Snell, *Introduction to Probability* – American Mathematical Society, 2nd ed., 2012.

REFERENCE BOOKS:

- [1] Henry Stark and John W. Woods, *Probability, Statistics and Random Processes for Engineers*, Pearson Education, 4th ed., 2011.
- [2] Geoffrey Grimmett and David Stirzaker, *Probability and Random Processes*, Oxford University Press, 3rd ed., 2021.

WEB REFERENCES:

- [1] "Introduction to Probability,"
https://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/book.html
- [2] "Introduction to Probability, Statistics, and Random Processes,"
<https://www.probabilitycourse.com/>

25PH251	APPLIED PHYSICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamental principles underlying intrinsic and extrinsic semiconductors.	1	-
CO2	Differentiate between the various types of magnetic materials and superconductors.	1	-
CO3	Understand the quantum mechanical principles, various sensors and insulators.	1	-
CO4	Apply appropriate techniques to synthesize and characterize nanomaterials for analyzing their structural and functional properties	1	-
CO5	Simulate experiments related to quantum mechanics and semiconductor physics	1,2,5,8,9	-

SEMICONDUCTOR MATERIALS

[6]

Intrinsic Semiconductor – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductor – Extrinsic semiconductor - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature Applications: LED, solar cell, Photo diodes, PIN diodes, Avalanche diodes.

MAGNETIC AND SUPERCONDUCTING MATERIALS

[6]

Magnetic materials: dia, para, ferro & ferrites - domain theory of ferromagnetism -hysteresis - Applications: Spintronics and Biomedical.

Principle & Properties of superconductor, Types: Type I, Type II, High-Temperature, Organic and Heavy Fermion Superconductors – Applications: SQUID & superconducting qubits in quantum computer.

QUANTUM PHYSICS

[6]

Classical vs quantum information - Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function- normalization. Schrodinger's equation of motion: Time dependent and independent form. Particle in a one-dimensional box and quantum tunneling.

NANO MATERIALS

[6]

Classification based on dimensionality - Quantum Dots, Wires and Wells -graphene- Synthesis of nano materials: Top-Down Process- Mechanical Milling, Bottom -up approach – CVD & PLD – engineering application - Sensors & Energy Storage.

SENSORS AND DIELECTRICS

[6]

Characteristics of sensors: sensitivity, range, resolution, linearity, hysteresis, response time, and accuracy. Temperature sensor: Hot wire anemometer, Thermocouples. Pressure Sensors: Capacitance based and Piezoelectric, Liquid level Sensors: Hall Effect and Ultrasonic. Dielectrics: Electrical, thermal and acoustic Insulators.

LIST OF EXPERIMENTS

[30]

1. Simulation and Analysis of PN Junction Diode V-I Characteristics.
2. Determination of band gap using semiconductor diode.
3. Thermistor: Measurement of temperature and band gap.
4. Experimental Analysis of Photodiode Characteristics
5. Determination of resistivity of metal and alloy using Carey Foster Bridge.
6. Determine the Planck's constant using Photo Electric method.
7. Generation and Initialization of a Qubit for Quantum Computation.
8. Simulation of the Quantum Double-Slit Experiment: Demonstrating Particle-Wave Duality.
9. Spintronic Device Simulation: Spin Valve / Magnetic Tunnel Junction.
10. Study of Graphene's properties.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Dr. M.N. Avadhanulu, Dr. P.G. Kshirsagar, *Engineering Physics* S. Chand Publishing, 1st ed., 2023.
- [2] David A. B. Miller, *Quantum Mechanics for Scientists and Engineers* Cambridge University Press, 2008.

REFERENCE BOOKS:

- [1] J.J. Sakurai, *Modern Quantum Mechanics* Cambridge University Press, 3rd ed., 2020.
- [2] Ashutosh Sharma and Goldie Oza *Nano chemistry: Synthesis, Characterization, and Applications*, CRC Press 1st ed., 2023.

WEB REFERENCES

- [1] "Fundamentals of Semiconductor Devices," <https://nptel.ac.in/courses/108108122>
- [2] "Concepts in Magnetism and Superconductivity," <https://nptel.ac.in/courses/115105131>
- [3] <https://nptel.ac.in/courses/115101010>
- [4] "Nanostructures and Nanomaterials: Characterization and Properties," <https://nptel.ac.in/courses/118104008>
- [5] "Sensors and Actuators," <https://nptel.ac.in/courses/108108147>

25PH252	MATERIAL PHYSICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamental quantum physics concepts, including the de Broglie hypothesis, the Heisenberg uncertainty principle, and the Schrödinger equation formulations.	1	-
CO2	Classify the schemes of nanomaterials based on dimensionality and identify key characterization techniques.	1	-
CO3	Analyze the particle in a box quantum mechanical model using the physical significance of wave functions	1	-
CO4	Understand synthesis methods and unique properties of graphene and quantum dots.	1	-
CO5	Perform experimental characterization of material properties, including band gap determination, resistivity measurement, and photoelectric effect analysis.	1,2,5,8,9	-

FUNDAMENTALS OF QUANTUM PHYSICS IN MATERIALS

[10]

Photons and light waves; electrons and matter waves- de Broglie hypothesis and experimental verification- Heisenberg uncertainty principle - Wave function- normalization - Schrödinger equation- Time-dependent and independent form. Physical Significant of wave function- Particle in a one-dimensional box. Applications: quantum computing.

NANO MATERIALS

[10]

Classification based on dimensionality - Quantum Dots, Wells and Wires- Carbon based nano materials -Graphene- Structure and properties- Applications of Graphene - Synthesis of nano materials: Top-Down Process- Mechanical Milling (Quantitative), Bottom -up approach – electro chemical deposition - chemical (CVD), physical (PVD) and applications of nanomaterials in engineering and medical field - bio materials and applications.

CHARACTERIZATION TECHNIQUES AND ADVANCED ENGINEERING MATERIAL

[10]

Introduction to Structural Characterization of Materials and properties. X-ray diffraction (XRD), electron microscopy Techniques fundamentals: SEM and TEM principles -Metallic glasses – preparation, properties and applications – Shape Memory Alloy (SMA) – mechanisms and phase transformations - Characteristics and properties of NiTi alloy and applications.

LIST OF EXPERIMENTS

[30]

1. Simulation and Analysis of PN Junction Diode V-I Characteristics.
2. Determination of band gap using semiconductor diode.
3. Thermistor : Measurement of temperature and band gap.
4. Experimental Analysis of Photodiode Characteristics
5. Determination of resistivity of metal and alloy using Carey Foster bridge.
6. Determine the Planck's constant using Photo Electric method.

7. Generation and Initialization of a Qubit for Quantum Computation.
8. Simulation of the Quantum Double-Slit Experiment: Demonstrating Particle-Wave Duality.
9. Spintronic Device Simulation: Spin Valve / Magnetic Tunnel Junction.
10. Study of Graphene's properties.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Dr.M.N.Avadhanalu , Dr.P.G. Kshirsagar P G, *Engineering Physics*, S. Chand & Company Ltd, Edition , 2023.
- [2] Halliday, Resnick and Walker, *Fundamentals of Physics*, Wiley International Publications, Extended 10th ed., 2015.

REFERENCE BOOKS:

- [1] Charles Kittel, *Introduction to Solid State Physics*, Wiley India Pvt. Ltd, 7 ed., 2012
- [2] Gaur R K and Gupta S L, *Engineering Physics*, Dhanpat Rai Publications, 2018.
- [3] Marikani A, *Engineering Physics, PHI Publications*, 2nd ed., 2014.
- [4] Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, *Concepts of Modern Physics*, McGraw Hill (Indian Edition), 2024.
- [5] Binns, Chris, *Introduction to nanoscience and nanotechnology*, John Wiley & Sons, 2021.

WEB REFERENCES

- [1] "Nanostructures and Nanomaterials: Characterization and Properties,"
<https://nptel.ac.in/courses/118104008>
- [2] "Quantum Computing," <https://nptel.ac.in/courses/104104082>
- [3] <https://nptel.ac.in/courses/115101010>

25PH253	ENGINEERING PHYSICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Classify various magnetic materials based on their fundamental properties and physical behavior.	1,2	-
CO2	Understand the core principles of quantum mechanics and the essential concepts of superconductivity.	1,2	-
CO3	Perform experiments to investigate semiconductor properties and relate the findings to theoretical models.	1,2	-
CO4	Simulate quantum phenomena and spintronic devices using computational tools to validate quantum principles.	1,2,5	-
CO5	Connect the theoretical foundations of quantum physics with the principles governing spintronics and the behavior of nanomaterials.	1,2,8,9	-

MAGNETIC MATERIALS

[7]

Classification of magnetic materials (diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, and ferrimagnetic), magnetic susceptibility, permeability, hysteresis, and domain theory application of magnetic materials in transformers, magnetic storage devices, and spintronics.

SUPERCONDUCTING MATERIALS

[7]

Principle & Properties of superconductor, Types: Type I, Type II, High-Temperature, Organic and Heavy Fermion Superconductors – Applications: SQUID & superconducting qubits in quantum computer.

QUANTUM PHYSICS

[9]

Classical vs quantum information - Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function- normalization. Schrodinger's equation of motion: Time dependent and independent form. Particle in a box. Importance of Quantum Computing in Modern Technology - Quantum States and Superposition -The Principle of Entanglement - qubit - Bra-ket notation: $|\psi\rangle$, $\langle\psi|$. Single-qubit gates - multi-qubit gates: CNOT.

NANO MATERIALS

[7]

Classification based on dimensionality - Quantum Dots, Wires and Wells- Carbon based nano materials -graphene- Synthesis of nano materials: Top-Down Process- Mechanical Milling, Bottom -up approach – chemical (CVD) and biological method – engineering applications.

LIST OF EXPERIMENTS

[30]

1. Simulation and Analysis of PN Junction Diode V-I Characteristics.
2. Determination of band gap using semiconductor diode.
3. Thermistor: Measurement of temperature and band gap.
4. Experimental Analysis of Photodiode Characteristics
5. Determination of resistivity of metal and alloy using Carey Foster bridge.

6. Determine the Planck's constant using Photo Electric method.
7. Generation and Initialization of a Qubit for Quantum Computation.
8. Simulation of the Quantum Double-Slit Experiment: Demonstrating Particle-Wave Duality.
9. Spintronic Device Simulation: Spin Valve / Magnetic Tunnel Junction.
10. Study of Graphene's properties.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Dr. M.N. Avadhanulu, Dr. P.G. Kshirsagar, *Engineering Physics* S. Chand Publishing, 1st ed., 2023.
- [2] David A. B. Miller, *Quantum Mechanics for Scientists and Engineers* Cambridge University Press, 2008.

REFERENCE BOOKS:

- [1] Kuldeep Singh Kaswan, Jagjit Singh Dhatteval, Anupam Baliyan, Shalli Rani *Quantum Computing: A New Era of Computing* John Wiley & Sons, 2023.
- [2] J.J. Sakurai, *Modern Quantum Mechanics* Cambridge University Press, 3rd ed., 2020.
- [3] Dietmar H. Vollath *Nanomaterials: An Introduction to Synthesis, Properties, and Applications* Wiley-VCH, (2nd ed.), 2013
- [4] Ashutosh Sharma and Goldie Oza *Nano chemistry: Synthesis, Characterization, and Applications*, CRC Press 1st ed., 2023.

WEB REFERENCES

- [1] "Concepts in Magnetism and Superconductivity," <https://nptel.ac.in/courses/115105131>
- [2] <https://nptel.ac.in/courses/115101010>
- [3] "Nanostructures and Nanomaterials: Characterization and Properties," <https://nptel.ac.in/courses/118104008>

ENGINEERING SCIENCE COURSES (ESC)

25AI251	EXCEL MACROS	L	T	P	C
		1	0	2	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of Excel macros and automation	1,2,3	1
CO2	Apply VBA programming concepts to automate tasks	1,2,3,4	1,2
CO3	Use Excel object model for data manipulation	1,2,3,5	1,2
CO4	Design user forms and develop applications	1,2,3,4,5	1,2,3
CO5	Develop real-time automation solutions using VBA	1,2,3,4,5	1,2,3

INTRODUCTION TO EXCEL MACROS

[3]

Overview of Microsoft Excel environment, Introduction to macros, Applications of automation, Enabling developer tab and macro security, Macro recorder, Recording and running macros, Absolute and relative references, Editing recorded macros

VBA PROGRAMMING FUNDAMENTALS

[3]

Introduction to VBA, Visual Basic Editor (VBE), Modules, Sub procedures and Functions, Variables and data types, Constants, Operators and expressions, InputBox and MsgBox

EXCEL OBJECT MODEL

[3]

Object-oriented programming concepts, Workbook, Worksheet, Range and Cells, Properties, Methods and Events, Referencing cells and ranges, Working with multiple worksheets and workbooks

CONTROL STRUCTURES AND ADVANCED CONCEPTS

[3]

Conditional statements (If, Select Case), Looping constructs (For, Do While, For Each), Arrays and collections, User Defined Functions (UDF), Error handling, Debugging techniques

FORMS AND REAL-TIME AUTOMATION

[3]

Creating UserForms, Controls (TextBox, CommandButton, ComboBox, ListBox), Event-driven programming, Automating reports, Dashboard creation basics, File handling (CSV/Text), Sending emails using Outlook

LABORATORY EXPERIMENTS

[30]

1. Record a macro to format a dataset (fonts, colors, borders)
2. Develop a macro to sort and filter data automatically
3. Write a VBA program to perform arithmetic operations on cells
4. Implement loops to calculate sum and average of data
5. Create a User Defined Function (UDF)
6. Write a program to copy data between worksheets
7. Design a simple data entry form using UserForms
8. Develop a macro for automated report generation

9. Implement error handling in VBA program
10. Import data from CSV file and perform data cleaning

Total Notional Hours:60

L	T	P	TW+SL	C
15	0	30	15	2

TEXT BOOKS

- [1] John Walkenbach, Excel VBA Programming for Dummies,Wiley India,2015
- [2] Michael Alexander & Dick Kusleika, Excel 2019 Power Programming with VBA,Wiley,2019

REFERENCE BOOKS

- [1] Paul McFedries, Absolute Beginners Guide to VBA,!st Edition,Kindle Edition
- [2] Bill Jelen, VBA and Macros for Microsoft Excel,Kindle Edition

WEB REFERENCES

- [1] Microsoft Learn – Excel VBA Documentation
- [2] NPTEL Excel/Data Analytics Courses

25CS251	C PROGRAMMING	L	T	P	C
		2	0	4	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of computer organization, generations of computers, and number system representations.	1,2,5,9	1
CO2	Outline the fundamental syntax rules of C programming, such as keywords, data types, operators, and control structures.	1,5	1
CO3	Describe the operational principles of arrays, strings, functions, and pointers in C programming.	1,2,5,9	1,2
CO4	Summarize the structure and usage of sequential and random file access in C.	1,2,5,9	1,2
CO5	Develop C programs using arrays, strings, and functions to solve mathematical, scientific, and statistical problems.	1,2,5,9	1,2
CO6	Implement file handling and structures in C to create applications such as student record management and transaction processing systems.	2,3,5,9	1,2,3

FUNDAMENTALS OF COMPUTING

[6]

Basic concepts of computer organizations, Generation and classification of computers, Number System Representation, Fundamentals of algorithms, Pseudo code, Flow charts.

C LANGUAGE FUNDAMENTALS

[6]

Introduction to C programming, Structure of a C program, Compilation and Linking Processes, Character Set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-Output Operations, Control Structures, Decision Making, Branching & Looping. Application: Solving Simple Scientific and Mathematical Problems.

ARRAYS AND STRINGS

[6]

Introduction to Arrays, One Dimensional Array, Multidimensional Array. Application: Matrix Operations, Sorting, Searching, Sum of Series and Statistical Problems. String Manipulation, String Arrays. Application: Solving problems using String Functions.

FUNCTIONS AND POINTERS

[6]

User Defined and Standard Functions, Formal and Actual arguments, Function Prototypes, Parameter Passing, Call-by-Value, Call-by-Reference, Recursion. Application: Math Functions, Computation of Sine Series, Random Number Generation, Tower of Hanoi and Factorial using Recursive Functions. Pointers, Pointer Variables, Pointer Arithmetic, Passing Parameters by Reference, Pointer to Pointer, Pointers to Functions, Dynamic Memory Allocation. Application: Card shuffling and Dealing Simulation using Pointers.

STRUCTURES, UNIONS AND FILE HANDLING

[6]

Declaration of Structures, Nested Structure, Pointer to Structure, Declaration of Unions, Pointer to Union, Application: Student Records. Storage Classes, Pre-Processor Directives. Files -Types of File Processing: Sequential Access, Random Access. Application: Transaction Processing Program.

LAB EXPERIMENTS:**[60]**

1. Basic I/O and Operators
2. Control Statements
3. Loops and Iterations
4. Arrays
5. Strings
6. Functions
7. Pointers
8. Structures
9. Unions
10. File Handling

Total Notional Hours: 120

L	T	P	TW+SL	C
30	0	60	30	4

TEXT BOOK:

- [1] B.A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach in C, 4th ed. Boston, MA: Cengage Learning, 2023.

REFERENCE BOOKS:

- [1] B. S. Gottfried, Programming with C (Schaum's Outlines Series), 3rd ed. New York, NY: McGraw-Hill Education, 2011.
- [2] E. Balagurusamy, Programming in ANSI C, 9th ed. New Delhi, India: McGraw Hill Education, 2024.
- [3] P. Deitel and H. Deitel, C How to Program, 9th ed. Hoboken, NJ: Pearson Education, 2023.
- [4] B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1988.
- [5] G. Perry and D. Miller, C Programming Absolute Beginner's Guide, 3rd ed. Indianapolis, IN: Que Publishing, 2020.

WEB RESOURCES:

- [1] "Introduction To Programming In C," https://onlinecourses.nptel.ac.in/noc22_cs40/
- [2] "C Programming Tutorial," <https://www.geeksforgeeks.org/c-programming-language/>
- [3] "C Programming," <https://www.programiz.com/c-programming/>

25CS252	DATA STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review key concepts, types, and operations of linear and non-linear data structures.	1,2, 5, 9	1
CO2	Compare the implementation and uses of different list and tree structures.	1,2, 5, 9	1,2
CO3	Describe the working principles of graph algorithms and sorting/searching techniques.	1,2, 5, 9	1,2
CO4	Implement stack and queue ADTs to solve practical problems such as expression evaluation and priority-based processing.	3,5, 9	1,2
CO5	Develop applications using tree and graph data structures for problems like expression trees and network routing.	3,5, 9	1,2,3
CO6	Analyze and compare the efficiency of different sorting algorithms and hashing techniques for various data scenarios.	1,2, 5, 9	1,2

LINEAR DATA STRUCTURES: (LIST)

[6]

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation – singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operation (Insertion, Deletion, Merge, Traversal).

LINEAR DATA STRUCTURES: (STACKS-QUEUES)

[6]

Stack ADT – Evaluating arithmetic expressions- other applications- Queue ADT – circular queue implementation – Double ended Queues – Priority queue - applications of queues.

NON-LINEAR DATA STRUCTURES: (TREES)

[6]

Tree ADT – Tree traversals - Binary Tree ADT – expression trees – applications of trees – Binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

NON-LINEAR DATA STRUCTURES: (GRAPH)

[6]

Representation of Graphs – Breadth-first search – Depth-first search – Topological sort – Minimum Spanning Trees – Kruskal and Prim algorithm – Shortest path algorithm – Dijkstra's algorithm – Bellman-Ford algorithm – Floyd - Warshall algorithm.

SORTING, SEARCHING AND HASHING TECHNIQUES

[6]

Sorting algorithms: Insertion sort - Selection sort - Shell sort - Bubble sort - Quick sort - Merge sort - Radix sort – Searching: Linear search –Binary Search - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendable Hashing.

LAB EXPERIMENTS:

[30]

1. Implementation of Linked List Operations.
2. Implementation of Stack using arrays and Linked list.
3. Implementation of Queue using arrays and Linked list.

4. Implementation of Sorting algorithms.
5. Implementation of Linear search and Binary Search.
6. Implementation of Tree traversal Techniques.
7. Implementation of Depth first Search.
8. Implementation of Breadth first Search.
9. Implementation of Minimum Spanning Trees.
10. Implementation of Shortest Path Algorithms.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Mark Allen Weiss, Data structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2020.
- [2] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 4th ed. Cambridge, MA, USA: MIT Press, 2022.

REFERENCE BOOKS:

- [1] M. de Berg, O. Cheong, M. van Kreveld, and M. Overmars, Computational Geometry: Algorithms and Applications, 3rd ed. Berlin, Germany: Springer, 2008.
- [2] D. E. Knuth, The Art of Computer Programming, Volume 1: Fundamental Algorithms, 3rd ed. Boston, MA, USA: Addison-Wesley, 1997.
- [3] B. Stroustrup, The C++ Programming Language, 4th ed. Upper Saddle River, NJ, USA: Addison-Wesley Professional, 2013.

WEB RESOURCES:

- [1] "Introduction to Algebraic Graph Theory," https://onlinecourses.nptel.ac.in/noc25_cs81/
- [2] "Introduction To Algorithms And Analysis," https://onlinecourses.nptel.ac.in/noc23_cs88/

25CS270	COMPUTER PRACTICES WORKSHOP	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamental components of computer systems and operating systems, including their functions and interactions.	1,2, 5, 9	1
CO2	Create, format, and manage professional documents using word processing software and presentations using presentation software.	3,5, 9	1
CO3	Apply spreadsheet functions (Microsoft Excel) to organize, analyze, and visualize data for practical problem-solving scenarios.	3,5, 9	1
CO4	Implement file management strategies, command line operations, and basic troubleshooting techniques to maintain efficient computer operations.	2,4, 5, 9	1

LAB EXPERIMENTS:

[30]

1. Basic components of a computer and the operating system.
2. Word processing (Microsoft word)
3. Spreadsheet and advanced excel features.
4. File management and organization
5. Command line operations (Windows or Linux)
6. Creating and formatting presentations (Microsoft PowerPoint)
7. Introduction to cloud storage and collaboration tools
8. Data analysis in Microsoft Excel
9. Basic computer security
10. Basic troubleshooting and maintenance

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

REFERENCE BOOKS:

- [1] ITL Education Solutions Limited, Introduction to Information Technology, 3rd ed. Noida, India: Pearson Education India, 2024.
- [2] J. Lambert, Microsoft Office 365 & Office 2021 Step by Step. Redmond, WA: Microsoft Press, 2022.
- [3] Goel, Computer Fundamentals, 11th ed. Noida, India: Pearson Education India, 2024.

WEB RESOURCES:

- [1] "Microsoft Support," <https://support.microsoft.com/>

25EC201	SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the concepts and configurations of diodes and transistors, including BJTs and MOSFETs.	1	-
CO2	Apply principles of BJTs and semiconductor diode in switching and amplifier circuit applications	1,5	2
CO3	Analyze the characteristics of Bipolar Junction Transistors, Field Effect Transistors, and special diodes to compute required parameters	2,5	2
CO4	Apply MOSFET switching principles and CMOS technology in the design of logic gates and VLSI circuits.	1,11	2
CO5	Apply basic testing methods to interpret data from diode and transistor datasheets.	1,11	-

DIODE CIRCUITS AND THEIR CHARACTERISTICS

[9]

Semiconductor diode -VI characteristics - Temperature dependence characteristics, Ideal Versus Practical Diode - static and dynamic resistance - Diode equivalent circuit - Transition and Diffusion capacitance - Switching time - Diode Data sheet - Diode testing using multimeter, Load - line analysis.

DIODE APPLICATIONS

[7]

Series and Parallel diode configuration, Applications – Rectifiers with filters, Clipper, Clamper.

SPECIAL DIODES

[8]

Zener diode, Varactor diode, Optical diodes - LED, LCD, Photodiode, Schottky diode, PIN Diode – Characteristics, Applications - voltage regulator circuit, Data sheet of special diodes.

BIPOLAR JUNCTION TRANSISTOR

[9]

Transistor configuration – CE, CB and CC, limits of operation, configuration parameters, Transistor specification sheet, Transistor testing, Applications - switch, amplifier, phototransistor.

FIELD EFFECT TRANSISTOR

[12]

Construction of JFET, specification sheet, Transfer Characteristics, Depletion and Enhancement type MOSFETs - operation, MOSFET handling, PMOS, NMOS, CMOS, MESFET, MOS capacitor charges and capacitance

Applications: Evolution of FET technology for VLSI applications, Realization of Inverter, NAND and NOR using CMOS

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	45	90	3

TEXT BOOKS:

[1] Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, 14th ed., 2023.

[2] Sedra and Smith, Micro Electronic Circuits, Oxford University Press, 8th ed., 2020.

REFERENCE BOOKS:

[1] Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill Publishing Limited, New Delhi, 4th ed., 2015.

[2] David A. Bell, Electronic Devices and Circuits, Oxford Higher Education, 5th ed., 2018.

[3] S. Salivahanan and N. Suresh Kumar, Electronic Devices & Circuits, Tata McGraw Hill Publishing Limited, 5th ed., 2022.

[4] Neamen Donald, Semiconductor Physics and Devices - Basic Principles, McGraw Hill Publishing Limited, 4th ed., 2021.

WEB REFERENCES:

[1] "Fundamentals of Semiconductor Devices," https://onlinecourses.nptel.ac.in/noc25_ee39/preview

[2] "Analog Electronic Circuits," https://onlinecourses.nptel.ac.in/noc25_ee05/preview

25EC202	DIGITAL PRINCIPLES AND SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply number systems and Boolean algebra to design and implement combinational and sequential digital circuits using appropriate logic families.	1	1,2
CO2	Design digital systems by integrating simplified Boolean logic, combinational and sequential circuits, and implement them using hardware description languages and suitable digital IC and memory technologies.	1,2,8	1,2
CO3	Simulate and test digital circuits using Verilog HDL, integrating optimized Boolean expressions, hardware building blocks, logic family constraints, and programmable logic devices.	2,5	1,2
CO4	Analyze and compare the performance of digital systems based on simplification strategies, logic family characteristics, memory design, and implementation complexity in both combinational and sequential circuits.	1	1,2,3
CO5	Design and integrate complete digital systems using simplified logic, combinational and sequential modules, logic family constraints, and programmable memory for real-time applications.	2,5	1,2,3

SIMPLIFICATION OF BOOLEAN EXPRESSIONS

[9]

Number systems, Boolean expressions and Notations, Karnaugh Maps - Up to Four-variable maps, Sum of products and product of sums, Minterms and Maxterms, Minimization of Boolean Functions using Karnaugh Maps.

COMBINATIONAL CIRCUIT DESIGN

[12]

Design with basic logic gates, adders and subtractors - Verilog models. Priority encoders, decoders, Multiplexers and Demultiplexers, comparators.

Lab modules:

1. Design of 4-bit Binary Adder using IC 7483
2. Implementation of 4:1 Multiplexer and 1:4 Demultiplexer
3. Simulation of Encoder and Decoder

SEQUENTIAL CIRCUIT DESIGN

[12]

Memory elements and their excitation functions, SR, JK, T, and D latches and flip-flops - Verilog models, master slave JK flip-flop, edge-triggered flip-flop, synchronous and asynchronous counters.

Lab modules:

1. Implementation of Shift Registers using Flip-Flops
2. Simulation of Synchronous and Asynchronous Counter

LOGIC FAMILIES AND MEMORY DEVICES**[12]**

Characteristics of Digital ICs, DTL, TTL, ECL, Calculation of noise margins and fan-out -
Memory: Basic Organization, ROM, RAM, PROM, EPROM, EEPROM, PLDs - FPGA -
Design of combinational circuits using PLDs

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] M. Morris Mano & Michael D. Ciletti, Digital Design, 6th ed., Pearson Education, 2021
- [2] Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw- Hill Education, 2025, 4th ed..

REFERENCE BOOKS:

- [1] John F. Wakerly, Digital Design: Principles and Practices, Prentice Hall India, 2005, 4th ed..
- [2] R.P. Jain & Kishor Sarawadekar, Modern Digital Electronics, McGraw-Hill Education, 5th ed., 2022.
- [3] Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd ed. 2003,
- [4] Thomas L. Floyd, *Digital Fundamentals* , 11th ed., Pearson Education, 2014
- [5] Salivahanan S, S.Arivazhagan, *Digital Circuits and Design*, 5th ed., Oxford university Press, 2019.

WEB REFERENCES

- [1] https://onlinecourses.nptel.ac.in/noc25_ee125
- [2] Digital Systems: From Logic Gates to Processors | Coursera

25EC270	ELECTRONICS ENGINEERING WORKSHOP	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Operate electronic instruments such as multimeters, oscilloscopes (CRO/DSO), signal generators, and power supplies to measure electrical parameters.	1,8,9	-
CO2	Test basic electronic components including resistors, capacitors, inductors, diodes, transistors, and ICs using standard procedures.	1,8,9	-
CO3	Analyze the V-I characteristics of PN junction and Zener diodes under different biasing conditions	2,8,9	2
CO4	Analyze the performance of rectifier circuits by determining the ripple factor and analyzing the role of filters and voltage regulators in improving output quality	2,8,9	2
CO5	Design digital logic circuits using basic logic gates and verify their operation using simulation tools.	1,8,9	2
CO6	Assemble electronic circuits through soldering and interconnection techniques, and interface sensors with microcontrollers for practical applications.	2, 5, 6 8,9,11	2,3

LAB EXPERIMENTS:

[30]

1. Familiarization of Electronic Tools/Equipment: Multimeters, Oscilloscopes, Signal generators, Power supplies.
2. Testing of Electronic components – Resistors, Inductors, Capacitors, Diodes, Transistors and ICs
3. Measurement of AC signal parameters using CRO/DSO.
4. V-I Characteristics of PN Junction Diode
5. V-I Characteristics of Zener Diode
6. Measurement of ripple factor of HWR and FWR.
7. Design of electronic circuits using logic gates: AND, OR, EX-OR, NOT, NAND and NOR.
8. Design of electronic circuits using simulation tools.
9. Inter-connection methods and soldering practice.
10. Familiarization/Identification of cables and connectors used in various Gadgets & Instruments/
11. Equipment.
12. Fixed voltage power supply with transformer, rectifier, filter, Zener/IC regulator.
13. Measurement of Temperature using Arduino-based sensor module.

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

25EE201	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the fundamental laws and principles to analyze DC and AC electrical circuits.	1,2,5	1
CO2	Solve electric circuit problems using systematic analysis techniques and network theorems.	1,2,5	1
CO3	Analyse the dynamic response of circuits with energy storage elements and coupled systems.	1,2,5	1
CO4	Evaluate the performance characteristics of AC circuits including power analysis and resonance phenomena.	1,2,5	1
CO5	Determine the response of three-phase systems and two-port networks for practical applications.	1,2,5	1

DC CIRCUIT CONCEPTS

[12]

Electrical elements and their classification, Ohm's law, KCL, KVL, sources- independent and dependent sources, Source Transformation, Constant current and constant voltage systems. Series and Parallel circuits, Voltage and current division in Series and Parallel Circuits, Network Reduction

AC CIRCUIT CONCEPTS AND RESONANCE

[13]

Sinusoidal Voltage and Current, RMS Value, Form Factor, Peak Factor, Phasor representation of Sinusoidal Voltage and Current, V and I relation in R, L, C circuits, impedance and Admittance, Power Analysis: Apparent Power, Real Power, Reactive Power and Complex Power, Power Factor. Resonance: Series Resonance, Parallel resonance. Computation of Circuit parameters using circuit simulation software.

NETWORK ANALYSIS AND THEOREMS

[12]

Mesh and nodal analysis with dependent/independent Voltage and Current sources for DC and AC circuits. Theorems: Superposition theorem -Thevenin's theorem - Norton's theorem - Reciprocity and Maximum Power Transfer theorem for AC and DC circuits. Analysis of Circuits using simulation software.

TRANSIENT RESPONSE, COUPLED CIRCUITS AND TWO-PORT NETWORKS [13]

Transient response of RL, RC and RLC Circuits using Laplace transform for source free, Step input and Sinusoidal input. Coupled circuits: Self-inductance, Mutual inductance, Coefficient of coupling, Dot Convention. Two Port Networks: Two-port network parameters, Interconnection of two-port networks, Driving point and transfer impedance/admittance.

THREE PHASE CIRCUITS

[10]

Three phase star/delta connected sources and load (Balanced & Unbalanced), Phasor representation of Voltage and Current, Star to Delta conversion and Delta to Star conversion, Power measurements in three-phase circuits.

Total Notional Hours:120

L	T	P	TW+SL	C
45	15	0	120	4

TEXT BOOKS:

[1] Charles K. Alexander and Matthew N. O. Sadiku, Fundamentals of Electric Circuits, McGraw-Hill Companies, 7th ed., 2022.

[2] Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, 10th ed., 2020.

REFERENCE BOOKS:

[1] R. L. Boylestad, *Introductory Circuit Analysis*, Pearson Education, 14th ed., 2023

[2] J. O. Bird, *Bird's Electrical Circuit Theory and Technology*, Taylor and Francis Group, 7th ed., 2022.

[3] Richard C. Dorf, James A. Svoboda, *Dorf's Introduction to Electric Circuits*, Wiley, 9th ed., 2018.

[4] Mahmood Nahvi, Joseph A. Edminister, *Schaum's Outline of Electric Circuits*, McGraw Hill Education, 7th ed., 2018.

WEB REFERENCES

[1] "Introduction to Electrical Engineering," https://onlinecourses.nptel.ac.in/noc25_ee45/preview

[2] "Basic Electrical Circuits," https://onlinecourses.nptel.ac.in/noc21_ee99/preview

[3] "Basic Electrical Circuits," https://onlinecourses.nptel.ac.in/noc20_ee64/preview

[4] "Fundamentals of Electrical Engineering," https://onlinecourses.nptel.ac.in/noc20_ee68/preview

25EE202	APPLIED ELECTRICAL AND ELECTRONICS SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze DC circuit parameters to solve electrical networks using basic laws and circuit analysis techniques.	1,2,5	1
CO2	Compare the construction, operating principles, and performance characteristics of DC generators, DC motors, BLDC motors, and PMSM motors to select appropriate machines for specific applications.	1,2	1
CO3	Analyse AC circuit parameters in given single-phase circuits, and apply star-delta conversion techniques for circuit analysis.	1,2	1
CO4	Assess the construction, operation, and performance characteristics of AC machines to determine their suitability for various industrial applications.	1,2,6	1
CO5	Design basic electronic circuits using diodes and transistors, integrate sensors with microcontrollers, and develop simple automation applications using MSP430 programming for real-world engineering problems.	1,2,5	1

DC CIRCUIT FUNDAMENTALS

[10]

Ohm's Law, Kirchhoff's voltage and current laws, Equivalent resistance calculations, Mesh and nodal analysis techniques, Verification of circuit laws using software.

DC MACHINES

[7]

DC Generator – structure, operation and characteristics, DC Motor – structure, operation and characteristics. BLDC and PMSM motor- construction and operation; performance testing of DC shunt and series motor.

AC CIRCUIT FUNDAMENTALS

[7]

AC circuits, RMS value, Average value, Form factor, Peak factor, Real power, Reactive power, Power factor, Star-delta conversion.

AC MACHINES

[10]

Transformer- construction, operation and characteristics, Applications. Synchronous machines - construction, operation and characteristics, Applications. Induction machines - construction, operation and characteristics, Applications.

ELECTRONIC CIRCUITS, SENSORS AND EMBEDDED SYSTEMS

[11]

Basics of Diode and Transistor, Working of Regulated Power Supply and Relays. Common sensors: temperature, pressure, position, proximity sensors - Signal conditioning and data acquisition - Basic

microcontroller concepts - Interfacing sensors and actuators - Simple automation applications – Introduction to MSP430 programming using Code Composer Studio.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	90	3

TEXT BOOKS:

[1] Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, 10th ed., 2020.

[2] Sedra and Smith, Micro Electronic Circuits, Oxford University Press, 8th ed., 2020.

[3] P. S. Bhimbra, Electrical Machinery, Khanna Publishing House, Rev. 1st ed., 2021.

REFERENCE BOOKS:

[1] R. L. Boylestad, Introductory Circuit Analysis, Pearson Education, 14th ed., 2023.

[2] J. O. Bird, Bird's Electrical Circuit Theory and Technology, Taylor and Francis Group, 7th ed., 2022.

[3] S. Salivahanan and N. Suresh Kumar, Electronic Devices & Circuits, Tata McGraw Hill Publishing Limited, 5th ed., 2022.

[4] Neamen Donald, Semiconductor Physics and Devices - Basic Principles, McGraw Hill Publishing Limited, 4th ed., 2021.

WEB REFERENCES

[1] "Fundamentals of Semiconductor Devices," https://onlinecourses.nptel.ac.in/noc25_ee39/preview

[2] "Analog Electronic Circuits," https://onlinecourses.nptel.ac.in/noc25_ee05/preview

[3] "Introduction to Electrical Engineering," https://onlinecourses.nptel.ac.in/noc25_ee45/preview

[4] "Basic Electrical Circuits," https://onlinecourses.nptel.ac.in/noc21_ee99/preview

[5] "Basic Electrical Circuits," https://onlinecourses.nptel.ac.in/noc20_ee64/preview

[6] "Fundamentals of Electrical Engineering," https://onlinecourses.nptel.ac.in/noc20_ee68/preview

25EE256	SENSORS AND INSTRUMENTATION	L	T	P	C
		1	0	2	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the characteristics of sensors and transducers in measurement systems for engineering applications.	1,2,3,4,5,11	2,3
CO2	Select appropriate technologies and intelligent methods for developing sensor-based systems.	1,2,3,4,5,11	2,3
CO3	Analyze the data acquisition techniques of sensors and transducers for measurement systems.	1,2,3,4,5,11	2,3
CO4	Demonstrate the use of appropriate sensing devices to measure physical parameters from various environments.	1,2,3,4,5,8,9,11	2,3
CO5	Develop a mini project integrating sensor interfacing, signal conditioning, and data acquisition techniques.	1,2,3,4,5,8,9,11	2,3

SENSORS AND TRANSDUCERS:

[5]

Principles and classification of transducers, Electrical Mechanical and Thermal Characterization. Definition, Classification & Characteristics of sensors, Displacement sensors: Potentiometer, LVDT, Measurement of force using strain gauge. Temperature sensors: Thermistor, Thermocouple & RTD. Position and proximity sensors: Hall effect, Inductive & Capacitive. Flow & Level Sensors: Ultrasonic, Laser & Capacitive.

DATA ACQUISITION METHODS

[5]

Instrumentation amplifiers, Analog-to-Digital Conversion (ADC): successive approximation, sigma-delta types, Digital-to-Analog Conversion (DAC): weighted resistor and R-2R ladder, Data Acquisition System (DAS): block diagram, analog & digital I/O, counters, timers.

INTELLIGENT SENSORS:

[5]

General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

PRACTICAL / EXPERIMENTS

[30]

1. Signal Conditioning Using ADC
2. Signal Conditioning Using DAC
3. Temperature Measurement Using a Thermistor.
4. Temperature Measurement Using RTD
5. Temperature Measurement Using a Thermocouple.
6. Design and implement a simple three-op-amp instrumentation amplifier for a low-level sensor.
7. Level Or Flow Sensing Using Ultrasonic Sensor.
8. Strain Gauge–Based Force/Load Measurement.
9. Pressure Measurement.
10. Mini Project.

Total Notional Hours: 60

L	T	P	TW+SL	C
15	0	30	15	2

TEXT BOOKS:

- [1] DVS Murthy, *Transducers and Instrumentation*, PHI 2nd ed. 2013
- [2] D. Patranabis, *Sensors and Transducers*, 2nd ed., PHI Learning, 2013.
- [3] S. Gupta, J.P.Gupta, *PC interfacing for Data Acquisition & Process Control*, 2nd ed., Instrument Society of America, 1994.

REFERENCE BOOKS:

- [1] Arun K. Ghosh, *Introduction to Measurements and Instrumentation*, PHI, 4th ed., 2012.
- [2] A.D. Helfrick and W.D. Cooper, *Modern Electronic Instrumentation & Measurement Techniques*, PHI, 2001
- [3] Hermann K.P. Neubert, *Instrument Transducers* 2nd ed. 2012, Oxford University Press.

WEB REFERENCES

- [1] "Sensors and Actuators," https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee13
- [2] https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee193
- [3] "Transducers For Instrumentation," https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ee105
- [4] "Embedded Sensing, Actuation and Interfacing Systems," https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee31
- [5] https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee01

25EE270	ELECTRICAL WORKSHOP	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Demonstrate the functions of basic electrical instruments including power supplies, function generators, digital multimeters, oscilloscopes, and power quality analyzers.	1,2,8,9	1
CO2	Measurements of electrical parameters using appropriate instruments and techniques.	1,2,8,9	1
CO3	Troubleshoot and diagnose faults in common electrical equipment including through systematic testing procedures.	1,2,6,8,9	1
CO4	Design, assemble, and test electrical circuits and systems like solar lamps, rectifiers, and general appliance wiring connections.	1,2,8,9	1
CO5	Assess and implement electrical safety protocols including proper earthing techniques, safety precautions with electrical components, and testing procedures for protective devices.	1,2,6,8,9	1

LIST OF EXPERIMENTS

1. Familiarization with power supplies, function generators, digital multimeters (DMMs), oscilloscopes (DSOs), power quality analyzer
2. Testing of Fuse, MCB and Relay
3. Troubleshooting of electrical equipment- Iron Box, Fan, Mixer- Grinder
4. Measurement of Electrical Parameters (Voltage, Current, Power, Energy)
5. Familiarization of different kinds of cables and wires and Wiring of General Appliances
6. Soldering and PCB Making for Rectifier
7. Solar Lamp Assembly and Performance Testing
8. Measurement of resistance, inductance and capacitance
9. Generation and measurement of signals using CRO.
10. Earthing and Safety precautions with electrical components.

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS:

- [1] R.P. Singh, *Electrical Workshop: A Textbook*, 2nd ed., I.K. International Publishing House, 2010
- [2] S.K. Kataria & Sons, *A Textbook of Electrical Workshop Practices*, 1st ed., S.K. Kataria & Sons, 2019.

REFERENCE BOOKS:

- [1] James W. Nilsson and Susan A. Riedel, *Electric Circuits*, 11th ed., Pearson Education, 2019.

- [2] A.K. Sawhney, *Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai & Co., 2021.
- [3] Charles R. Miller, *Ugly's Electrical Safety and NFPA 70e*, 5th ed., Jones & Bartlett Learning, 2021
- [4] S.C. Bhatia and R.K. Gupta, *Textbook of Renewable Energy*, 1st ed., WPI Publishing, 2019

WEB REFERENCES

- [1] "Basic Electrical Science," <https://bes-iitr.vlabs.ac.in/>

25EE271	ELECTRIC CIRCUITS AND ELECTRON DEVICES LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Construct and analyze fundamental electrical circuits using resistors, capacitors, and inductors to verify basic electrical laws and network theorems.	1,2,5,8,9	1
CO2	Build and analyze transient response circuits of RL, RC, and RLC configurations using simulation software and demonstrate circuit behaviour in time domain.	1,2,5,8,9	1
CO3	Build and test three-phase power measurement circuits and analyze power parameters in balanced and unbalanced three-phase systems.	1,2,5,8,9	1
CO4	Analyze semiconductor device characteristics through experimentation with diodes, Zener regulators, and rectifier circuits.	1,2,5,8,9	1
CO5	Evaluate transistor and FET performance parameters by investigating input-output characteristics and various transistor configuration behaviours.	1,2,5,8,9	1

LIST OF EXPERIMENTS

1. Verification of Ohm's and Kirchhoff's Laws.
2. Determination of mesh current and node voltage by Mesh and Nodal Analysis.
3. Verification of Network Theorems (Thevenin's/ Super Position).
4. Transient Response of RL, RC and RLC using simulation software.
5. Measurement of three phase power.
6. Temperature Dependence of Diode Characteristics.
7. Verification of Zener Diode Characteristics as Voltage Regulator.
8. Half Wave and Full Wave Rectifier with & without Filters.
9. Verification of Input & Output Characteristics of Transistor Configurations.
10. Verification of FET Characteristics.

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS:

- [1] Robert Boylestad and Louis Nashelsky, *Electron Devices and Circuit Theory*, 10th ed., Pearson, 2020
- [2] Sedra and Smith, *Micro Electronic Circuits*, 8th Edition, Oxford University Press, June 2020.

REFERENCE BOOKS:

- [1] Jacob. Millman, Christos C. Halkias, *Electronic Devices and Circuits*, 4th ed., Tata McGraw Hill Publishing Limited, New Delhi, 2015.
- [2] David A. Bell, *Electronic Devices and Circuits*, 5th ed., Oxford Higher Education, 2018.
- [3] S.Salivahanan and N. Suresh Kumar *Electronic Devices & Circuits*, 5th ed., Tata McGraw Hill Publishing Limited, August 2022.
- [4] Neamen Donald, *Semiconductor Physics and Devices- Basic Principles*, 4th ed., McGraw Hill Publishing Limited, 2021

WEB REFERENCES

- [1] "Basic Electrical Science," <https://bes-iitr.vlabs.ac.in/>

25IT205	UNIVERSAL ACCEPTANCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the fundamental principles of Unicode.	1	1
CO2	Describe the architecture, necessity, and inherent security challenges of Internationalized Domain Names (IDNs) and Email Address Internationalization (EAI)	1,2	1
CO3	Apply Unicode standards and algorithms to manipulate and query textual data programmatically.	1, 2, 3, 4, 5	1
CO4	Deploy internationalization protocols and libraries to configure and handle non-ASCII data in network identifiers and messages.	1, 2, 3, 5	1
CO5	Use the Unicode and Internationalization frameworks in a development environment to build a feature for a mobile or web application that stores, processes, and validates internationalized data.	1, 2, 3, 4, 5	1

UNICODE PROGRAMMING

[6]

Introduction to encoding schemes – Need for Unicode - Character data type for Unicode code points - Unicode code charts - Processing Unicode Strings - Store Unicode data - The character-glyph model - difference between processing textual information and displaying text - Displaying text - use of text engines, fonts, glyph shapers - Normalization of Unicode strings - NFC and NFD - Comparing Unicode strings - bidirectional and shaped scripts: Display format, File storage in key-press order, Glyph Shapers - Interface/Class/Object: Variables, Methods - Other file formats and their handling - JSON File Unicode handling - Unicode libraries - ICU and others.

UNICODE IN COMPUTATIONAL METHODOLOGIES

[6]

Data structures using local language strings - Unicode collation algorithm for sorting of Unicode Strings - Searching through Unicode data (Normalization + Collation) – Unicode in Database Systems: Indexing on columns with Unicode characters - Integrity constraints based on columns - Queries- regular expression - Storing Unicode data in databases.

INTERNATIONALIZED DOMAIN NAMES (IDNS)

[6]

Introducing the root zone: TLD, gTLD, ccTLD – Need for IDNs - Unicode-based domain names: U-label - Need for A-labels - Punycode algorithm (RFC 3492) - IDNA2003 and its limitations - IDNA2008 - Limitations of protocols on IDNs: FTP, HTTP, HTTPS - Network troubleshooting commands with U-Labels- IDNA2008 compatible libraries - Python, Java, and/or other platform(s) - Pitfalls of Using the IDNA2003 Library: Avoiding IDNA2003 libraries - Limitations of IDNA2008 - Label Generation Rules (LGRs) - Exploring XML-based Label Generation Rules format (RFC7940; RFC 4690, and RFC 3743) - Using available LGRs in ICANN to create valid labels.

EMAIL ADDRESS INTERNATIONALIZATION (EAI)

[6]

Need for EAI - Storing EAI mail - Email protocol changes for EAI - SMTP - signaling flag - POP/IMAP - EAI and Mail message formats - EAI and MIME standard - Adoption challenges - Technical Compatibility Issues – Technical Solutions - Email and Anti-spam measures - EAI and cross-cultural

email communication skills - Communication Etiquette and Best Practices - Handling UTF-8/non-ASCII characters:

Subject line, Header, Email body text, Attachments – Libraries/APIs that handle SMTP interactions with EAI support - Validating internationalized email addresses using confirmation link workflow - Email address parsing for internationalized email addresses - Considerations for setting up email mailbox names.

IDN MOBILE APPS, SECURITY AND SUPPORT

[6]

Unicode Character set support - Unicode Text layout and rendering - Unicode Support in Mobile Apps Development Frameworks - iconv/ICU Converter APIs - Processing IDNs on mobile devices - relevant libraries - Processing EAI on mobile devices - relevant libraries - Unicode Security: Unicode Security Mechanisms, Mitigating EAI addresses blocking, DNS Security, ASCII Homograph, Phishing, Spamming - IDN Security - IDN homographs - LGRs and variants - String similarity - Unicode Support in Operating Systems: File systems support for Unicode - Working with Unicode - Unicode APIs for OS.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] Jukka K Korpela. Unicode Explained: Internationalize Documents, Programs, and Web Sites. O'Reilly Media, 2006.

REFERENCE BOOKS:

[1] Richard Gillam. Unicode Demystified: A Practical Programmer's Guide to the Encoding Standard. Addison Wesley, 2002.
[2] The Unicode® Standard Version 17.0 – Core Specification. Unicode Consortium, 2025.

WEB RESOURCES:

[1] "ICANN Universal Acceptance," <https://www.icann.org/ua>
[2] "Unicode," <https://home.unicode.org/>

25IT251	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		2	0	4	4

COURSE OUTCOMES:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the fundamental concepts of Object-Oriented Programming (OOP), including its benefits, basic structure of a C++ program, and core elements like tokens, keywords, data types, and operators.	1,2, 5, 9	1
CO2	Outline the primary characteristics of classes and objects, encompassing access specifiers, constructors, destructors, and memory management operators.	1,3, 5, 9	1,2
CO3	Explain the principles of function and operator overloading, inheritance hierarchies, and the role of virtual functions in polymorphism.	1,2,5, 9	1,2
CO4	Describe the concepts of generic programming, file handling, and exception handling mechanisms in C++.	1,5,9	1,2,3
CO5	Write C++ programs using classes, objects, inheritance, and operator overloading to solve real-world problems.	3,4,5,9	1,2
CO6	Develop applications leveraging advanced C++ features such as virtual functions, templates, file I/O operations, and structured exception handling for robust software solutions.	3,4,5,9	1,2,3

FUNDAMENTALS OF OOP AND C++

[6]

Structural versus object-oriented Programming - Elements of object-oriented programming benefits of OOP – Structure of C++ program - Variables - Tokens - Keywords – Identifiers - Type modifiers - Type casting - Input and Output - Data Types and Expressions - Operators - Flow of control - Arrays, Strings and Pointers.

CLASSES AND OBJECTS

[6]

Classes and Objects - Class specification: Class Members, Access Specifier, Scope resolution operator- Class Instantiation - Accessing class members- Passing and returning objects - Array of objects – Constructors: Parameterized constructors - Default arguments – Copy Constructor - Constructor overloading, Destructors - new, delete operators - “this” pointer - Friend classes and friend functions.

OVERLOADING AND INHERITANCE

[6]

Function overloading - Operator overloading: Overloadable operators - Unary operator overloading - Binary operator overloading, Overloading the Operator Using Friend Function - Inheritance: Base class and derived class relationship - Derived class declaration - Types of inheritance - Member accessibility - Constructors in derived class.

VIRTUAL FUNCTIONS AND GENERIC PROGRAMMING

[6]

Virtual Functions: Need for virtual function - Pointer to derived class objects - Pure virtual functions - Abstract classes – Virtual Destructors, Generic programming with templates: Function templates - class templates.

I/O STREAMS AND EXCEPTION HANDLING**[6]**

Streams: Formatted and unformatted data – Manipulators - Files: Opening and Closing a file - File modes - File pointers and their manipulation, Sequential access to a file - Random access to a file - Reading and Writing files, Exception handling: Exception handling constructs - Handling exceptions.

LAB EXPERIMENTS:**[60]**

1. Basics of C++
2. Flow Control Statements
3. Arrays, Strings & Pointers
4. Class and Object Basics
5. Constructors and Destructors
6. Array of Objects & Object Passing
7. Overloading
8. Inheritance
9. Virtual Functions and Friend Function
10. File and Exception Handling

Total Notional Hours: 120

L	T	P	TW+SL	C
30	0	60	30	4

TEXT BOOK :

[1] H. Schildt, C++ The Complete Reference, 4th ed. New Delhi, India: Tata McGraw Hill, 2017.

REFERENCE BOOKS:

- [1] B. Stroustrup, The C++ Programming Language, 4th ed. Upper Saddle River, NJ: Addison-Wesley Professional, 2013.
- [2] P. Deitel and H. Deitel, C++ How to Program, 10th ed. Hoboken, NJ: Pearson Education, 2017.
- [3] R. Lafore, Object-Oriented Programming in C++, 4th ed. Indianapolis, IN: Sams Publishing, 2001.
- [4] S. B. Lippman, J. Lajoie, and B. E. Moo, C++ Primer, 5th ed. Upper Saddle River, NJ: Addison-Wesley Professional, 2012.
- [5] E. Balagurusamy, Object Oriented Programming with C++, 8th ed. New Delhi, India: McGraw Hill Education, 2021.

WEB REFERENCES:

- [1] "Programming in Modern C++," https://onlinecourses.nptel.ac.in/noc24_cs44

25IT252	PYTHON FOR SCIENTIFIC COMPUTING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply Python programming constructs to solve engineering and scientific problems using appropriate data structures and program flow techniques.	1, 2, 5	1
CO2	Perform numerical computations using NumPy for vector/matrix operations, linear algebra, and statistical analysis.	1, 2, 4, 5	1
CO3	Visualize and animate mathematical models using Matplotlib for 2D/3D plotting, subplots, and dynamic simulations.	2, 3, 5	1
CO4	Utilize symbolic computation with SymPy for algebraic manipulation, equation solving, differentiation, integration, and differential equations.	2, 4, 6	1
CO5	Implement advanced numerical methods using SciPy for optimization, interpolation, numerical integration, and solving differential equations.	2, 4, 5	1
CO6	Develop interactive simulations and 3D visualizations using VPython and integrate GUI elements with Tkinter for engineering applications.	3, 5	1

Foundations of Python Programming

[6]

Development Environments – Modules of Python: NumPy – Matplotlib – SymPy – SciPy – Vpython – Keywords – Linear Program Structures – Functions – Branching Structures – Repetitive Structures – Data Structures – Functional Program Style – Object-oriented program style.

Numerical Computing

[5]

NumPy Functions – One-dimensional array – two-dimensional array – slicing – mathematical and statistical functions – Vectors: addition – product – Matrix Multiplication – Linear Systems of Equations.

Data Visualization and Animation

[5]

2D function plots – 3D function plots – Vector Field – Displaying Figures, Lines and Arrows - Animations.

Symbolic Mathematics

[5]

Basic Mathematical Operations – Multiplying Matrices – Equations – Simplification of terms – series expansion – partial fractions – Limits – Differentiation – Integrations – Differential Equations – Laplace Transform.

Advanced Numerical Methods

[9]

Numerical computation of zeros – optimizations – interpolations – numerical differentiation – numerical integration – solving differential equations numerically – Discrete Fourier Transform – basic shapes, points, and lines – bodies in motion – generating, saving, and reading measurements – frequency distribution – location parameters – dispersion parameters – normal distribution – skew – regression analysis – layout manager of Tkinter – Radio button - slider.

LAB EXPERIMENTS:

[30]

1. Solve a system of linear equations using NumPy's solve() function.

2. Compute scalar, cross, and triple products for given vectors and visualize them using Matplotlib.
3. Plot multiple functions (e.g., harmonics of a square wave) with custom line styles, legends, and axis labels.
4. Use SymPy to find derivatives and integrals of given functions and plot the results alongside numerical approximations.
5. Compare rectangle, trapezoidal, and Simpson's rule using SciPy for a definite integral and analyze error trends.
6. Solve a second-order ordinary differential equation using SymPy and SciPy and animate the solution with Matplotlib.
7. Simulate a bouncing ball or planetary orbit using VPython and analyze motion parameters.
8. Generate normally distributed random data, compute mean/median/variance, and plot histograms with regression lines.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Veit Steinkamp. Python for Engineering and Scientific Computing. Rheinwerk Computing, 2024.

REFERENCE BOOKS:

[1] Claus Führer, Jan Erik Solem, Olivier Verdier. Scientific Computing with Python: High-performance scientific computing with NumPy, SciPy, and pandas, 2/E. Packt Publishing Limited, 2021.

[2] Stephen Lynch. Python for Scientific Computing and Artificial Intelligence. CRC Press, 2025.

WEB RESOURCES:

[1] "Scientific Computing using Python, 2023," <https://nptel.ac.in/courses/115104135>

[2] "The Joy of Computing using Python, 2025," <https://nptel.ac.in/courses/106106182>

[3] "Introduction to Computer Science and Programming in Python," <https://ocw.mit.edu/courses/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/>

25ME270	ENGINEERING GRAPHICS	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall drawing instruments, sheet layout, BIS conventions, and standard lettering and scales used in technical drawing.	1,5	1
CO2	Construct engineering curves such as ellipse, parabola, hyperbola, cycloid, and involutes using geometric methods.	1,5	1
CO3	Determine true length and inclination of lines and planes using projection methods.	1,2,5	1
CO4	Develop orthographic and sectional views of solids and interpret true shapes of sections.	1,2,5	1,2
CO5	Apply isometric and perspective projection principles to visualize and represent 3D objects through sketching and CAD tools.	1,5	1,2

INTRODUCTION

[4]

Drawing Instruments - Drawing Sheet size and Layout - BIS conventions and specifications - Lettering – Geometrical, Scales: Reducing Scale and Enlarging Scale.

PLANE GEOMETRY

[12]

Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

PROJECTION OF POINTS, LINES AND PLANE SURFACES

[12]

Projection of points - Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method– Projection of planes inclined to both the principal planes.

PROJECTION OF SOLIDS AND ORTHOGRAPHIC PROJECTION

[12]

Projection of simple solids, when the axis is inclined to one of the principal planes by rotating object method. Principles of Orthographic Projections; simple engineering components using first angle projection.

PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

[12]

Sectioning of simple solids in a simple position – obtaining true shape of section. Development of lateral surfaces of simple solids.

ISOMETRIC AND PERSPECTIVE PROJECTIONS

[8]

Principles of isometric projection-isometric projections of simple solids. Introduction to Perspective projection. Practicing by freehand sketching and CAD Software.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Natarajan, K.V., A Textbook of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
- [2] Venugopal, K. and Prabhu Raja, V., Engineering Graphics, New Age International (P) Limited, 15th Edition, 2018.

REFERENCE BOOKS:

- [1] Bhatt N.D. and Panchal V.M., *Engineering Drawing*, Charotar Publishing House, 54rd ed., 2023.
- [2] Gopalakrishna K.R., *Engineering Drawing* (Vol. I&II combined), Subhas Publications, Bangalore, 2017.
- [3] Jolhe, D. A., Engineering drawing, Tata McGraw Hill, 2017.
- [4] Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2015.

WEB REFERENCES:

- [1] https://onlinecourses.swayam2.ac.in/aic22_ts40/preview
- [2] https://onlinecourses.swayam2.ac.in/ntr25_ed52/preview
- [3] https://onlinecourses.nptel.ac.in/noc25_me173/preview

25ME271	DIGITAL HARDWARE TECHNOLOGIES	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Demonstrate proficiency in measurement techniques and digital fabrication processes including 3D scanning, 3D printing, laser cutting, and CNC routing to create precise engineering prototypes.	1,5	1,2
CO2	Apply fundamentals of hand tools, power tools, and workshop machinery with emphasis on proper selection, safe operation, and maintenance procedures.	1,5,6	1
CO3	Master basic electronic measurement, circuit testing, and troubleshooting using multimeters and other diagnostic equipment essential for electrical engineering applications.	1,4,5	2
CO4	Develop practical skills in manufacturing processes including sheet metal fabrication, arc welding techniques, and plumbing assemblies according to industry standards.	1,5,6	1,3
CO5	Execute material manipulation techniques across various substrates including metal, wood, plastic, and composite materials with appropriate tools and joining methods.	1,5	1
CO6	Evaluate manufactured components using appropriate inspection techniques and quality control measures to ensure adherence to specifications and functional requirements.	1,4,5	1,2

1. Precision Measurement Techniques: Vernier Calipers, Micrometers, and Dial Indicators
2. Electrical Parameter Measurement and Circuit Testing with Digital Multimeters
3. 3D Scanning and Geometry Capture: From Physical Objects to Digital Models
4. Power Tool Operation and Safety: Angle Grinders, Jigsaws, and Rotary Tools
5. CNC Router Programming and 2D Profile Cutting for Press-Fit Assemblies
6. Laser Cutting and Engraving for Precision Prototype Enclosures
7. Sheet Metal Fabrication: Design and Production of Functional Dust Pans
8. Arc Welding Fundamentals: Preparation and Testing of Lap and Butt Joints
9. Household Plumbing Systems: Assembly, Testing, and Troubleshooting
10. Additive Manufacturing: FDM 3D Printing Techniques and Material Properties

Total Notional Hours: 60

L	T	P	TW+SL	C
60	0	0	0	2

TEXT BOOK:

- [1] Practical 3D Printing for Engineers: Digital Fabrication Technologies for Rapid Prototyping" by Samira Khan and Michael R. Anderson (2024)
- [2] Black, Bruce. Workshop processes, practices and materials. Routledge, 2015.

REFERENCE BOOKS:

- [1] Digital Fabrication in Engineering Education: From Theory to Practice by Sarah Mitchell and Kai Chang (2024)

- [2] Scherz, Paul. Practical electronics for inventors. McGraw-Hill, Inc., 2006.
- [3] AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), ISBN: 978-9391505332.

WEB REFERENCES:

- [1] https://onlinecourses.swayam2.ac.in/ntr25_ed67/preview
- [2] https://onlinecourses.nptel.ac.in/noc25_me130/preview

25EC251	DIGITAL CIRCUITS AND MICROCONTROLLERS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply number systems, Boolean algebra, and logic simplification techniques in digital circuits.	1,2	2
CO2	Analyze and design combinational logic circuits using digital logic components and simplification techniques.	1,2	2
CO3	Analyze and design sequential logic circuits, including flip-flops, registers, and synchronous/asynchronous counters.	2,3	2
CO4	Program 8-bit (8051) and 32-bit (ARM Cortex-M/STM32) microcontrollers for digital I/O, ADC, timers, and interrupts.	1,2,3	2
CO5	Integrate and implement embedded systems using digital logic and microcontrollers for applications like PWM motor control and sensor-based automation	1,2,3	2

BOOLEAN ALGEBRA, LOGIC GATES & COMBINATIONAL LOGIC [10]

Number systems: Binary, Octal, Hex, BCD - Logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR - Boolean algebra & simplification techniques - Karnaugh Maps (K-Maps) – 2, 3, 4 variable reduction
Combinational circuits: Adders, subtractors, multiplexers, demultiplexers, encoders & decoders

SEQUENTIAL LOGIC & PROGRAMMABLE DEVICES [8]

Flip-Flops: SR, JK, D, T - Registers and Counters - Memory elements: RAM, ROM, EEPROM - Introduction to PLDs (PAL, PLA) and FPGAs

MICROCONTROLLER PROGRAMMING & APPLICATIONS [12]

Microcontroller architecture basics - Comparison: Microprocessor vs Microcontroller - 32-bit MCUs (ARM Cortex-M based boards like STM32) : Pin functions, memory organization, I/O ports - MCU instruction set, Programming - Digital input & output, analog input- Timers & delays -Interrupts (basic idea) - PWM concepts (for motor speed control)

LIST OF EXPERIMENTS [30]

1. Verification of logic gates
2. Implementation of half and full adder
3. Design of counters and registers
4. Interfacing LED, switch, buzzer
5. ADC-based temperature sensing
6. Motor control using PWM (DC/servo/stepper)
7. Sensor-based automation (IR/ultrasonic)
8. Mini project related to mechanical automation

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Morris Mano M. and Michael D. Ciletti, *Digital Design*, 6th ed., Pearson Education, 2018
- [2] Mazidi, M.A., Naimi, S. and Naimi, S., *STM32 Arm Programming for Embedded Systems: Using C Language*, MicroDigitalEd Publications, 1st ed., 2018.
- [3] Yifeng Zhu, *Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C*, Pearson Education, 3rd ed., 2021.
- [4] Muhammad Ali Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson Education, 2013

REFERENCE BOOKS:

- [1] Subrata Ghoshal, *8051 Microcontrollers: Internals, Instructions, Programming & Interfacing*, 2nd ed., Pearson education, 2014.
- [2] James K. Peckol, *Embedded Systems: A Contemporary Design Tool*, 2019
- [3] Carmine Noviello, *Mastering STM32*, Leanpub Publications, 1st ed., 2018.
- [4] Alexander G. Dean, *Embedded Systems Fundamentals with ARM Cortex-M based Microcontrollers: A Practical Approach*, ARM Education Media, 2nd ed., 2017.

WEB REFERENCES

- [1] "Principles of Signals and Systems," https://onlinecourses.nptel.ac.in/noc20_ee15/preview

EMERGING TECHNOLOGY COURSE (ETC)

25AI203	AUTOMATED INTELLIGENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Comprehend intelligent agent frameworks and its usage in solving real world problems	1,2,5,6,10	1,2
CO2	Apply Artificial Intelligence algorithms in constraint-based game design	2,3,5,9,11	1
CO3	Infer Deep impact of Logical Reasoning in real time problem solving	2,4,6,8,10	2,3
CO4	Apply Probabilistic mechanisms in solving problems of uncertainty	1,2,3,4,5	1,3
CO5	Apply Knowledge based agents to solve critical problems	1,2,3,4,5	1

COURSE CONTENT:

INTELLIGENT AGENTS

[6]

Introduction to Artificial Intelligence, Intelligent Agents and Environments, Rational Agents, Problem Solving Agents, Uninformed and Heuristic Search Techniques, Human–AI Interaction.

SEARCH AND OPTIMIZATION

[6]

Local Search and Optimization Problems, Search in Continuous and Partially Observable Environments, Online Search Agents, Non-deterministic Search.

GAME PLAYING AND CSP

[6]

Game Theory, Alpha-Beta Pruning, Monte Carlo Tree Search, Stochastic and Partially Observable Games, Constraint Satisfaction Problems, Backtracking and Local Search for CSP, Multi-Agent Systems

LOGICAL REASONING

[6]

Knowledge-based agents – propositional logic – propositional theorem proving – Knowledge-Based Agents, Propositional Logic, First-Order Logic, Knowledge Representation, Forward and Backward Chaining, Resolution Techniques.

PROBABILISTIC REASONING

[6]

Reasoning under Uncertainty, Bayesian Inference, Naïve Bayes Model, Bayesian Networks, Exact and Approximate Inference, Causal Networks

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Stuart Russell and Peter Norvig, *Artificial Intelligence – A Modern Approach*, 4th ed., Pearson Education, 2021.

REFERENCE BOOKS:

- [1] Dan W. Patterson, *Introduction to AI and ES*, Pearson Education, 2007
[2] Kevin Night, Elaine Rich, and Nair B., *Artificial Intelligence*, McGraw Hill, 2008
[3] Patrick H. Winston, *Artificial Intelligence*, 3rd ed., Pearson Education, 2006
[4] Deepak Khemani, *Artificial Intelligence*, Tata McGraw Hill Education, 2013.

WEB REFERENCES:

- [1] "Artificial Intelligence: Foundations and Algorithms," <https://nptel.ac.in/courses/106102220>
[2] "Artificial Intelligence," <https://nptel.ac.in/courses/106105079>
[3] "Artificial Intelligence (MIT 6.034)," <https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/download/>

25CS201	DATA SCIENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the architecture and components of modern language models.	1	-
CO2	Describe methods for interpreting model outputs.	1,2	-
CO3	Identify the processes for labeling data, generating synthetic data, and prompt engineering.	3	-
CO4	Implement retrieval-augmented generation (RAG) and retrieval-augmented classification to build applications.	1,2,3	-
CO5	Implement agentic AI systems by decomposing complex tasks and integrating language models.	1,2,3	-

Language Models, Tools and Terminology

[6]

Language Model – Representing Meaning – Encoder-Decoder Models – Attention Mechanism – The Transformer – Self-attention – Encoder Language Models – Decoder Language Models – InstructGPT and Fine-Tuning – Text Generation – Distillation – AI Agents – Libraries – Language Model Vendors – Frameworks – Data-Generating Processes – Adequate Experimentation – Test and Measure – Business Case Metrics – Launch and Evaluate – Case Studies.

Semantic Vectors and Interpretability

[6]

Case Study: Detecting AI-Generated Text – Topic Modeling – Analyzing Semantic Vectors – Explaining Model Outputs – Explaining Semantic Vector Models – Mechanistic Interpretability – Comment Classification – Sorting Resumes by Selection Criteria.

Labeling and Synthetic Data Generation

[6]

Case Study: Industry Vertical Classification – Student Essay Features – Case-based Prompting – Prompt Variation – Iterated Auditing – Case Study: Customer Complaint Routing – Variables – Custom Parser – Case Study: Translation of Idioms – Sentence Pair Classification.

Retrieval Applications and Code as Language

[6]

Retrieval Augmented Generation – Case Study: RAG for Recruiters – Retrieval Augmented Classification – Code Comprehension – Case Study: Code Reviewer – Code Generation – Case Study: Code Revisions.

Automated Analytics and Agentic AI

[6]

Task Decomposition – EDS Analyst Bot – Agents – Language Models into Agents – Tool Use – Case Study: Data Query Engine – Model Context Protocol – Case Study: Dataset Research Agent – Checks and Balances – Agentic Use Cases.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] John Hawkins. Data Science First. Wiley, 2026.

REFERENCE BOOKS:

[1] Joel Grus. Data Science from Scratch, 2/E. O'Reilly Media, 2019.

[2] Thomas Nield. Essential Math for Data Science. O'Reilly Media, 2022.

WEB REFERENCES:

[1] "Python for Data Science," <https://nptel.ac.in/courses/106106212>

[2] "Scalable Data Science," <https://nptel.ac.in/courses/106105186>

25CS202	ARTIFICIAL INTELLIGENCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of artificial intelligence.	1	-
CO2	Describe intelligent agent architectures, uninformed and informed search algorithms.	1,2	-
CO3	Explain probabilistic reasoning, reinforcement learning, and the operation of convolutional neural networks.	1,2	-
CO4	Apply supervised and unsupervised machine learning algorithms to preprocess data, train models, and evaluate performance using appropriate metrics and tools.	1,2,3,4	-
CO5	Implement a natural language processing (NLP) component, such as a simple chatbot, and integrate speech recognition fundamentals.	2,3	-

Artificial Intelligence Technologies

[6]

Introduction – History – Types – Machine Learning and Deep Learning – Applications of AI – Robotics – Drones using AI – Future of AI – No Code AI – Low Code AI – Techniques in AI – Machine Learning Model – Regression Analysis in Machine Learning - Classification Techniques – Clustering Techniques – Naïve Bayes Classification – Neural Network – Support Vector Machines.

AI Machine and Knowledge Representation

[6]

Intelligence – Components of Intelligence – Human vs Machine Intelligence – Agent and Environment – Search – Uninformed Search Algorithms – Informed Search Algorithms – Hill Climbing Algorithm – Adversarial Search – Alpha-beta Pruning – Local Search Algorithms – Single Agent Path-finding problems – Knowledge Representation – Knowledge-based Agent – Types of Knowledge – Techniques of Knowledge Representation in AI – Propositional Logic – Inference Rules – Forward Chaining and Backward Chaining.

Reasoning and Computer Vision

[6]

Reasoning – Probabilistic Reasoning – Baye's Theorem – Learning – Clustering – Explanation-based Learning – Reinforcement Learning – Human Vision vs Computer Vision – Working of Computer Vision – Evolution – Tasks – Applications – Challenges – Understanding Image Pixels – Convolutional Neural Networks – Immersive Experience.

Natural Language Processing and Current Trends

[6]

Introduction – Everyday NLP examples – Chatbot – Working – Components – Steps – Phases – Syntax vs Semantic analysis – Applications – Pros and Cons – Evolution – Handling Ambiguities – NLP model of Perceptron – Constituency Grammar – Context-Free Grammar – Speech Recognition – AI and ethical concerns – AI as a Service – Robotics – Recent Trends in AI.

AI Today

[6]

Expert Systems – Internet of Things – Artificial Intelligence of Things – Edge Computing – Metaverse – Fuzzy Logic – Genetic Algorithms – Soft Computing – Transfer Learning.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] Reema Thareja. Artificial Intelligence: Beyond Classical AI. Pearson India, 2024.

REFERENCE BOOKS:

[1] Tom Taulli. Artificial Intelligence Basics: A Non-Technical Introduction. Apress, 2019.

[2] John Paul Mueller, Luca Massaron, Stephanie Diamond. Artificial Intelligence For Dummies, 3/E. Wiley, 2024.

WEB REFERENCES:

[1] "An Introduction to Artificial Intelligence," <https://nptel.ac.in/courses/106102220>

[2] "Artificial Intelligence," <https://nptel.ac.in/courses/106105077>

25EC219	PRINTED CIRCUIT BOARD DESIGN	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the basics of electronic components and PCB fundamentals.	1	-
CO2	Learn schematic capture and PCB layout techniques using EDA tools.	1,2	1,2
CO3	Apply design rules for single and multi-layer PCBs.	1,2	1,2
CO4	Explore fabrication processes and testing of PCBs.	1,2	1,2

FUNDAMENTALS OF PRINTED CIRCUIT BOARDS

[7]

Introduction to printed circuit boards, need and applications of PCBs, basic electronic components and symbols, types of PCBs and materials. Introduction to schematic diagrams and basic PCB design software. Case study- PCB used in a simple electronic product such as an LED lamp or mobile charger.

BASIC PCB DESIGN AND LAYOUT

[8]

Schematic capture of simple circuits, component footprints, pads, tracks and vias. Basic component placement, manual routing, and introduction to design rule checking. Case study on design of a simple PCB such as a regulated power supply or sensor board.

PCB FABRICATION, ASSEMBLY AND TESTING

[15]

Overview of PCB manufacturing process and board fabrication steps-Introduction to soldering methods, component mounting, inspection and basic testing-Case study on fabrication and assembly of a basic PCB and analysis of common manufacturing defects.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] R. S. Khandpur, Printed Circuit Boards: Design, Fabrication and Assembly, 2nd ed., Tata McGraw-Hill Education, New Delhi, 2006.
- [2] Simon Monk, Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards, 1st ed., McGraw-Hill Education, New York, 2014.

REFERENCE BOOKS:

- [1] Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, 2nd ed., Academic Press / Elsevier, 2019.
- [2] Tim Williams, The Printed Circuit Designer's Companion, 4th ed., Newnes (Elsevier), 2018 — Comprehensive reference on PCB layout, design rules, and best practices
- [3] Christopher T. Robertson, Printed Circuit Board Designers Reference: Basics, 1st ed., Prentice Hall, 2020.

WEB REFERENCES:

- [1] “Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software,” https://onlinecourses.nptel.ac.in/noc25_ee163/preview
- [2] “ESim – EDA Tool for Circuit Design, Simulation, Analysis and PCB Design,”https://onlinecourses.swayam2.ac.in/aic20_sp59/preview
- [3] “PCB Design and Fabrication For Beginners,” <https://alison.com/course/pcb-design-and-fabrication-for-beginners>
- [4] “PCB Design Tips | Free PCB Mistakes Guide,” <https://www.classcentral.com/course/youtube-introduction-to-pcb-design-437154>

25EE215	PLC PROGRAMMING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the architecture and I/O interfacing principles of PLCs for industrial automation applications.	1,2	-
CO2	Apply ladder diagram and function block diagram programming using timers, counters and arithmetic operations.	1,2	-
CO3	Analyze modular PLC programs using functions, function blocks and data blocks for discrete control applications.	1,2	-
CO4	Analyze PLC-based solutions for industrial case studies including conveyor, level and motor interlock control.	1,2,3	-
CO5	Evaluate PLC programs for multi-axis robot control and assess their performance against industrial automation requirements.	1,2,3,4	-

PLC FUNDAMENTALS

[9]

Introduction – Evolution of PLC – Manufacturing and Assembly process – PLC advantages and disadvantages – Architecture of PLC: CPU, memory, power supply, communication ports. Digital and analog I/O modules, wiring of field devices (sensors, pushbuttons, contactors, actuators). Role of PLC in industrial automation; comparison with relay and microcontroller systems.

PLC PROGRAMMING

[9]

Programming languages: Ladder Diagram (LAD), Function Block Diagram (FBD) basics. Bit logic, timers, counters, comparators, edge detection, arithmetic, and move operations. Development of modular programs using functions, function blocks, and data blocks.

PLC APPLICATIONS

[12]

Case studies: conveyor control, level control, motor interlocks, start–stop–jog, simple sequence control, Two Axis-Robot with PLC sequence control, Industrial three-axis robot control.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Frank D. Petruzella, Programmable Logic Controllers, 6th ed., McGraw-Hill, 2024.
- [2] John W. Webb & Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, 5th ed., Pearson, 2015.

REFERENCE BOOKS:

- [1] Liam Bee, PLC and HMI Development with Siemens TIA Portal, Packt, 2022.

WEB REFERENCES:

- [1] "Introduction to Industry 4.0 and Industrial Internet of Things,"
https://onlinecourses.nptel.ac.in/noc20_cs69/preview

25IT202	MODERN DIGITAL TECHNOLOGIES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of digital transformation, including key technologies like cloud computing, big data, and IoT, and their evolutionary development.	1,2	1,2
CO2	Identify key components of digital accelerators: AI, machine learning, blockchain, and cybersecurity.	1,5	1,2,3
CO3	Explain the impact of digitalization and the internet on businesses and society, including economic and social implications.	2,6	2,3
CO4	Summarise elastic cloud computing architecture, its advantages, big data issues, and the shift from CapEx to OpEx models.	1,2	1,2
CO5	Interpret the role of AI and IoT in modern enterprises, including their strategic importance, ethical considerations, and real-world use cases.	2,4	1,2,3
CO6	Suggest solutions for digital transformation using technologies such as AI, IoT, cloud computing, or blockchain, with supporting case studies.	3,4	1,2,3

COURSE CONTENT

DIGITAL TRANSFORMATION

[6]

Digitalization – The Internet – Impact of Digitalization and the Internet – Evolutionary Adaptation – Modern Digital Transformation – Future of Digital Transformation.

INFORMATION AGE ACCELERATORS

[6]

Big Data - Cloud Computing – Virtualization and Containers – Multi-cloud and Hybrid Cloud – Artificial Intelligence – Machine Learning – Deep Learning – Internet of Things – AI and IoT – Model Driven Architecture.

ELASTIC CLOUD AND BIG DATA

[6]

Evolution of Elastic Cloud: From mainframes to Virtualization – rise of public cloud – Cloud features – Cloud Service Models – Global Public Cloud Infrastructure – CapEx to OpEx – History of Computer Storage – Data Center Storage – Evolution of Big Data – Size, Speed and Shape – Challenges of Big Data in a Modern Enterprise.

ARTIFICIAL INTELLIGENCE AND INTERNET-OF-THINGS

[6]

The AI Renaissance – Open-Source AI software – Machine Learning – Neural Networks – Business benefits – Economic and Social impact of AI – Origin of IoT – IoT Technology Solution – Potential and Impact – IoT Use Cases – Moore’s Law – Metacalfe’s Law – AI in government – Strategic Role of AI – Case Studies – Responsible AI – Safety in AI systems.

OTHER TECHNOLOGIES

[6]

Block chains – Consensus Mechanism – Use Case: Cryptocurrency – 3D printing – Augmented Reality – Virtual Reality – Digital Twin – Case Study: Remote Healthcare, Non-terrestrial networks – Fintech – Case Study: UPI, Digital Banking – Cyber security – Cybercrimes and Awareness.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXTBOOK:

[1] Thomas M. Seibel, *Digital Transformation: Survive and Thrive in an Era of Mass Extinction*, Rosetta Books, 1st ed., 2019. ISBN: 9781948122481

WEB REFERENCES:

[1] "2024 Technology Megatrends, IEEE Future Directions accessible via," <https://engage.ieee.org/FD-Megatrends-2024.html>

25IT203	PROMPT ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain LLM architectures, capabilities and limitations and how prompts steer outputs	1,2,4,5,8,10	1
CO2	Design and structure prompts (instruction, context, constraints, templates) to achieve desired outputs	2,3,4,5,9,10	1
CO3	Evaluate and quantitatively compare prompt strategies and mitigation approaches for bias, toxicity and hallucination.	2,4,5,6,8,10	1
CO4	Implement prompt-driven applications (chatbots, summarizers, code assistants) and follow responsible-AI practices for deployment	1,2,3,4,5,6,8,9,10,11	1

COURSE CONTENT:

FOUNDATIONS OF GENERATIVE AI & PROMPTS

[6]

What is Generative AI, LLMs (e.g., GPT, Claude, Gemini) & how they work, What is prompt engineering, Role of prompts in guiding AI output, Basic types of prompts: instruction-based, open-ended, zero-shot, few-shot, Tools & platforms overview (OpenAI APIs, Hugging Face, local models).

CRAFTING EFFECTIVE PROMPTS

[6]

Principles of prompt design: clarity, specificity, context, constraints, Iterative prompt refinement & prompt testing, Prompt types in depth: zero-shot vs few-shot vs chain-of-thought (CoT). Common pitfalls: ambiguous prompts, overly broad prompts, model hallucination.

ADVANCED PROMPT ENGINEERING TECHNIQUES & WORKFLOWS

[6]

Multi-turn dialogues / conversational prompting, Context engineering: specifying history, memory, agent-style prompting, Prompt chaining & workflow design (agentic prompts, tools + LLMs). Optimization: prompt templates, meta-prompts, prompt tuning.

APPLICATIONS OF PROMPT ENGINEERING IN DOMAINS

[6]

Text summarization, paraphrasing, classification via prompts, Creative generation: story writing, scripts, images (via text → image prompts), Domain-specific use-cases: education, business, marketing, data analysis, Low-code / no-code tool integration (UI tools + LLMs).

ETHICS, LIMITATIONS AND FUTURE OF PROMPT ENGINEERING

[6]

Ethical issues: bias, fairness, safety, misuse of generative AI, Limitations of LLMs and prompts: hallucinations, domain-bias, context limitations, Evaluation & metrics: how to measure prompt performance, fairness, reliability, Emerging trends: multimodal prompting (text+image+voice), agentic AI, customizing models

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] James Phoenix, Mike Taylor,” Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs”, O’Reilly & Associates Inc,2024

REFERENCE BOOKS:

- [1] Yashwant Sai Palghat,” Prompt Engineering: The Art of Asking: Master Generative AI Tools Like ChatGPT & MidJourney”, Notion Press
- [2] Jayant Deshmukh,” Prompt Engineering - The Ultimate Guide for Success in Artificial Intelligence”,2024

WEB REFERENCES:

- [1] "Prompt Engineering Guide," <https://www.promptingguide.ai/>
- [2] "Learn Prompting: Introduction," <https://learnprompting.org/docs/introduction>
- [3] "The 2026 Guide to Prompt Engineering," <https://www.ibm.com/think/prompt-engineering>
- [4] "What is Prompt Engineering - Meaning, Working, Techniques," <https://www.geeksforgeeks.org/blogs/what-is-prompt-engineering-the-ai-revolution/>

25IT204	CYBERSECURITY FOR CRITICAL INFRASTRUCTURE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the interdependencies and sector-specific impacts of cyberattacks across the critical infrastructure sectors.	1	-
CO2	Describe the evolution of cyber threats against critical infrastructure.	1	-
CO3	Conduct a vulnerability assessment for a critical infrastructure asset.	2, 4	-
CO4	Interpret the impact of common cyberattacks against critical infrastructure.	2, 4	-
CO5	Design a protection strategy for a critical infrastructure environment.	3	-

Critical Infrastructure and Cybersecurity

[6]

Impact of compromise and cyberattack scenarios in Chemical Sector – Commercial facilities – Communications – Critical Manufacturing - Dams – Defense Industrial base - Emergency Services – Energy – Financial Service – Food and agriculture services – Government facilities – Healthcare – Information Technology – Nuclear reactors – Transportation system – Water and Wastewater.

Growing Threat of Cyberattacks on Critical Infrastructure

[3]

History of CI protection and attacks – impact of 9/11 attacks on CI – old attacks – cyberattacks and countermeasures – state of CI in the face of cyberattacks – COVID-19 period cyberattack landscape – The colonial pipeline ransomware attack – attacks in 2023.

Critical Infrastructure Vulnerabilities

[7]

Difference between threat, vulnerability and risk – vulnerability assessment – scope definition – asset inventory – threat modeling – vulnerability scanning – manual assessment – risk prioritization – remediation planning – verification and validation – ongoing monitoring – reporting and documentation – security vulnerability management life cycle – Most common vulnerabilities and threats in CI – Inadequately secured industrial control systems – common vulnerabilities in industrial control systems – ransomware targeting CI – Physical Security breaches – IoT vulnerabilities.

Common attacks against CI

[7]

DDoS attack – Volumetric attacks – reflection and amplification attacks – resource depletion attacks – protocol-based attacks – application layer attacks – ransomware attack – infection – encryption – ransom note – ransom payment – data recovery – no guarantee of data recovery – supply chain attack – scope of attack – attack vector – stealth and persistence – data exfiltration – impersonation – APT – phishing – deception and lure – malicious links and attachments.

Incidents and Protection

[7]

Stuxnet attack on Iran's nuclear program – Ukrainian power grid attack – Dyn attack – Wannacry – Notpetya – Solarwinds attack – Colonial pipeline ransomware attack – network security and continuous monitoring – access control – Intrusion detection and prevention systems – VPNs – Security audits and

penetration testing – Honeypots and deception techniques – Zero trust architecture - NIST cybersecurity framework – ISO/IEC 27001 and 27002.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] Soledad Antelada Toledano. Critical Infrastructure Security. Packt Publishing, 2024.

REFERENCE BOOKS:

[1] Sajal K. Das, Krishna Kant, Nan Zhang. Handbook on Securing Cyber - Physical Critical Infrastructure Foundations and Challenges. Morgan Kaufmann, 2012.

[2] Betty Biringir, Eric Vugrin, Drake Warren. Critical Infrastructure System Security and Resiliency. CRC Press, 2013.

WEB REFERENCES

[1] "MITRE ATT&CK for Industrial Control Systems," <https://attack.mitre.org/matrices/ics/>

[2] "CISA (Cybersecurity and Infrastructure Security Agency) – Industrial Control Systems," <https://www.cisa.gov/ics>

25ME216	3D PRINTING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamentals of 3D printing and additive manufacturing technologies	1,2	1
CO2	Operate 3D printers and prepare models for printing using slicing software	3,5	2
CO3	Operate 3D printers and prepare models for printing using slicing software	2,6	2
CO4	Apply 3D printing for practical applications in their respective engineering domains.	1,3	1
CO5	Evaluate printing parameters and troubleshoot common printing issues.	2,4	1,2

INTRODUCTION TO 3D PRINTING

[6]

Introduction to Additive Manufacturing – History and evolution – Applications in engineering. Types of 3D Printing Technologies – FDM (Fused Deposition Modeling) – SLA (Stereolithography) – SLS (Selective Laser Sintering). 3D Printing Materials – PLA, ABS, PETG – Resins – Material properties and selection.

3D MODELING AND DESIGN

[6]

3D Modeling Basics – CAD software introduction (Tinker CAD/Fusion 360) – Basic shapes and operations. Design Principles for 3D printing – Design constraints – Wall thickness – Overhangs and supports. File Formats – STL, OBJ, 3MF – File preparation and validation.

FDM/PLA 3D PRINTING

[6]

FDM Technology – Working principle – Printer components – Print bed and nozzle. Slicing Software – Introduction to Cura/PrusaSlicer – Layer height – Infill patterns – Support structures. Print Parameters – Temperature settings – Print speed – Bed adhesion techniques.

SLA/RESIN 3D PRINTING

[6]

SLA Technology – Working principle – UV curing process – Resin types. SLA Printing Process – Build platform setup – Layer exposure – Post-processing requirements. Comparison – FDM vs SLA – Advantages and limitations – Application suitability.

APPLICATIONS AND TROUBLESHOOTING

[6]

Domain-Specific Applications – CSE/IT: IoT enclosures, custom components; EEE/ECE: PCB enclosures, circuit holders; General: Prototyping and product development. Troubleshooting – Common printing failures – Warping, stringing, layer adhesion – Quality improvement techniques. Future Trends – Multi-material printing – Metal 3D printing – Bio printing – Industry 4.0 integration.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Redwood, B., Schoffer, F., & Garret, B., *The 3D Printing Handbook: Technologies, Design and Applications*, 3D Hubs B.V., 2017.
- [2] Gibson, I., Rosen, D., & Stucker, B., *Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*, Springer, 2015.

REFERENCE BOOKS:

- [1] Chua, C.K., & Leong, K.F., *3D Printing and Additive Manufacturing: Principles and Applications*, World Scientific Publishing, 2017.
- [2] Lipson, H., & Kurman, M., *Fabricated: The New World of 3D Printing*, John Wiley & Sons, 2013.
- [3] Hoskins, S., *3D Printing for Artists, Designers and Makers*, Bloomsbury Publishing, 2013.
- [4] Karunakaran, K.P., et al., *Additive Manufacturing: Technology, Applications and Research*, Springer, 2020.

WEB REFERENCES

- [1] "The 3D Printing Revolution," <https://www.coursera.org/learn/3d-printing-revolution>
- [2] "3D Printing," <https://www.instructables.com/3D-Printing/>

ABILITY ENHANCEMENT COURSE (AEC)

25HS208	QUANTITATIVE APTITUDE AND LOGICAL REASONING (CDPC-1)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of quantitative aptitude including numbers, percentages, ratios, and averages for placement preparation.	1,2,4,5	-
CO2	Apply arithmetic and algebraic techniques to solve aptitude problems related to profit and loss, time and work, and equations.	1,2,3,4,5	-
CO3	Analyse logical reasoning problems involving series, coding-decoding, seating arrangement, and blood relations.	1,2,3,4,5	-
CO4	Evaluate data interpretation, analytical reasoning, and decision-making problems using appropriate problem-solving strategies.	1,2,4,5,11	-
CO5	Develop effective aptitude and reasoning skills for competitive examinations, placement tests, and interview assessments.	3,4,5,9,10,11	-

COURSE CONTENT

FUNDAMENTALS OF QUANTITATIVE APTITUDE

[6]

Number systems; divisibility rules; LCM and HCF; simplification; percentages; ratios and proportions; averages; ages; partnership problems; basic arithmetic shortcuts and problem-solving techniques.

ARITHMETIC AND ALGEBRAIC APTITUDE

[6]

Profit and loss; simple and compound interest; time and work; pipes and cisterns; time, speed and distance; boats and streams; permutations and combinations; probability; linear and quadratic equations, Alligations and Mixture.

LOGICAL REASONING AND ANALYTICAL THINKING

[6]

Series completion; coding and decoding; blood relations; direction sense test; seating arrangements; syllogisms; statement and conclusions; logical puzzles; analytical reasoning techniques.

DATA INTERPRETATION AND DECISION MAKING

[6]

Tabular data interpretation; bar graphs; pie charts; line graphs; caselets; data sufficiency; critical reasoning; decision making; problem-solving approaches for placement aptitude tests.

VERBAL REASONING AND PLACEMENT PREPARATION

[6]

Non-verbal reasoning; pattern recognition; mirror and water images; cube and dice problems; logical sequence; mock aptitude tests; interview-oriented reasoning practice; strategies for campus recruitment examinations.

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS

[1] R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishing.

- [2] Arun Sharma, How to Prepare for Quantitative Aptitude for CAT, McGraw Hill.
- [3] A Modern Approach to Logical Reasoning, R.S. Aggarwal, S. Chand Publishing.

REFERENCE BOOKS

- [1] M. Tyra, Magical Book on Quicker Maths, BSC Publishing.
- [2] Edgar Thorpe, Test of Reasoning, Pearson Education.
- [3] Nishit K. Sinha, Quantitative Aptitude for Competitive Examinations, Pearson.

WEB REFERENCES

- [1] IndiaBix Aptitude and Reasoning Resources
- [2] Freshersworld Placement Preparation Portal
- [3] GeeksforGeeks Aptitude Preparation
- [4] PrepInsta Placement Training Materials

25HS209	PROBLEM SOLVING AND DATA STRUCTURES (CDPC-2)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of C programming including variables, operators, control structures, and functions for problem solving.	1,2,4,5	-
CO2	Apply arrays, strings, pointers, and user-defined functions to develop efficient C programs.	1,2,3,4,5	-
CO3	Analyse linear data structures such as stacks, queues, and linked lists for computational problem solving.	1,2,3,4,5	-
CO4	Evaluate non-linear data structures including trees and graphs for searching and traversal operations.	1,2,4,5,11	-
CO5	Develop optimized programs using sorting, searching, and placement-oriented coding techniques for technical interviews and assessments.	3,4,5,9,10,11	-

COURSE CONTENT

FUNDAMENTALS OF C PROGRAMMING

[6]

Introduction to programming; algorithms and flowcharts; structure of C program; data types; variables and constants; input and output statements; operators and expressions; decision making statements; looping statements; break and continue statements.

FUNCTIONS, ARRAYS AND POINTERS

[6]

Functions and recursion; storage classes; arrays and multidimensional arrays; strings and string handling functions; pointers and pointer arithmetic; pointers with arrays and functions; structures and unions; file handling concepts.

LINEAR DATA STRUCTURES

[6]

Introduction to data structures; arrays as data structures; stack operations and applications; queue operations and circular queues; linked lists – singly, doubly, and circular linked lists; applications of linked lists.

TREES AND GRAPHS

[6]

Tree concepts and terminology; binary trees; binary search trees; tree traversals; heap and priority queue; graph representation; graph traversal using BFS and DFS; shortest path concepts and applications.

SEARCHING, SORTING AND PLACEMENT CODING

[6]

Searching techniques – linear and binary search; sorting techniques – bubble sort, selection sort, insertion sort, merge sort, quick sort; complexity analysis; problem-solving approaches; placement-oriented coding exercises and mock programming tests.

Total Notional Hours: 30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS

- [1] E. Balagurusamy, Programming in ANSI C, McGraw Hill Education.
- [2] Reema Thareja, Programming in C, Oxford University Press.
- [3] Seymour Lipschutz, Data Structures with C, Schaum's Outline Series.

REFERENCE BOOKS

- [1] Yashavant Kanetkar, Let Us C, BPB Publications.
- [2] Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.
- [3] Aho, Hopcroft and Ullman, Data Structures and Algorithms, Pearson.

WEB REFERENCES

- [1] GeeksforGeeks C Programming and Data Structures Tutorials
- [2] Tutorialspoint C Programming Resources
- [3] HackerRank Practice Problems
- [4] LeetCode Coding Interview Preparation

25HS210	LINGUA SKILL	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	To strengthen grammar and vocabulary skills for accurate and effective communication in various contexts.	9	1
CO2	Describe the various strategies for effective reading and listening, such as skimming, scanning, and extracting specific information from a range of texts and audio sources.	9	1
CO3	To improve reading comprehension by utilizing different reading techniques and critically analysing texts	9,11	2
CO4	Apply appropriate writing strategies to compose professional documents, including formal letters, emails, resumes, and technical reports.	9,11	3
CO5	To refine writing skills for academic and professional contexts.	5,9,11	3
CO6	Interpret visual graphics and respond appropriately in professional scenarios such as a sales talk, a product description, or an interview.	5,9,11	1,2

COURSE CONTENT

FOUNDATION OF COMMUNICATIVE SKILLS

[3]

Reading: Skimming & Scanning, identifying main ideas and supporting details in short texts

Writing: Informal & Formal Letters, Listening: Listening to short presentations and workplace conversations, Speaking: Just a Minute (JAM), Picture Description

BUILDING FLUENCY AND ACCURACY

[3]

Reading: Reading Newspaper and Articles, Speaking: Describing a product/place, Conversation practice, Writing: Email writing, Listening: Listening to motivational talks / TED talks.

COMMUNICATION IN ACADEMICS AND WORKPLACE CONTEXTS

[3]

Reading: Cloze reading, Speaking: Role-Play, Picture description., Writing: Article writing
Listening: Listening to stories and event narration.

PRESENTATION SKILLS

[3]

Reading: Interpreting pictures of Visual, graphics

.Speaking: Group Discussion,

Writing: Formal Letters (Quotations, Clarification, Placing orders & Complaint letter), SOP for conducting an event, Listening: Listening to Group Discussion and Interview Skills.

CREATIVE COMMUNICATION

[3]

Reading: Reading advertisements and company profiles.

Speaking: Master of Ceremonies (MC) Practice

Writing: Blog Writing

Listening: Listening to Product description and Process

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Technical English 2nd ed. Level2 Course Book and eBook, David Bonamy, 2022
- [2] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).

REFERENCE BOOKS:

- [1] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).
- [2] Cambridge BEC4 Preliminary (BEC Practice Tests), Cambridge University Press, 2021.

WEB REFERENCES

- [1] "NPTEL," https://www.youtube.com/playlist?list=PLzf4HHlsQFwIQUeZq_ykEVB6qZrTRnJZn
- [2] https://www.youtube.com/playlist?list=PL3qvHcrYGy1sU_1nMMVrfFEhYROpQtVXV

25HS204	DESIGN THINKING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply empathy research methods to identify and understand user needs in engineering contexts.	2,4	1,3
CO2	Synthesize user data and formulate clear problem statements using structured analysis techniques.	2,4	1,2
CO3	Generate innovative solutions through systematic ideation methods and concept evaluation frameworks.	2,3	1,2,3
CO4	Create and validate prototypes using rapid testing methods to iterate engineering solutions.	3,4	2,3

EMPATHIZE PHASE

[3]

Human-centred design principles, user interviews, empathy mapping, persona development, stakeholder identification, journey mapping. Case Study.

ANALYSE PHASE

[4]

Data synthesis, insight generation, pattern recognition, problem statement formulation, root cause analysis, affinity mapping, How Might We questions, problem definition canvas, 5 Whys technique. Case Study.

SOLVE PHASE

[4]

Creative ideation, divergent vs convergent thinking, brainstorming, SCAMPER technique, idea sketching, concept selection matrix, solution feasibility assessment. Case Study.

TEST PHASE

[4]

Rapid prototyping, prototype fidelity levels, testing methodologies, iteration principles, paper prototyping, digital wire framing, user testing scripts, feedback collection methods. Case Study.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Brown, Tim. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, 2019

REFERENCE BOOKS:

- [1] Norman, Donald A. The Design of Everyday Things: Revised and Expanded Edition. Basic Books, 2013.
- [2] Kumar, Vijay. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization. Wiley, 2012.

WEB RESOURCES:

- [1] "IDEO Design Kit:," www.designkit.org

25EE222	INTRODUCTION TO MODEL BASED SYSTEMS ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe concepts and workflows of Model-Based Systems Engineering.	1,2,11	1
CO2	Model engineering systems using appropriate modeling tools and techniques	1,2,3,5,8	1
CO3	Trace and integrate requirements, design decisions, and simulation results across the system lifecycle	1,2,3,5,8	1
CO4	Develop strong systems thinking skills for modeling, analyzing, and validating system behavior against requirements.	1,2,3,5,8	1
CO5	Evaluate the system model developed by validating simulation results against defined requirements and presenting the integrated mini project.	1,2,3,4,5,8,9	1,2,3

INTRODUCTION TO MBSE & SYSTEMS THINKING

[6]

Systems Engineering, Need for MBSE vs traditional document-based approach, Overview of system lifecycle (concept to validation), Introduction to V-Model (simplified), Basic system thinking with everyday examples, Introduction to modelling using Simulink.

REQUIREMENTS AND FUNCTIONAL MODELLING

[6]

Introduction to RFLP(Requirement, Functional, Logical and Physical) framework, introduction to system requirements and their role in guiding the development process, conceptual modelling, and the abstraction of automotive systems for simulation purposes, understanding the personas of different engineering teams involved in development cycle. system requirements, Introduction to Requirement–Function relationship, Functional decomposition (what the system should do), Representing system functions using block diagrams, Traceability concept (requirement ↔ model). Mini case study: Smart lighting / water tank system.

LOGICAL MODELLING AND SIMULATION

[6]

Logical architecture (how system works), Signal flow and behaviour modelling in Simulink, Running simulations and observing outputs, Parameter variation and scenario testing. Case study: Automatic street light.

BASIC VALIDATION AND CONTROL CONCEPTS

[6]

Verification vs validation (intuitive), Checking model behaviour against requirements, Introduction to feedback and control logic, Simple decision-making systems using Simulink. Plant Modelling, Control Design Controller performance - software-in-the-loop (SIL) and Processor-in-loop, introduction to hardware-in-the-loop (HIL) testing to validate control systems. Mini project: Temperature control / smart irrigation.

INTEGRATED MBSE MINI PROJECT

[6]

Applying MBSE workflow: Requirement → Function → Model → Simulation → Validation Team-based project development Introduction to multidisciplinary systems (mobility, energy, etc.). Project presentation and model demonstration

1. Introduction to Simulink environment
2. Modelling a simple system (input-output system)
3. Representing system requirements in simple form
4. Functional decomposition using block diagrams
5. Building a logical model in Simulink
6. Running simulations and analysing outputs
7. Parameter tuning and scenario testing
8. Basic validation of model vs requirement
9. Mini-project implementation using MBSE workflow
10. Final integrated MBSE project

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] *Model-Based Systems Engineering with AI and Machine Learning*; by Dr. Robert Johnson
- [2] Azad M. Madni, Norman Augustine, Michael Sievers, *Handbook of Model-Based Systems Engineering*, Springer Nature Switzerland AG, 2023

REFERENCE BOOKS:

- [1] *Case Studies in Model-Based Systems Engineering*; by the International Council on Systems Engineering (INCOSE)
- [2] MATLAB Simulink Documentation
- [3] MAAB Guidelines

WEB REFERENCES:

- [1] "INCOSE - Learn," <https://www.incose.org/learn>

LIBERAL ARTS COURSE (LAC)

25EC203	EVOLUTION OF SEMICONDUCTOR TECHNOLOGIES	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the concepts of discrete and integrated components to explain the need for integrated circuits in electronic systems.	1,2,3,11	1
CO2	Apply basic IC fabrication steps and SoC concepts to interpret modern integrated circuit development.	1,2,3,11	1
CO3	Analyze different types of ICs, levels of integration, and packaging methods for given applications.	1,2,3,11	1
CO4	Analyze the semiconductor industry ecosystem and performance parameters to compare semiconductor technologies.	1,2,3,11	1
CO5	Apply knowledge of semiconductor technologies to analyze their use in industry-oriented and emerging applications such as AI chips, IoT, and 3D ICs.	1,2,3,11	1,2

Discrete devices to Integrated circuits

[7]

Limitations of discrete components – Emergence and necessity of ICs over discrete circuits– Concept of integrated circuits and system-on-chip (SoC) architecture – Fabrication overview (oxidation, diffusion, photolithography – Classification of ICs: Analog, Digital – Levels of integration: SSI, MSI, LSI, VLSI – Examples of each level – Evolution of IC packaging from DIP to SMD– Trends in miniaturization- Introduction to stick diagrams and basic CMOS layout representation for IC physical design.

Semiconductor industry and applications

[8]

Semiconductor manufacturing ecosystem – Overview of the global and Indian semiconductor industry– Performance parameters of semiconductor technologies (speed, power consumption, area, time delay- Semiconductor applications in industry-oriented domains: consumer electronics, communication systems (5G/6G), automotive electronics (ADAS, EVs), medical electronics (imaging, diagnostics), renewable energy systems, industrial automation, and IoT – Future trends: AI chips, Intelligent electronics, nanotechnology, 3D ICs and sustainable semiconductor technologies.

CASE STUDIES

1. AI-enabled semiconductor chips in autonomous vehicles for real-time decision-making
2. Semiconductor role in smartphones and electric vehicles.
3. Miniaturization of electronics in wearable medical devices using SMD and SoC technologies

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS

- [1] S. M. Sze and Kwok K. Ng, *Physics of Semiconductor Devices*, 3rd ed., Wiley, 2021.
- [2] R. Jacob Baker, *CMOS: Circuit Design, Layout, and Simulation*, 4th ed., Wiley, 2024.

REFERENCE BOOKS

- [1] Behzad Razavi, *Fundamentals of Microelectronics*, 3rd ed., Wiley, 2021.
- [2] Neil H. E. Weste and David Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, 5th ed., Pearson, 2019
- [3] Peter Van Zant, *Microchip Fabrication: A Practical Guide to Semiconductor Processing*, 7th ed., McGraw-Hill, 2022.

WEB REFERENCES:

- [1] "Integrated Circuits, MOSFETs, Op-Amps and their Applications,"
https://onlinecourses.nptel.ac.in/noc21_ee31/preview
- [2] https://onlinecourses.nptel.ac.in/noc21_mm03/preview
- [3] "Basic Overview of Semiconductor Device Processing and IC Fabrication,"
https://onlinecourses.nptel.ac.in/noc26_ee04/preview
- [4] https://onlinecourses-archive.nptel.ac.in/noc19_ee25/course
- [5] "VLSI Design Flow: RTL to GDS,"
https://onlinecourses.nptel.ac.in/noc24_ee102/preview

25EE217	HISTORY OF SCIENCE AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Trace the origin and development of science and technology across ancient civilizations	-	-
CO2	Analyse the contributions of ancient India in mathematics, astronomy, medicine, metallurgy, and architecture, and their relevance to modern science.	-	-
CO3	Analyse the scientific and industrial revolutions, the contributions of pioneers and the emergence of modern technological infrastructure.	-	-
CO4	Evaluate contemporary developments in digital technology, Artificial Intelligence, robotics, biotechnology, and renewable energy and their societal implications	6	-
CO5	Assess the ethical, social, and sustainability dimensions of scientific and technological advancements and relate them to future trends.	6,7	-

ANCIENT CIVILIZATIONS AND SCIENTIFIC KNOWLEDGE

[5]

Origin and development of science and technology, Scientific achievements of ancient civilizations: Egypt, Mesopotamia, Greece, China, and India, Ancient Indian contributions in mathematics, astronomy, medicine, metallurgy, and architecture, Traditional knowledge systems and their relevance.

EVOLUTION OF MODERN SCIENCE AND TECHNOLOGY

[5]

Renaissance and Scientific Revolution, Contributions of Copernicus, Galileo, Newton, and other pioneers, Industrial Revolution and technological transformation, Development of electricity, communication, transportation, and computing technologies.

SCIENCE, TECHNOLOGY, AND FUTURE SOCIETY

[5]

Digital Revolution and Information Technology, Artificial Intelligence, Robotics, and Biotechnology, Renewable Energy and Sustainable Technologies, Ethical and social dimensions of scientific and technological advancements, Future trends in science and technology.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] James E. McClellan III and Harold Dorn, *Science and Technology in World History: An Introduction*, 3rd ed., Johns Hopkins University Press, Baltimore, 2015.
- [2] B. V. Subbarayappa, *Science in India: A Historical Perspective*, 2nd ed., Rupa Publications, New Delhi, 2011.

REFERENCE BOOKS:

- [1] Daniel R. Headrick, *Technology: A World History*, 1st ed., Oxford University Press, New York, 2009.
- [2] Donald Cardwell, *The Norton History of Technology*, 1st ed., W. W. Norton & Company, New York, 1995.
- [3] Arnold Pacey and Francesca Bray, *Technology in World Civilization: A Thousand-Year History*, Revised and Expanded Edition, MIT Press, Cambridge, 2021

WEB REFERENCES:

- [1] "Aerospace Structural Analysis," <https://nptel.ac.in/courses/101104065>
- [2] "Science, Technology and Society," <https://nptel.ac.in/courses/109103024>
- [3] "Sociology Of Science," https://onlinecourses.nptel.ac.in/noc24_hs100/preview
- [4] "Science, Technology & Modernity," <https://www.coursera.org/learn/science-technology-modernity-odc>

25HS201	தமிழர் மரபு Heritage of Tamils	L	T	P	C
		1	0	0	1

கற்றல் அடைவுகள்

பாட நெறியின் முடிவில் மாணவர்களின் கற்றலின் அடைவுகள்

COs	கற்றல் அடைவுகள்	POs	PSO
CO 1	மொழி மற்றும் இலக்கியம், சங்க இலக்கியத்தில் அறக்கோட்பாடுகள் மற்றும் தமிழ்க் காப்பியங்கள் பற்றி அறிதல்.	11	-
CO 2	பழந்தமிழரின் பாரம்பரியக் கலைகள் மற்றும் வாழ்வியல் முறைகள் குறித்து அறிந்துகொள்ளுதல்.	11	-
CO 3	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகளில் தமிழரின் பங்களிப்பு மற்றும் உறுதித்தன்மையை உணர்ந்துகொள்ளுதல்.	11	-
CO 4	தமிழர்களின் வாழ்க்கைமுறைகள், அறக்கோட்பாடு மற்றும் கல்விமுறைகள் குறித்து தெரிந்து கொள்ளுதல்.	11	-
CO 5	தமிழர்களின் கலாச்சாரத் தாக்கம், சுயமரியாதை இயக்கம் மற்றும் தமிழ் நூல்களின் அச்ச வரலாறு குறித்து அறிந்துகொள்ளுதல்.	11	-

மொழி மற்றும் இலக்கியம்

[3]

இந்தியாவில் உள்ள மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி, தமிழின் செம்மொழித் தகுதிகள் - சங்க இலக்கியத்தின் மதச்சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கோட்பாடுகள் - தமிழ் காப்பியங்கள் மற்றும் தமிழில் பௌத்தம் & சமணத்தின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் தமிழில் நவீன இலக்கியம், வளர்ச்சி - பாரதியார் மற்றும் பாரதிதாசன் பங்களிப்பு.

பாரம்பரியம் - பாறை ஓவியங்கள் மற்றும் நவீன கலைகள் - சிற்பம்

[3]

நடுகல் முதல் நவீன சிற்பம் - வெண்கல சின்னங்கள் - பழங்குடியினர் மற்றும் அவர்களின் கைவினைப்பொருட்கள் , பொம்மைகள் - தேர்செய்யும் கலை, சுடுமண் சிற்பங்கள் - நாட்டுப்புற தெய்வங்கள், கன்னியாகுமரியில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பாறை, வீணை, யாழ் மற்றும் நாதஸ்வரம் - தமிழர்களின் சமூக மற்றும் பொருளாதார வாழ்வில் கோயில்களின் பங்கு

நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள்

[3]

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியன் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம் - தமிழர்களின் விளையாட்டுகள்.

தமிழர்களின் திணைக்கோட்பாடுகள்

[3]

தமிழர்களின் தாவரங்கள் மற்றும் விலங்கினங்கள் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கருத்து - சங்க காலத்தில் கல்வி மற்றும் எழுத்தறிவு - சங்ககால நகரங்கள் மற்றும் துறைமுகங்கள் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

இந்திய தேசிய இயக்கம் மற்றும் இந்தியப்பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு [3]

இந்திய சுதந்திரப் போராட்டத்தில் தமிழர்களின் பங்களிப்பு - இந்தியாவின் சில பகுதிகளில் தமிழர்களின் கலாச்சார தாக்கம் - சுயமரியாதை இயக்கம் - சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள் & கையெழுத்துப்

பிரதிகள் – தமிழ் நூல்களின் அச்ச வரலாறு.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

Text Books:

- [1] தமிழர் மரபு - ஆக்கம்:தமிழ்ப் பேராசிரியர்கள் ,அண்ணா பல்கலைக்கழகம் வெளியீடு : பொறியியல் தொழில்நுட்பத் தமிழ் வளர்ச்சி மையம் ,அண்ணா பல்கலைக்கழகம் ,சென்னை - 600 025. (முதல் பதிப்பு 2023)

Reference Books:

- [1] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.)
- [2] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
- [3] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
- [4] Keeladi – *Sangam City Civilization on the banks of river Vaigai* (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- [5] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
- [6] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- [7] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.
- [8] தமிழக வரலாறும் மக்களும் பண்பாடும் – டாக்டர் கே.கே.பிள்ளை(தமிழ்நாடு பாடநூல் மற்றும் பணிகள் கழகம்)
- [9] கணினித் தமிழ் முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
- [10] கீழடி வைகை நதிக்கரையில் நகர நாகரிகம்(தொல்லியல் துறை வெளியீடு) .

WEB REFERENCES:

- [1] "Tamil Virtual Academy," <https://www.tamilvu.org/>
- [2] "Tamil Wikipedia," <https://ta.wikipedia.org/>
- [3] "TVA | Tamil Nadu Information Technology Department," <https://it.tn.gov.in/en/node/47>
- [4] "Official Website of Alagappa University," <https://www.alagappauniversity.ac.in>
- [5] "Tamil Language and Culture Resources," <https://clcl.uiowa.edu/language-resources/tamil-language-and-culture-resources>
- [6] "A collection of Tamil Online Resources," <https://avvaitamil.org/online-resources/>
- [7] "Tamil Archives," <https://www.alllanguageresources.com/tamil-resources/>

25HS202	தமிழரும் தொழில்நுட்பமும் Tamils and Technology	L	T	P	C
		1	0	0	1

கற்றல் அடைவுகள்

பாட நெறியின் முடிவில் மாணவர்களின் கற்றலின் அடைவுகள்

COs	கற்றல் அடைவுகள்	POs	PSO
CO 1	நெசவு மற்றும் பாணைத் தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 2	சங்க காலத்திய வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 3	இரும்பு, எஃகு மற்றும் உலோகவியல் ஆய்வுகள் குறித்து புரிந்து கொள்ளுதல்.	11	-
CO 4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி அறிதல்	11	-
CO 5	அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் வளர்ச்சி சார்ந்த தொழில்நுட்ப முறைகளை அறிதல்	11	-

நெசவு மற்றும் பாணைத் தொழில்நுட்பம்

[3]

சங்க காலத்தில் நெசவுத் தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு மற்றும் சிவப்பு பாத்திரங்கள் - மட்பாண்டங்கள் மீது கீரல் குறியீடு.

வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம்

[3]

சங்க காலத்தில் வீட்டு உபயோகப் பொருட்களில் வடிவமைத்தல் மற்றும் கட்டமைப்பு, கட்டுமானங்கள் - கட்டிட பொருட்கள் மற்றும் சங்க காலத்து நடுகற்கள் - சிலப்பதிகாரத்தில் கட்டப்பட்ட கட்டடங்களின் விவரங்கள் மாமல்லபுரத்தில் உள்ள சிற்பங்கள் மற்றும் கோவில்கள் - சோழர்களின் பெரிய கோவில்கள் மற்றும் பிற வழிபாட்டு தலங்கள் - நாயக்கர் கால கோவில்கள் - வகை ஆய்வு (மதுரை மீனாட்சி கோயில்)- திருமலை நாயக்கர் மஹால் - செட்டி நாடு வீடுகள், ஆங்கிலேயர் காலத்தில் சென்னையில் உள்ள இந்தோ - சரசெனிக் கட்டிடக்கலை.

உற்பத்தித் தொழில்நுட்பம்

[3]

கப்பல் கட்டும் கலை - உலோகவியல் ஆய்வுகள் - இரும்புத் தொழில் - இரும்பு உருக்குதல், எஃகு - வரலாற்றின் ஆதாரமாக தாமிரம் மற்றும் தங்க நாணயங்கள் அச்சிடுதல் - மணிகள் செய்யும் தொழில்கள், கல் மணிகள் - கண்ணாடி மணிகள் - டெரகோட்டா மணிகள் - சங்கு மணிகள் / எலும்புத்துண்டுகள் தொல்பொருள் சான்றுகள் - சிலப்பதிகாரத்தில் விவரிக்கப்பட்டுள்ள மணிகள் .

வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம்

[3]

அணை, தொட்டி, குளங்கள், மதகு, சோழர் கால குமிழி தூம்பு முக்கியத்துவம், கால்நடை பராமரிப்பு - கால்நடைகள் பயன்படுத்த வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த தொழில்நுட்பம் - கடல் சார் அறிவு - மீன்வளம் - முத்து - சங்கு அறுத்தல் - கடல் பற்றிய பண்டைய அறிவு கடல் குறிப்பிட்ட அறிவு சார் உலகம்.

அறிவியல் தமிழ் & கணினி தமிழ்

[3]

அறிவியல் தமிழ் மற்றும் கணினி தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருள் உருவாக்கம் - தமிழ் மெய்நிகர் அகாடமி - தமிழ் மின்நூலகம் - இணைய தமிழ் அகராதிகள் - சொற்குவை திட்டம்.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] தமிழர் மரபு - ஆக்கம்:தமிழ்ப் பேராசிரியர்கள் ,அண்ணா பல்கலைக்கழகம் வெளியீடு : பொறியியல் தொழில்நுட்பத் தமிழ் வளர்ச்சி மையம் ,அண்ணா பல்கலைக்கழகம் ,சென்னை - 600 025. (முதல் பதிப்பு 2023)

REFERENCE BOOKS:

- [1] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
- [2] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
- [3] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
- [4] Keeladi – *Sangam City Civilization on the banks of river Vaigai* (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- [5] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
- [6] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
- [7] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.
- [8] தமிழக வரலாறும் மக்களும் பண்பாடும் – டாக்டர் கே.கே.பிள்ளை(தமிழ்நாடு பாடநூல் மற்றும் பணிகள் கழகம்)
- [9] கணினித் தமிழ் முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
- [10] கீழடி வைகை நதிக்கரையில் நகர நாகரிகம்(தொல்லியல் துறை வெளியீடு).

WEB REFERENCES:

- [1] "Tamil Virtual Academy," <https://www.tamilvu.org/>
- [2] "Tamil Wikipedia," <https://ta.wikipedia.org/>
- [3] "TVA | Tamil Nadu Information Technology Department," <https://it.tn.gov.in/en/node/47>
- [4] "Official Website of Alagappa University," <https://www.alagappauniversity.ac.in>
- [5] "Tamil Language and Culture Resources," <https://clcl.uiowa.edu/language-resources/tamil-language-and-culture-resources>
- [6] "A collection of Tamil Online Resources," <https://avvaitamil.org/online-resources/>
- [7] "Tamil Archives," <https://www.alllanguageresources.com/tamil-resources/>

25HS203	YOGA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Review the basic concepts of Yoga, such as its origins, the eightfold path, and various classifications.	6	-
CO2	Summarise the benefits of Yoga for physical and mental health.	6	-
CO3	Explain the connection between the philosophical foundations of Yoga and their influence on individual development.	6	-
CO4	Demonstrate basic Yoga postures and breathing techniques to enhance strength, endurance, and mental quietude through personalized practice.	6	-

Introduction to Yoga – Origin - Need for Yoga – Yoga Mind Power – The Yoga Tradition – Classification - Yoga’s Eightfold path – Breathing Practices – Hatha Yoga – Yoga Practice – Procedure – Personalizing Yoga Practice – Postures to Build strength and endurance – Postures to Quiet the Body and Mind – Chakras – Mudras – Mandalas – Mantras – Practices.

Total Notional Hours:30

L	T	P	TW+SL	C
15	0	0	15	1

Assessment

Grading based on Attendance and Participation

Any two asanas

Any two pranayamas

One kriya

TEXT BOOK:

[1] Joan Budilovsky and Eve Adamson, *The Complete Idiot’s Guide to Yoga*, Alpha Books, ISBN: 0-02-863970-7, 2024.

REFERENCE BOOKS:

[1] Deepak Chopra and David Simon, *The Seven Spiritual Laws of Yoga: a practical guide to healing body, mind, and spirit*, John Wiley and Sons, ISBN: 0-471-64764-0, 2023.

[2] Sri Swami Sivananda, *Yoga in Daily Life*, Divine Life Trust Society, ISBN: 81-7052-055-X, 2024

25HS211	INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational structure, classification, and core disciplines of the Vedic corpus.	1	1
CO2	Describe the unique contributions and historical development of Indian mathematics.	1	1
CO3	Explain the principles and contributions of Indian astronomy.	1	1
CO4	Identify key achievements in traditional Indian engineering and technology.	1	1
CO5	Describe the principles of Indian town planning and architecture as derived from Vāstu-śāstra and Arthaśāstra, and explain their application in the design of temples, cities, and iconography.	1, 3	1

Vedic corpus

[3]

Introduction to Vedas - A synopsis of the four Vedas - Sub-classification of Vedas - Messages in Vedas - Introduction to Vedāṅgas - Prologue on Śikṣā and Vyākaraṇa - Basics of Nirukta and Chandas - Introduction to Kalpa and Jyotiṣa - Vedic Life: A Distinctive Features.

Mathematics

[3]

Number systems in India - Historical evidence - Salient aspects of Indian Mathematics - Bhūta-Saṁkhyā system - Kaṭapayādi system - Measurements for time, distance, and weight - Piṅgala and the Binary system - Introduction to Indian Mathematics - Unique aspects of Indian Mathematics - Indian Mathematicians and their Contributions – Algebra – Geometry – Trigonometry - Binary mathematics and combinatorial problems in Chandaḥ Śāstra - Magic squares in India.

Astronomy

[3]

Introduction to Indian astronomy - Indian contributions in astronomy - The celestial coordinate system - Elements of the Indian calendar - Notion of years and months - Pañcāṅga – The Indian calendar system - Astronomical Instruments (Yantras) - Jantar Mantar of Rājā Jai Singh Sawai.

Engineering and Technology

[3]

Wootz Steel: The rise and fall of a great Indian technology - The Indian S & T heritage - Mining and ore extraction - Metals and metalworking technology - Iron and steel in India - Lost wax casting of idols and artefacts - Apparatuses used for extraction of metallic components - Irrigation systems and practices in South India - Literary sources for science and technology - Physical structures in India - Irrigation and water management - Dyes and painting technology - The art of making perfumes - Surgical techniques – Shipbuilding - Sixty-four art forms (64 Kalās) - Status of Indigenous S & T.

Town Planning and Architecture

[3]

Perspective of Arthaśāstra on town planning - Vāstu-śāstra – The science of architecture - Eight limbs of Vāstu - Town planning - Temples in India: marvelous stone architecture for eternity - Temple architecture in India - Iconography.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOK:

- [1] Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. Introduction to Indian Knowledge System: Concepts and Applications. PHI Learning Pvt. Ltd., 2022.

REFERENCES:

- [1] Kapoor Kapil, Singh Avadhesh. Indian Knowledge Systems Vol – I & II. Indian Institute of Advanced Study, 2021.

WEB RESOURCES:

- [1] "Indian Knowledge System (IKS): Concepts and Applications in Engineering,"
https://onlinecourses.swayam2.ac.in/imb23_mg53/

25MA205	VEDIC MATHEMATICS FOR ENGINEERS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall key Vedic Math sutras and their use in arithmetic, algebra, and number theory.	1,11	-
CO2	Understand fast computation methods for arithmetic operations and algebraic simplifications.	1,2,11	-
CO3	Apply Vedic techniques to solve engineering mathematics problems in matrices, calculus, and trigonometry.	1,2	*
CO4	Use Vedic methods in real-time computing scenarios such as algorithm optimization and error detection.	1,2,5	*
CO5	Demonstrate the benefits of Vedic computation through practical problem-solving in engineering applications.	1,2,5,11	*

VEDIC MATHEMATICS ESSENTIALS

[7]

Introduction to Vedic Maths & Sutras – Overview and applications - Fast Addition and Subtraction Techniques - Multiplication Tricks – Vertically and Crosswise, Duplex method - Division Shortcuts – Straight Division, Flag Method - Squares and Cubes of Numbers.

APPLICATIONS IN ENGINEERING MATHEMATICS

[7]

Solving determinants and matrices - Simplifying calculus computations (derivatives, integration shortcuts) - Trigonometric simplifications - Number theory basics useful in cryptography and coding theory.

REAL-TIME APPLICATIONS AND PRACTICE

[1]

Applications in computer algorithms, digital electronics, and error checking Use in competitive exams: GATE, GRE, CAT, etc. Practice problems and speed tests, Mini project or assignment: Implement a Vedic math-based calculator using C/C++/Python/Excel.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Bharati Krishna Tirthaji, Vedic Mathematics, Motilal Banarsidass Publishers, Latest Reprint 2022.
- [2] Atul Gupta, Foundation Course in Vedic Mathematics, Motilal Banarsidass Publishers, Latest Reprint 2021.
- [3] V. K. Jain, Engineering Applications of Vedic Mathematics, Khanna Publishing, Latest Reprint 2020.

REFERENCE BOOKS:

- [1] Shri Dhaval Bathia, Vedic Mathematics Made Easy, Jaico Publishing House, Reprint 2020.

- [2] Gaurav Tekriwal, Maths Sutra: The Art of Indian Speed Calculation, Penguin Books India, Reprint 2022.
- [3] K.S. Oza, Vedic Mathematics for All Ages, CBS Publishers, Reprint 2019.

WEB REFERENCES

- [1] "NPTEL – Ancient Indian Science and Technology (Module: Vedic Mathematics)," <https://nptel.ac.in/courses/111106084>
- [2] "Coursera – Speed Math Techniques (related to Vedic methods)," <https://www.coursera.org/learn/speed-math>
- [3] "YouTube – Vedic Maths India Official Channel," <https://www.youtube.com/user/vedicmathsindia>
- [4] "MIT OCW – Mental Math (complements Vedic strategies)," <https://ocw.mit.edu/high-school/mathematics/mathematics-of-everyday-life/>

25MA206	FOUNDATIONS OF PROBLEM SOLVING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall and apply mental math tricks for basic arithmetic operations.	1,11	*
CO2	Understand structured visual thinking methods like SAW, OX, Mirror, and High5 to solve problems.	1,2,4,11	*
CO3	Apply creative and logical thinking strategies to solve numerical and word-based puzzles.	1,2,4,11	*
CO4	Use problem-solving tools to analyse and solve real-world problems involving time, money, and work.	1,2,4	*
CO5	Demonstrate reflective learning and peer collaboration through group activities and challenges.	1,2,9,11	*

SPEED MATHEMATICS AND VISUAL PROBLEM SOLVING TOOLS

[7]

Quick tricks for addition, subtraction, multiplication, division - Fun number patterns and mental math hacks - Thinking fast with numbers - SAW – See, Analyze, Work: A method to break down problems clearly - OX – Options vs. Cross-checking: Strategy for choosing the best answers - Mirror – Reflective Thinking: Look back, learn, and fix errors. - High5 – 5-step method: Understand, Plan, Do, Check, Reflect.

CREATIVE THINKING TOOLS AND PROBLEM SOLVING WITH NUMBERS

[7]

Inception – Think within a problem and go deeper step by step - Minion – Use small helper ideas to solve big problems - Butterfly – See connections between unrelated ideas (lateral thinking) - Thinking logically using numbers - Puzzles, patterns, and simple number games - Word problems simplified with numbers.

REAL-TIME APPLICATIONS AND PRACTICE

[1]

- Real-world problems (time, work, money, distance).
- Mini challenges and fun math puzzles.
- Group activities and quick tests using course tools.

Total Notional Hours : 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publications, Latest Reprint 2022.
- [2] Rajesh Verma, Fast Track Objective Arithmetic, Arihant Publications, Latest Reprint 2022.

REFERENCE BOOKS:

- [1] M. Tyra, Magical Book on Quicker Maths, BSC Publishing Co., Latest Reprint 2021

- [2] Arun Sharma, How to Prepare for Quantitative Aptitude for CAT, McGraw Hill Education, Latest ed. 2023.
- [3] Nishit K. Sinha, Logical Reasoning and Data Interpretation for CAT, Pearson Education, Latest ed. 2022.

WEB REFERENCES:

- [1] "Mental Math Tricks (YouTube) – Easy-to-follow video tutorials,"
<https://www.youtube.com/@mathantics>
- [2] "Khan Academy – Arithmetic & Number Properties Fun Math Games & Practice (Math Playground) <https://www.mathplayground.com>," <https://www.khanacademy.org/math/arithmetic>
- [3] "MindTools – Problem Solving Techniques,"
https://www.mindtools.com/pages/main/newMN_TMC.htm
- [4] "Project Euler – Math Puzzles and Logical Thinking," <https://projecteuler.net>
- [5] "NRICH – Math Challenges and Games for Students," <https://nrich.maths.org>

25ME202	INDUSTRIAL REVOLUTIONS AND EMERGING TRENDS IN MANUFACTURING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the key developments of the First, Second, Third, and Fourth Industrial Revolutions, including major inventions like the steam engine, assembly line, CNC machines, and Industry 4.0 technologies.	1,11	2
CO2	Explain the concepts of mass production, automation, and the role of mechanical engineers in transforming manufacturing.	1,6	1,2
CO3	Apply basic knowledge of CAD/CAM, CNC, and robotics in understanding how manufacturing efficiency and precision are improved in modern factories.	1,5	1,2
CO4	Analyze the transition from craftsmanship to smart factories, identifying the technological and engineering contributions that drove each industrial revolution.	2,6,11	2
CO5	Evaluate the advantages and challenges of Industry 4.0 including AI integration, big data utilization, and real-time decision-making in smart manufacturing environments.	2,6,10	2,3

CRAFTSMANSHIP TO MACHINES

[7]

Introduction to the First Industrial Revolution- Steam Engine and Its Impact- Industry and Mechanization- Rise of Factories- Economic and Global Effects- Criticism and Challenges.

MASS PRODUCTION

[7]

Introduction to the Second Industrial Revolution-Assembly Lines and COMPRE

Mass Production- Standardization of Parts- Role of Mechanical Engineers in Production- Advancements in Manufacturing Technology.

AUTOMATION IN MANUFACTURING

[8]

Introduction to the Third Industrial Revolution- Automation in Factories- Use of Computers in Manufacturing- CNC Machines -CAD/CAM Software- Advancements in Precision and Quality- Introduction of Robotics in Manufacturing.

SMART FACTORIES – INDUSTRY 4.0

[8]

Introduction to Industry 4.0- Smart and Connected Factories- Use of AI in Industry- Big Data and Real-Time Decision Making- Enhanced Factory Flexibility and Efficiency- Impact of Industry 4.0 on Production.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

[1] R. C. Allen, The Industrial Revolution: A Very Short Introduction, Oxford: Oxford University Press, 2017.

- [2] P. Dennis, *Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System*, 3rd New York, NY: Productivity Press, 2015.

REFERENCE BOOKS:

- [1] P. Clavin, Ed., *The Second Industrial Revolution, 1870–1914*. Oxford: Oxford University Press, 2014.
- [2] M. P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 4th ed., Upper Saddle River, NJ: Pearson, 2015.
- [3] K. Schwab, *The Fourth Industrial Revolution*. London, UK: Penguin Books Limited, 2017.
- [4] A. Ustundag and E. Cevikcan, *Industry 4.0: Managing the Digital Transformation*. Cham, Switzerland: Springer, 2018. doi: 10.1007/978-3-319-57870-5.

WEB REFERENCES

- [1] "Automation In Manufacturing," <https://nptel.ac.in/courses/112103293>
- [2] "Fundamentals of Manufacturing Processes," <https://nptel.ac.in/courses/112107219>
- [3] "Rapid Manufacturing," <https://nptel.ac.in/courses/112104265>

SKILL DEVELOPMENT COURSE (SDC)

25EC271	THINK BUILD INNOVATE: LAB	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Understand the basic concepts and working principles of simple electronic systems used in idea lab projects.	1	1,2,3
CO2	Identify problems and analyze simple electronic circuits to understand their input–output behaviour.	2	1,2,3
CO3	Design and develop basic electronic circuits to meet given functional requirements.	3	1,2,3
CO4	Build and test simple hardware prototypes by integrating components and verifying their operation.	4	1,2,3
CO5	Demonstrate teamwork, communication, and basic project planning skills during the execution of idea lab projects.	8,9	1,2,3

The Think, Build, Innovate Laboratory introduces students to the fundamentals of creative thinking, problem identification, and hands-on learning. The course provides opportunities to explore simple engineering concepts through guided activities, basic experiments, model making, and team-based tasks. Students learn to observe real-world problems, generate ideas, use basic tools and materials, and build simple prototypes. The laboratory encourages curiosity, teamwork, communication, and systematic thinking while fostering an interest in engineering design and innovation. Through experiential learning activities, students develop foundational technical skills and confidence in applying classroom knowledge to practical situations.

Total Notional Hours:30

REFERENCE BOOKS:

- [1] Jacob Millman, Christos C. Halkias, Electronic Devices and Circuits, 4th ed., Tata McGraw Hill Publishing Limited, New Delhi, 2015.
- [2] R. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, 14th ed., Pearson Education, 2021.
- [3] Donald A. Neamen, Microelectronics: Circuit Analysis and Design, 4th ed., McGraw Hill Education, New Delhi, 2019.
- [4] S. Salivahanan, N. Suresh Kumar, Electronic Devices and Circuits, 5th ed., McGraw Hill Publishing Limited, New Delhi, 2022.
- [5] M. A. Mazidi, J. G. Mazidi, The Arduino Microcontroller and Embedded Systems, 2nd ed., Pearson Education, 2017.

WEB REFERENCES

- [1] “Arduino.cc,”<https://www.arduino.cc>
- [2] “All about circuits,” <https://www.allaboutcircuits.com>
- [3] “Basic Electronics Tutorials,”<https://www.electronics-tutorials.ws>
- [4] “Easy EDA,” <https://easyeda.com>

25CS275	COMPREHENSIVE VIVA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply mathematical foundations and aptitude concepts to solve competitive examination and technical interview problems.	1,2	1
CO2	Analyze and implement programming concepts, data structures, and algorithms to solve computing problems.	1,2,3,9	1
CO3	Demonstrate proficiency in core Computer Science subjects including Operating Systems, DBMS, Computer Networks, and Computer Organization.	1,2,10	1
CO4	Apply software engineering, web technologies, and emerging computing concepts to develop efficient solutions.	1,3,4,11	1,2,3
CO5	Evaluate technical problems and formulate effective strategies for GATE, placement, and higher studies examinations.	2,4,5	1,3

Engineering Mathematics and Aptitude

[3]

Discrete Mathematics: Logic, Sets, Relations, Functions, Combinatorics, Graph Theory.

Linear Algebra: Matrices, Determinants, Eigenvalues and Eigenvectors.

Calculus: Differentiation and Integration.

Probability and Statistics.

Quantitative Aptitude, Logical Reasoning, Verbal Ability and Analytical Skills.

Programming, Data Structures and Algorithms

[3]

C Programming Fundamentals and Problem Solving.

Object-Oriented Programming Concepts.

Arrays, Linked Lists, Stacks, Queues, Trees and Graphs.

Algorithm Analysis and Asymptotic Notations.

Searching and Sorting Techniques.

Greedy, Divide-and-Conquer and Dynamic Programming Approaches.

Core Computer Science Fundamentals

[3]

Computer Organization and Architecture.

Operating Systems: Process Management, Scheduling, Memory Management and File Systems.

Database Management Systems: ER Model, SQL, Normalization and Transactions.

Computer Networks: OSI/TCP-IP Models, Routing, Transport and Application Layer Protocols.

Compiler Design Basics and System Software Concepts.

Software Development and Emerging Technologies**[3]**

Software Engineering Principles and SDLC Models.
Web Technologies and Full Stack Development Fundamentals.
Cloud Computing and Virtualization.
Cyber Security Fundamentals and Cryptography Basics.
Internet of Things (IoT) and Mobile Computing Concepts.

Advanced Computing and Competitive Preparation**[3]**

Artificial Intelligence and Machine Learning Fundamentals.
Distributed Systems and Parallel Computing Concepts.
Open-Source Technologies and DevOps Practices.
Previous GATE CSE Question Analysis.
Technical Interview Preparation, Coding Practice, Mock Viva and Revision.

Total Notional Hours: 30

L	T	P	TW&SL	C
15	-	-	15	1

TEXT BOOKS:

- [1] Made Easy Publications, *GATE Computer Science and Information Technology 2026*. Made Easy Publications, 2026.
[2] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 4th ed. MIT Press, 2022.
[3] W. Stallings, *Computer Organization and Architecture: Designing for Performance*, 11th ed. Pearson, 2019.
[4] I. Sommerville, *Software Engineering*, 10th ed. Pearson, 2016.
[5] S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Pearson, 2021.

REFERENCES:

- [1] A. Silberschatz, P. B. Galvin, and G. Gagne, *Operating System Concepts*, 10th ed. Wiley, 2018.
[2] A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 7th ed. McGraw-Hill, 2020.
[3] J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*, 8th ed. Pearson, 2021.
[4] R. S. Pressman and B. R. Maxim, *Software Engineering: A Practitioner's Approach*, 8th ed. McGraw-Hill Education, 2015.
[5] T. Erl, R. Puttini, and Z. Mahmood, *Cloud Computing: Concepts, Technology & Architecture*. Pearson, 2015

25EE216	COMPREHENSIVE VIVA	L	T	P	C
		0	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall and explain core EEE concepts from subjects studied across all semesters.	-	-
CO2	Apply engineering principles to answer practical and scenario-based questions.	1,2,4,9	1
CO3	Analyse and connect concepts from different subject areas to answer integrated questions.	1,2,4,9	1,2
CO4	Evaluate engineering solutions with awareness of industry needs, society, and sustainability.	1,2,4,6,9,10	1,2
CO5	Communicate technical knowledge clearly and confidently in an oral examination setting.	8,9,10,11	1

The objective of this course is to ensure that every student has acquired consolidated and coherent knowledge across all core subjects studied from Semester III to Semester VIII. The viva voce is conducted by a three-member committee comprising a senior faculty from the department, an industry or research expert, and a faculty from another department. On successful completion of this course, students will be able to recall and explain fundamental EEE concepts (CO1), apply core principles to practical scenarios (CO2), analyse and interconnect concepts across subject domains (CO3), evaluate contemporary engineering solutions with reference to industry and sustainability requirements (CO4), and demonstrate clarity and confidence in oral technical communication (CO5).

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	0	30	1

TEXT BOOKS:

- [1] Made Easy Editorial Board, GATE 2024 — Electrical Engineering Chapterwise Previous Years Solved Papers, 1st ed., Made Easy Publications, New Delhi, 2023.
- [2] ACE Engineering Academy, GATE 2024 — Electrical Engineering Topic-wise Previous Solved Papers, 1st ed., ACE Engineering Publications, Hyderabad, 2023.
- [3] G. K. Publications, GATE 2024 Guide — Electrical Engineering, 1st ed., G. K. Publications Pvt. Ltd., New Delhi, 2023.
- [4] Arihant Experts, GATE Tutor 2024 — Electrical Engineering, 1st ed., Arihant Publications India Limited, Meerut, 2023.
- [5] Sangam Sinha and Sanjeev Kumar, GATE 2023 Electrical Engineering — Chapterwise Solved Papers with Practice Sets, 1st ed., Upkar Prakashan, Agra, 2022.

REFERENCE BOOKS:

- [1] Made Easy Editorial Board, Objective Electrical Engineering for GATE, PSUs and ESE Prelims, 3rd ed., Made Easy Publications, New Delhi, 2022.
- [2] ACE Engineering Academy, Electrical Engineering — Objective Practice Workbook for GATE and PSUs, 2nd ed., ACE Engineering Publications, Hyderabad, 2022.
- [3] R. K. Kanodia and Ashish Murolia, GATE Electrical Engineering MCQ — Topic-wise Practice Book, 5th ed., Nodia and Company, Jaipur, 2021.
- [4] IES Master Editorial Board, GATE — Electrical Engineering Solved Paper and Practice Book, 2nd ed., IES Master Publications, New Delhi, 2023.
- [5] Disha Experts, Chapter-wise GATE Electrical Engineering Solved Papers 2000–2023, 3rd ed., Disha Publication, New Delhi, 2023

WEB REFERENCE BOOKS:

- [1] "GATE 2025," <https://gate2025.iitr.ac.in>
- [2] "MADE EASY," <https://madeeasyonline.com>

25EC281	COMPREHENSIVE VIVA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	Course Outcomes	POs	PSO
CO1	Apply mathematical foundations and aptitude concepts to solve GATE-level problems.	1,2	1,2,3
CO2	Analyse and implement data structures and algorithms for competitive examinations and technical interviews.	1,2,3	1,2,3
CO3	Demonstrate proficiency in core ECE subjects including Demonstrate proficiency in core Electronics and Communication Engineering (ECE) subjects including Electronic Devices and Circuits, Analog and Digital Electronics, Signals and Systems, Communication Engineering, Electromagnetic Theory.	1,2	1,2,3
CO4	Develop intelligent solutions by applying learning techniques to communication networks, IoT systems, and smart healthcare applications."	1,3,4	1,2,3
CO5	Evaluate GATE-level problems and develop effective strategies for various examinations.	2,4,5	1,2,3

CIRCUIT ANALYSIS AND NETWORK THEOREMS

Node and mesh analysis, superposition, Thevenin theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation. Continuous-time and applications.

SIGNAL & SYSTEMS

Continuous-time Signals Fourier series and Fourier transform, sampling theorem .discrete-time Signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

ELECTRONIC DEVICES

Electronic Devices Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

ANALOG CIRCUITS

BJT and MOSFET Amplifiers: Biasing, AC coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers. Op-amp Circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators.

DIGITAL CIRCUITS

Number Representations: Binary, integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders.

CONTROL SYSTEMS

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and rootlocus plots.

ELECTROMAGNETICS

Maxwell Equations: Differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector. Plane Waves and Properties: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

COMMUNICATIONS

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers. Information Theory: Entropy, mutual information and channel capacity theorem. Digital Communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference.

TEXTBOOKS:

- [1] GATE Tutor Electronics & Communication Engineering, Arihant Publications, 2025.
- [2] GATE Book, Electronics and Communication Engineering, Pearson Publications, 2025.
- [3] GATE, Electronics Communication Engineering, Complete Study Guide, G.K. Publications, 2026.
- [4] GATE ECE Practice Book, | Electronics & Communication Engineering | Chapter-Wise MCQs for GATE, ESE & PSUs | Solved Papers, 2027.
- [5] GATE ECE Practice Book | Electronics & Communication Engineering | Chapter-Wise MCQs for GATE, 2027
- [6] Arihant GATE TUTOR Study Guide for Electronics & Communication Engineering Exam 2025.

WEB REFERENCES

- [1] “GATE Overflow Books”, <https://gatecse.in/gate-overflow-book-qa-only-previous-gate-tifr/>
- [2] “GATE handwritten notes”, [Online]. Available: <https://www.selfstudys.com/page/gate-electronics-communication-engineering-notes>.

25ME277	COMPREHENSIVE VIVA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Understand and explain the fundamental concepts of Engineering Mechanics, Mechanics of Materials, Theory of Machines, and Machine Design for analyzing mechanical systems and components.	1,2,3	1
CO2	Apply principles of statics, dynamics, strength of materials, vibrations, and machine design to solve engineering problems related to structures and machine elements.	1,2,3,4	1
CO3	Analyze fluid flow, thermodynamic systems, heat transfer processes, power cycles, refrigeration, and air-conditioning systems using engineering principles and mathematical models.	1,2,3,4	1
CO4	Describe the properties of engineering materials and explain manufacturing processes including casting, forming, joining, machining, metrology, CAD/CAM, and additive manufacturing techniques.	1,2,3,4,5,6	1,2
CO5	Evaluate the performance of mechanical and thermal systems using analytical methods, testing procedures, measurement techniques, and design standards.	1,2,3,4,5,7	1
CO6	Develop analytical thinking, technical competency, and problem-solving skills required for higher studies, competitive examinations like GATE, and professional practice in mechanical engineering.	1,2,3,8,9,10,11	3

Engineering Mechanics: Free body diagrams, equilibrium, friction applications, trusses and frames, virtual work, rigid body kinematics and dynamics, impulse, momentum, energy methods and Lagrange's equations.

Mechanics of Materials: Stress-strain relations, elastic constants, Mohr's circle, thin cylinders, shear force and bending moments, bending and torsional stresses, beam deflection, columns, thermal stresses, strain gauges, and material testing methods.

Theory of Machines: Kinematic and dynamic analysis of mechanisms, cams, gears and gear trains, flywheels, governors, balancing, and gyroscopic effects.

Machine Design: Design under static and dynamic loading, failure theories, fatigue, and design of machine elements such as joints, shafts, gears, bearings, brakes, clutches and springs.

Fluid Mechanics: Fluid properties and statics, continuity and momentum equations, Bernoulli's equation, dimensional analysis, viscous flow, boundary layer theory, pipe flow and compressible flow basics.

Heat Transfer: Conduction, convection, and radiation; fins; transient heat transfer; boundary layer concepts; heat exchangers; LMTD and NTU methods; and radiation heat transfer analysis.

Thermodynamics & Applications: Laws of thermodynamics, properties of substances, thermodynamic cycles, compressors, IC engines, refrigeration and air-conditioning, psychrometrics, and power plant concepts.

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment and stress–strain behaviour.

Manufacturing Processes: Casting, forming, welding, powder metallurgy, machining operations, cutting tools, CNC machining, non-traditional machining, jigs and fixtures.

Metrology and Inspection: Limits, fits and tolerances, measurement systems, comparators, interferometry, surface finish, CMM, tolerance analysis and inspection methods.

Computer Integrated Manufacturing: Fundamentals of CAD/CAM integration and additive manufacturing.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

REFERENCE BOOKS:

- [1] Rattan, S.S, *Theory of Machines*, 4th ed., Tata McGraw-Hill, 2014.
- [2] Bansal, R.K., *Fluid Mechanics and Hydraulics Machines*, 11th ed., Laxmi Publications Pvt. Ltd, New Delhi, 2023.
- [3] *Manufacturing Engineering and Technology*, Serope Kalpakjian & Steven R. Schmid, Pearson Education, 8th ed., 2021.
- [4] Raghavendra N V, Krishnamurthy L, *Engineering metrology and measurements*, Oxford university press, New Delhi, 2021
- [5] R. K. Rajput, *Strength of Materials (Mechanics of Solids)*, 8th. New Delhi, India: S. Chand Publishing, 2025.
- [6] R.K. Rajput, *Thermal Engineering*, 10th ed., Laxmi Publications Pvt. Ltd., 2018.
- [7] Bhandari V, *Design of Machine Elements*, 5th ed., Tata McGraw-Hill Book Co, 2020.
- [8] F.B. Sayyad, *Kinematics of Machinery*, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
- [9] Yunus A. Cengel and Michael A. Boles, *Thermodynamics: An Engineering Approach*, 9th ed., McGraw-Hill Education, 2019.

WEB REFERENCES

- [1] "Kinematics of Machines," <https://nptel.ac.in/courses/112104121>
- [2] "Thermal Engineering: Basic and Applied," <https://nptel.ac.in/courses/112103316>
- [3] "Mechanical Measurements and Metrology," <https://nptel.ac.in/courses/112106138>
- [4] "Sustainability through Green Manufacturing Systems: An Applied Approach," <https://nptel.ac.in/courses/112104225>
- [5] "Basic Thermodynamics," <https://nptel.ac.in/courses/112105123>
- [6] "Design of Machine Elements I," <http://nptel.ac.in/courses/112105124/>

25IT275	COMPREHENSIVE VIVA	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	Course Outcomes	POs	PSO
CO1	Apply concepts of discrete mathematics, linear algebra, calculus, and probability & statistics to solve engineering mathematics problems.	1,2	1
CO2	Analyze digital logic design and computer organization & architecture concepts including ALU/control unit design, memory hierarchy, and instruction pipelining.	1,2	1
CO3	Design solutions using C programming and fundamental data structures including arrays, stacks, queues, linked lists, trees and graphs.	1,2,3	1
CO4	Apply searching, sorting, hashing and algorithm design techniques (greedy, dynamic programming, divide-and-conquer) to solve computational problems.	1,2,3,9	1
CO5	Demonstrate proficiency in theory of computation, compiler design, operating systems, database management systems, and computer networks.	1,2,10	1

Engineering Mathematics

[3]

Discrete Mathematics: Propositional and first order logic; sets, relations, functions, partial orders and lattices; monoids and groups; graphs — connectivity, matching, colouring; combinatorics — counting, recurrence relations, generating functions.

Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus: Limits, continuity and differentiability, maxima and minima, mean value theorem, integration.

Probability and Statistics: Random variables; uniform, normal, exponential, Poisson and binomial distributions; mean, median, mode and standard deviation; conditional probability and Bayes' theorem.

Digital Logic, Computer Organization and Architecture

[3]

Digital Logic: Boolean algebra and minimization — algebraic technique, Karnaugh map, tabular method; design of combinational and sequential circuits; number representation and arithmetic (fixed and floating point).

Computer Organization and Architecture: Instruction set and addressing modes; design of the arithmetic and logic unit (ALU); design of control unit — hardwired and microprogrammed; memory interfacing and hierarchy, cache memory mapping; I/O interface (interrupt and DMA); instruction pipelining and pipeline hazards.

Programming and Data Structures

[2]

Programming in C, recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Algorithms

[1]

Searching, sorting, hashing; asymptotic worst-case time and space complexity; algorithm design techniques — greedy, dynamic programming and divide-and-conquer; graph traversals, minimum spanning trees, shortest paths.

Theory of Computation and Compiler Design

[3]

Theory of Computation: Regular expressions and finite automata; context-free grammars and push-down automata; regular and context-free languages, pumping lemma; Turing machines and undecidability.

Compiler Design: Lexical analysis, parsing, syntax-directed translation; runtime environments; intermediate code generation; local optimisation; data flow analyses — constant propagation, liveness analysis, common sub-expression elimination.

Operating Systems, Databases and Computer Networks

[3]

Operating System: System calls, processes, threads, inter-process communication, concurrency and synchronization; deadlock; CPU and I/O scheduling; memory management and virtual memory; file systems.

Databases: ER-model; relational model — relational algebra, tuple calculus, SQL; integrity constraints, normal forms; file organization, indexing (B and B+ trees); transactions and concurrency control.

Computer Networks: Principles of layering; basics of switching (circuit, packet and virtual circuit) and performance metrics; data link layer — error detection, medium access control, Ethernet; distance vector and link state routing; IPv4 — fragmentation, CIDR notation, NAT; TCP — flow control and congestion control, socket API; DNS and HTTP.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXTBOOKS:

[1] Made Easy Publications, GATE Computer Science and Information Technology 2027, Made Easy Publications, 2027.

[2] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, 4th ed., MIT Press, 2022.

[3] W. Stallings, Computer Organization and Architecture: Designing for Performance, 11th ed., Pearson, 2019.

[4] A. Silberschatz, P. B. Galvin, and G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.

[5] A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 7th ed., McGraw-Hill, 2020.

REFERENCE BOOKS

[1] J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 8th ed., Pearson, 2021.

[2] A. V. Aho, M. S. Lam, R. Sethi, and J. D. Ullman, Compilers: Principles, Techniques, and Tools, 2nd ed., Pearson, 2006.

[3] J. E. Hopcroft, R. Motwani, and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd ed., Pearson, 2006.

[4] M. Morris Mano and M. D. Ciletti, Digital Design, 6th ed., Pearson, 2018.

[5] GATE Overflow, "Previous Year GATE CS Questions," <https://gateoverflow.in>

25AI275	COMPREHENSIVE VIVA	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

COs	Course Outcomes	PO	PSO
CO1	Apply mathematical foundations and aptitude concepts to solve GATE-level problems.	1,2,9	1
CO2	Analyse and implement data structures and algorithms for competitive examinations and technical interviews.	1,2,3,10	1
CO3	Demonstrate proficiency in core CSE subjects including OS, DBMS, CN and Computer Organization.	1,2,11	1,2
CO4	Apply data science and machine learning techniques to solve real-world analytical problems.	1,3,4	2
CO5	Evaluate GATE-level problems and develop effective strategies for CSE and Data Science examinations.	2,4,5	1,2

COURSE CONTENT

ENGINEERING MATHEMATICS AND APTITUDE FOR GATE

[3]

Linear Algebra: matrices, determinants, eigenvalues and eigenvectors, Calculus: limits, continuity, differentiation, integration. Probability and Statistics: random variables, distributions, mean, variance. Numerical methods and basic optimization concepts. General Aptitude: quantitative aptitude, verbal ability, logical reasoning.

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS

[3]

C Programming fundamentals and problem solving, Arrays, linked lists, stacks, queues, trees and graphs, Algorithm analysis and asymptotic notations, Searching and sorting techniques, Recursion, greedy algorithms, divide-and-conquer, dynamic programming.

CORE COMPUTER SCIENCE FOR GATE CSE

[3]

Discrete Mathematics: logic, sets, relations, combinatorics, graph theory, Computer Organization and Architecture, Operating Systems: processes, scheduling, memory management, Database Management Systems: ER model, SQL, normalization, transactions, Computer Networks: OSI/TCP-IP models, routing and transport protocols.

DATA SCIENCE AND MACHINE LEARNING FOUNDATIONS

[3]

Data Science lifecycle and data preprocessing, Data visualization and exploratory data analysis, Supervised and unsupervised learning techniques, Regression, classification and clustering algorithms, Model evaluation metrics and validation techniques.

ADVANCED DATA SCIENCE AND GATE PRACTICE

[3]

Deep Learning fundamentals and neural networks, Natural Language Processing and recommendation systems, Big Data concepts and distributed computing, Previous GATE CSE and Data Science question analysis, Mock tests, problem-solving strategies and revision.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] GATE Computer Science and Information Technology 2026, Made Easy Publications, Latest ed., 2026.
- [2] Introduction to Algorithms, 4th ed., MIT Press, 2022.
- [3] Data Science for Business, Rev. ed., O'Reilly Media.
- [4] Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, 3rd ed., O'Reilly Media, 2022.
- [5] Data Mining: Concepts and Techniques, 4th ed., Morgan Kaufmann, 2022.

REFERENCE BOOKS:

- [1] Computer Networking: A Top-Down Approach, 8th ed., Pearson, 2021.
- [2] Operating System Concepts, 10th ed., Wiley.
- [3] Database System Concepts, 7th ed., McGraw-Hill.
- [4] Pattern Recognition and Machine Learning, Springer.
- [5] Deep Learning, MIT Press.

MANDATORY COURSES (MC)

25HS252	UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY I	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	Course Outcomes	PO	PSO
CO1	Understand the significance of values like justice, trust, and respect in human relationships and their role in fostering harmony	7,11	-
CO2	Differentiate between respect and differentiation, highlighting their impact on interpersonal relationships	7,11	-
CO3	Apply the Universal Order and its progression from family to the world family, emphasizing the interconnectedness of relationships.	7,11	-
CO4	Assess the presence or absence of core human values in societal structures through real-life case studies	7,11	-
CO5	Demonstrate how the nine universal values in relationships can be applied to resolve conflicts and strengthen bonds in diverse social settings.	7,11	-
CO6	Integrate and utilize the understanding of universal values to critically evaluate their relationships and propose ways to cultivate a more just and respectful environment within their social circles.	7,11	-

HUMAN UNDERSTANDING: FAMILY VALUES

[15]

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) - Trust and Respect Difference between respect and differentiation; the other salient values in relationship, Universal Order- from family to world family. Practical – Case Study on Old- Age Home and Orphanages.

Total Notional Hours: 15

TEXT BOOKS:

- [1] A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Rev. ed., Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
- [2] Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Rev. ed., Excel Books, New Delhi, 2019. ISBN 978-93-87034 53-2.

REFERENCE BOOKS:

- [1] Universal Human values, Dr.Kuldeep S Sharma, Dr. Sarveen Kaur Sachdeva, Booksclinic Publisher, 2023.
- [2] Universal Human Values and Professional Ethics, Dr. Anand Vyas, Anandvyas publisher, 2023.

WEB REFERENCES

- [1] "Universal Human Values (UHV) - Home," <https://www.uhv.org.in/>
- [2] "UHV-II Course Material," https://www.uhv.org.in/UHV-II_Cours_Material
- [3] "Higher Education - UHV," <https://uhv.org.in/highereducation>
- [4] "Universal Human Values - YouTube," https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

25HS253	UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY II	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

COs	Course Outcomes	PO	PSO
CO1	Understand the interconnectedness and mutual fulfilment of four orders in nature (material, plant, animal, and human) and their role in maintaining ecological balance.	7,11	
CO2	Describe the principles of recyclability and self-regulation in nature, highlighting their significance in sustainability.	7,11	
CO3	Discuss the concept of existence as co-existence, emphasizing the interdependent relationship between all units in nature within all-pervasive space.	7,11	
CO4	Document the interconnectedness observed during a field visit to farms, as demonstrated through a comprehensive report.	7,11	
CO5	Prepare a structured report based on field observations, integrating theoretical concepts of holistic harmony with practical findings.	7,11	

HARMONY IN SOCIETY: NURTURING DISPOSITION

[15]

Understanding the harmony in the Nature-Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space- Holistic perception of harmony at all levels of existence. Practical - Field trip to various farms and Report writing on field work.

Total Notional Hours: 15

TEXT BOOKS:

- [1] A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Rev. ed., Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.
- [2] Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Rev. ed., Excel Books, New Delhi, 2019. ISBN 978-93-87034 53-2.

REFERENCE BOOKS:

- [1] Universal Human values, Dr.Kuldeep S Sharma, Dr. Sarveen Kaur Sachdeva, Booksclinic Publisher, 2023.
- [2] Universal Human Values and Professional Ethics, Dr. Anand Vyas, Anandvyas publisher, 2023.

WEB REFERENCES

- [1] "Universal Human Values (UHV) - Home," <https://www.uhv.org.in/>
- [2] "UHV-II Course Material," https://www.uhv.org.in/UHV-II_Cours_Material
- [3] "Higher Education - UHV," <https://uhv.org.in/highereducation>
- [4] "Universal Human Values - YouTube," https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

25HS212	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the provisions and guiding principles of the Constitution of India.	6,8	2,3
CO2	Explain the Constitutional Rights, Fundamental Rights, and Duties guaranteed under the Indian Constitution.	6,8	2,3
CO3	Describe the structure, powers, and functions of the Government of India	6,8	2,3
CO4	Analyze the Parliamentary System and the Constitutional Scheme of governance in India.	6,8	2,3

HISTORICAL PERSPECTIVE OF THE CONSTITUTION OF INDIA

[3]

Meaning of the Constitution, law, and constitutionalism - Historical perspective of the Constitution of India - Salient features and characteristics of the Constitution of India.

FUNDAMENTAL RIGHTS AND LEGAL STATUS

[3]

Scheme of the fundamental rights - The scheme of the Fundamental Duties and its legal status - The Directive Principles of State Policy – Its importance and implementation.

THE CONSTITUTION POWERS

[3]

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India – The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure.

CONSTITUTIONAL AMENDMENTS

[3]

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency - Local Self Government – Constitutional Scheme in India.

RIGHT TO LIFE AND PERSONAL LIBERTY

[3]

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19- Scope of the Right to Life and Personal Liberty under Article 21.

Total Notional Hours:15

L	T	P	TW+SL	C
15	0	0	15	1

REFERENCE BOOKS:

[1] Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.

[2] Busi S N, Ambedkar B R framing of Indian Constitution, 1st ed., 2015.

- [3] Granville Austin, *Working Democratic Constitution: The Indian Experience*, Oxford Publication. 2003.
- [4] Jain M P, *Indian Constitution Law*, 7th ed., Lexis Nexis, 2014.
- [5] *The Constitution of India (Bare Act)*, Government Publication, 1950.

25EC216	ELECTRONIC STANDARDS	L	T	P	C
		1	0	0	0

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the need and importance of standards in electronic systems.	1,2,7	-
CO2	Identify national and international standardizing organizations and their roles.	1, 2,7	-
CO3	Interpret EMI/EMC, safety and environmental standards applicable to electronic products.	1,2,3,7	-
CO4	Understand certification, compliance and conformity assessment procedures.	1,2,3,7,8	-

STANDARDS AND REGULATION

Need for Standards – Generic/General Standards for Residential and Industrial environment – Basic Standards – Product Standards – National and International EMI Standardizing Organizations – IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, AEC – Electromagnetic Emission and Susceptibility standards and specifications – MIL 461E Standards.

SAFETY, COMPLIANCE AND CERTIFICATION STANDARDS

Electrical and electronic safety standards – Objective and need – Product safety requirements for electronic equipment – Low Voltage Directive (LVD) – Safety compliance – IEC 60950 and IEC 62368 standards – Environmental standards and regulations – Restriction of Hazardous Substances (RoHS) – Waste Electrical and Electronic Equipment (WEEE) – Quality management standards – ISO 9001 overview – Certification and conformity assessment procedures – CE marking process and requirements – BIS certification scheme for electronic products.

Total Notional Hours:15

L	T	P	TW+SL	C
15	0	0	15	1

TEXT BOOKS:

- [1] Robert L. Boylestad, Louis Nashelsky, *Electronic Devices and Circuit Theory — Basic concepts of analog and digital electronics*, 11th ed. , Pearson, 2013.
- [2] Adel S. Sedra, Kenneth C. Smith, *Microelectronic Circuits — Semiconductor devices and circuit analysis*, Oxford University Press, 7th ed. , 2015.
- [3] Donald P. Leach, Albert Paul Malvino, Goutam Saha, *Digital Principles and Applications — Digital electronics fundamentals*, 8th ed., 2015.

REFERENCE BOOKS:

- [1] W. Prasad Kodali, *Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models*, Wiley Press , 2nd ed.,2001.
- [2] Tim Williams , *EMC for Product Designers*, Elsevier / Academic Press,5th ed. ,2016.

WEB REFERENCES

- [1] “EMI /EMC and Signal Integrity: Principles, Techniques and Applications,” nptel.ac.in/courses/108105375.

25CS203	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles of algorithm analysis.	1, 2	1
CO2	Apply divide-and-conquer, greedy, and dynamic programming techniques to solve classical computational problems.	1, 2	1
CO3	Derive the time and space complexity of algorithmic strategies.	2, 4	1
CO4	Design algorithmic solutions for real-world problems using appropriate paradigms such as greedy methods, dynamic programming, and heuristic-based approaches.	3	1,3
CO5	Evaluate the suitability and efficiency of different algorithmic approaches for solving NP-hard problems and justify the use of approximation algorithms where exact solutions are intractable.	2, 4	1,3

INTRODUCTION TO ALGORITHM ANALYSIS

[9]

Algorithm analysis: Fundamentals of Algorithmic Problem Solving, the Analysis Framework, Asymptotic Notations and its properties, Recurrence relation: substitution method and Master's method.

DIVIDE-AND-CONQUER

[9]

Divide and Conquer: Finding Maximum and Minimum, Quick Sort, Merge Sort, Strassen's Matrix Multiplication, Closest pair and convex hull.

GREEDY METHOD TECHNIQUES & DYNAMIC PROGRAMMING TECHNIQUES

[9]

Knapsack problem, Dijkstra's Algorithm. Dynamic Programming techniques: Principle of Optimality, Floyd's algorithm, longest common subsequence, Optimal binary search trees.

BACKTRACKING AND BRANCH-AND-BOUND TECHNIQUES

[9]

N-Queens's problem, Sum of subsets, Hamiltonian Cycle, Branch and Bound: Knapsack problem – Traveling salesman problem.

NP-PROBLEMS AND APPROXIMATION ALGORITHMS

[9]

P and NP problems, NP-Complete problems, Cook's theorem, Theory of reducibility, Approximation Algorithms: Knapsack problem, Traveling salesman problem.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

- [1] Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education, 3rd ed., 2012. (ISBN 978 0132316811) 3rd ed., Published: 2021

REFERENCE BOOKS:

- [1] Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. Fundamentals of Computer Algorithms, 2/E. University Press, 2024.
- [2] Sridhar S. Design and Analysis of Algorithms, 2/E. Oxford University Press, 2014.
- [3] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein., Introduction to Algorithms, 4/E, PHI Learning, 2018.
- [4] Jon Kleinberg, Eva Tardos. Algorithm Design, Pearson, 2013

WEB REFERENCES

- [1] "Design and analysis of algorithms, 2025," <https://nptel.ac.in/courses/106106131>
- [2] "Design and Analysis of Algorithms, 2023," <https://nptel.ac.in/courses/106101060>
- [3] "Design and Analysis of Algorithms," <https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2012/>

25CS204	COMPUTER ORGANISATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of computer organization.	1, 2	1, 3
CO2	Apply computer arithmetic principles to design and evaluate hardware algorithms for signed and unsigned integer operations, floating-point arithmetic, and their implementation in ARM architecture.	1, 2	1, 3
CO3	Distinguish between processor design techniques.	2, 4	1, 3
CO4	Design memory and I/O interfacing systems.	3	1, 3
CO5	Evaluate parallel processing architectures and their performance implications.	2, 4	1, 3

BASIC STRUCTURE OF COMPUTERS

[9]

Functional units – basic operational concepts – Bus Structures - Technology – Performance – Power wall – Uniprocessor to multiprocessor – Instructions: Operations and Operands – Instruction Set: RISC and CISC - Representing Instructions — Addressing modes.

COMPUTER ARITHMETIC

[9]

Addition and Subtraction – Multiplication – Multiplication Algorithm and Hardware – Signed Multiplication - Faster Multiplication in ARM - Division – Division Algorithm and Hardware - Signed Division – Faster Division in ARM - Floating Point Representation – Floating Point Operations: Addition - Multiplication – Floating point instructions in ARM.

PROCESSOR DESIGN

[9]

An abstract view of implementation - Logic design Conventions - Building a Datapath – Simple implementation scheme – Pipelining – Pipelined Datapath and Control - Hazards – Data Hazards – Control Hazards – Exceptions.

MEMORY AND I/O INTERFACING

[9]

Memory Technologies – Basics of Caches – Measuring and Improving Cache Performance – Virtual Memory – Transaction- Look aside Buffer (TLB) - Memory Hierarchy - Input/output system, programmed I/O, DMA and interrupts, I/O processors.

PARALLEL PROCESSING

[9]

Parallelism - Instruction-level-parallelism – Parallel processing challenges - Hardware multithreading – SISD, MIMD, SIMD, SPMD and Vector - Multicore processors – Shared memory Multiprocessors – Graphical Processing Units – Multiprocessor Network Topologies.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

- [1] David A. Patterson and John L. Hennessey, Computer Organization and Design: The Hardware / Software Interface, Morgan Kaufman / Elsevier, ARM Edition, 2021.

REFERENCE BOOKS:

- [1] V. Carl Hamacher, Zvonko G Vranesic and Safwat G Zaky. Computer Organization, 6/E. McGraw-Hill Inc, 2021.
- [2] William Stallings. Computer Organization and Architecture – Designing for Performance, 11/E, PHI Learning, 2022.
- [3] Morris Mano M, Rajib Mall. Computer System Architecture, 3/E, Pearson, 2023.
- [4] Andrew S. Tanenbaum. Structured Computer Organization, 6/E, Pearson, 2024.

WEB REFERENCES

- [1] "Computer Architecture, 2025," <https://nptel.ac.in/courses/106102157>
- [2] "Computer Architecture and Organization, 2023," <https://nptel.ac.in/courses/106105163>
- [3] "Computer System Architecture," <https://ocw.mit.edu/courses/6-823-computer-system-architecture-fall-2005/>

25CS255	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe fundamental DBMS concepts, data models, database architecture, and schema design principles.	1, 2	1
CO2	Apply relational algebra and SQL queries to create, manipulate, and retrieve database data.	1, 2	1
CO3	Recommend normalization techniques and ER modelling to eliminate redundancy and improve database integrity.	1,2,5	1, 3
CO4	Evaluate query execution and optimization strategies for improving database performance.	1,2,3,5	1,3
CO5	Design ETL pipelines, data warehousing solutions, and data engineering workflows for scalable data processing.	1,2,3,5	1,2,3

DATABASE CONCEPTS AND ARCHITECTURE [6]

Database system overview, DBMS architecture, data models (hierarchical, network, relational), schema vs instance, data independence, ER modelling, enhanced ER concepts (specialization, generalization, aggregation), relational schema mapping.

RELATIONAL MODEL AND QUERY LANGUAGES [6]

Relational algebra (operators and expressions), relational calculus (tuple and domain), SQL: DDL, DML, DQL, constraints, joins, nested/correlated subqueries, views, triggers, assertions, transactions, concurrency basics.

NORMALIZATION AND INTEGRITY [6]

Functional, multivalued, and join dependencies, attribute closure, keys and candidate keys, normal forms (1NF, 2NF, 3NF, BCNF), lossless decomposition, dependency preservation, indexing concepts (B-tree, B+-tree).

QUERY PROCESSING, STORAGE & OPTIMIZATION [6]

Query execution stages, cost estimation, sorting, hashing, join techniques, query rewrite rules, plan selection, buffer management, caching, RAID storage, file organizations (heap, sorted, hashed, clustered).

DATA ENGINEERING AND WAREHOUSING [6]

Introduction to data engineering, ETL lifecycle, data integration techniques, data warehousing architecture, OLTP vs OLAP, star/snowflake schema, dimensional modelling, ETL/ELT tools, Big Data platforms and distributed processing.

LABORATORY EXPERIMENTS

[30]

1. Create and query relational databases using SQL DDL/DML/DQL.
2. Implement joins, nested and correlated queries.
3. Apply constraints, triggers, and views in database design.
4. Perform ER modeling and map to relational schemas.
5. Normalize database tables to 3NF/BCNF and test for integrity.
6. Develop a mini ETL pipeline or data warehousing workflow using a sample dataset.

Total Notional Hours: 90

L	T	P	TW&SL	C
30	-	30	30	3

TEXT BOOK:

- [1] Abraham Silberschatz, Henry F. Korth, S. Sudharshan. Database System Concepts, 7/E. McGraw-Hill, 2021.

REFERENCE BOOKS:

- [1] Ramez Elmasri and Shamkant B. Navathe. Fundamentals of Database Systems, 7/E. Pearson, 2017.
- [2] Garcia-Molina H., Ullman J.D., Widom J. Database Systems: The Complete Book, 3/E, Pearson, 2020.
- [3] Mark L. Gillenson, Pradeep Singh. Fundamentals of Database Management Systems, 3/E, Wiley, 2025.

WEB REFERENCES

- [1] "Database Systems, 2025," https://onlinecourses.nptel.ac.in/noc24_cs55
- [2] "Data Engineering Foundations, 2025," <https://www.coursera.org/specializations/data-engineering-foundations>

25IT253	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of AI and the ethical implications of modern AI systems.	1, 2	1
CO2	Apply supervised learning algorithms to build predictive models using appropriate performance metrics and optimization techniques.	1,2,3,5	1
CO3	Deploy unsupervised learning techniques to discover hidden patterns in unlabeled data.	1,2,3,5	1
CO4	Use reinforcement learning algorithms to develop agents that learn optimal behaviors through interaction with environments.	1,2,3,5	1
CO5	Select appropriate machine learning models considering the limitations, bias, fairness, and data privacy concerns.	1,2,3,4,5	1

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

[6]

History and evolution of AI - Turing Test - intelligent agents - agent environments - State space representation - uninformed search (BFS, DFS, UCS) - informed search (Greedy BFS, A* algorithm) - heuristic functions, adversarial search (Minimax, Alpha-Beta pruning) - Propositional logic - first-order logic - knowledge graphs - inference rules – resolution - expert systems.

MODERN AI CONCEPTS

[6]

Bayesian networks - probabilistic inference - Markov chains - Monte Carlo methods - Dempster-Shafer theory for uncertainty handling - LLM architectures (transformers, attention mechanisms) - prompt engineering - fine-tuning - Retrieval-Augmented Generation (RAG) - ethical considerations - Fuzzy set theory - fuzzy inference systems - genetic algorithms (selection, crossover, mutation) - swarm intelligence - applications in optimization and control.

SUPERVISED LEARNING

[6]

Linear regression - polynomial regression - logistic regression - performance metrics (MSE, MAE, R^2 , accuracy, precision, recall, F1-score, ROC-AUC) - bias-variance tradeoff - cross-validation techniques - K-Nearest Neighbors (KNN) - Decision Trees (ID3, C4.5, CART) - Random Forest, Support Vector Machines (SVM) - Naïve Bayes classifier - ensemble methods (bagging, boosting, AdaBoost) - Perceptron - multi-layer perceptrons (MLP) - activation functions (sigmoid, ReLU, tanh) - backpropagation - gradient descent optimization (SGD, Adam) - introduction to CNNs and RNNs.

UNSUPERVISED LEARNING

[6]

Curse of dimensionality - Principal Component Analysis (PCA) - t-SNE - Linear Discriminant Analysis (LDA) - feature selection methods - K-Means clustering, hierarchical clustering – DBSCAN - Gaussian Mixture Models - cluster evaluation metrics (silhouette score, Davies-Bouldin index) - Apriori algorithm - FP-Growth - market basket analysis - support-confidence-lift framework - rule generation and pruning.

REINFORCED LEARNING

[6]

Markov Decision Processes (MDPs) - rewards and returns - policy and value functions - exploration vs. exploitation - Q-learning - SARSA - Deep Q-Networks (DQN) - policy gradient methods (REINFORCE, PPO) - Actor-Critic architectures - applications in robotics and autonomous systems - AI ethics (bias, fairness, transparency, accountability) - explainable AI (XAI) - data privacy (GDPR, anonymization) - real-world case studies in healthcare, finance, autonomous vehicles and NLP.

LAB EXPERIMENTS

1. Introduction to Python for AI/ML
2. Search Algorithm Implementation
3. Knowledge Graph Construction
4. Bayesian Network Inference
5. Regression and Classification
6. Neural Network Implementation.
7. Dimensionality Reduction and Visualization
8. Clustering for Customer Segmentation
9. Q-Learning
10. Generative AI Application

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Pradeep Singh, Tapan K. Gandhi, & Balasubramanian Raman. Artificial Intelligence and Machine Learning, 1/E. McGraw-Hill, 2025.

REFERENCE BOOKS:

- [1] Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 4/E. Pearson, 2022.
[2] Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das. Machine Learning, Pearson, 2024.
[3] Reema Thareja. Artificial Intelligence: Beyond Classical AI. Pearson, 2023.

WEB REFERENCES

- [1] "Introduction to Machine Learning," <https://nptel.ac.in/courses/106106139>
[2] "Artificial Intelligence: Search Methods for Problem Solving," <https://nptel.ac.in/courses/106106226>

25CS254	OPERATING SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental organization and architecture of computer systems, the evolution of operating systems, OS structure, and the process of building and booting an OS.	1, 2	1
CO2	Implement process management techniques to solve scheduling problems.	1, 2	1
CO3	Apply synchronization mechanisms to coordinate concurrent processes and resolve resource conflicts.	1,2, 3, 5	1
CO4	Recommend memory management strategies to improve system performance.	1, 2, 3, 4, 5	1
CO5	Compare their trade-offs across different operating systems in terms of system structure.	1,2,4	1

INTRODUCTION TO OPERATING SYSTEMS

[4]

Computer System Organization – Computer System Architecture- Evolution of Operating System- OS Structures: OS Services - System Calls –OS Structures- Building and Booting an OS.

PROCESS MANAGEMENT

[8]

Processes: Process Concept- Process Scheduling-Operations on Process- Inter-process Communication – Threads - Multithread Models. CPU Scheduling: Basic Concept-Scheduling Criteria-Scheduling Algorithms- Multi-Processor Scheduling. Process Synchronization: Critical Section Problem – Peterson’s Solution-Semaphores - Monitors – Hardware Synchronization: Deadlocks: System Model-Characterization-Methods-Prevention -Avoidance and Detection-Recovery from Deadlocks.

MEMORY MANAGEMENT

[6]

Memory Management Strategies: Swapping – Contiguous Memory Allocation -Segmentation - Paging. Virtual Memory Management: Demand Paging - Page Replacement Algorithms- Thrashing.

FILE MANAGEMENT AND DISK MANAGEMENT

[8]

File System: File concepts – Access Methods -Directory and Disk Structure-File System Mounting- File System Structure-Implementation-Directory Implementation-Allocation Methods-Free Space Management. Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management -Swap Space Management- I/O Systems - System Protection and Security.

ADVANCEMENTS IN OPERATING SYSTEMS

[4]

Virtual Machines- Network and Distributed Systems – Case Studies: Linux-Windows 11.

LIST OF EXPERIMENTS

[30]

7. Linux Commands
8. System Calls
9. CPU Scheduling

10. Semaphore
11. Deadlock Avoidance
12. Paging
13. Page Replacement Algorithms
14. File Allocation Methods
15. Directory Implementation
16. Disk Scheduling

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. Operating System Concepts, 10/E. John Wiley and Sons, 2021.

REFERENCE BOOKS:

- [1] William Stallings. Operating Systems - Internals and Design Principles, 9/E. Pearson, 2018.
 [2] Andrew S. Tanenbaum. Modern Operating Systems, Pearson, 2024.

WEB REFERENCES

- [1] "Introduction to Operating Systems, 2021," https://onlinecourses.nptel.ac.in/noc21_cs72
 [2] "Operating System Fundamentals, 2021," https://onlinecourses.nptel.ac.in/noc21_cs88/

25CS205	COMPUTATIONAL THEORY AND AUTOMATA	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of finite automata.	1,2	1
CO2	Describe regular expressions and the limitations of finite automata.	1, 2	1
CO3	Construct a DFA/NFA/ ϵ -NFA for the given languages and apply the pumping lemma to prove that a language is not regular.	1,2,3,4	1
CO4	Design context-free grammar and construct push-down automata from CFGs for language acceptance by the final state or the empty stack.	1,2,3	1
CO5	Design Turing machines for language acceptance and integer functions to evaluate the halting problem and the Post correspondence problem (PCP).	1,2,3,4	1

FINITE AUTOMATA

[9]

Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata – Weighted Automata.

REGULAR EXPRESSION

[9]

Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleene's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for Regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.

GRAMMARS

[9]

Grammar Introduction– Types of Grammar - Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols - Unit productions - Null productions – Greibach Normal form – Chomsky Normal form – Problems related to CNF and GNF.

PUSHDOWN AUTOMATA

[9]

Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.

TURING MACHINES & UNDECIDABILITY

[9]

Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Recursive and recursively enumerable languages - Halting problem - Introduction to undecidability - undecidable

problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of Post correspondence problem.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Hopcroft J.E., Motwani R. and Ullman J.D. Introduction to Automata Theory, Languages and Computations, 2/E. Pearson Education, 2016.

REFERENCE BOOKS:

- [1] John C. Martin. Introduction to Languages and the Theory of Computation, 4/E. Tata McGraw-Hill, 2010.
[2] Mishra K L P and Chandrasekaran N. Theory of Computer Science – Automata, Languages and Computation, 3/E, Prentice Hall of India, 2006.
[3] K.R. Chowdhary. Theory of Computation: Automata, Formal Languages, Computation and Complexity, Springer, 2025.

WEB REFERENCES

- [1] "Theory of Computation, 2025," <https://nptel.ac.in/courses/106104148>
[2] "Theory of Computation, 2025," <https://nptel.ac.in/courses/106106242>
[3] "Theory of Computation," <https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/>

25CS206	LLM WITH DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of deep learning, neural networks, activation functions, and optimization techniques	1,2	1,2
CO2	Apply training techniques for deep neural networks using backpropagation, optimization algorithms, and regularization methods	1,2,5	1,2
CO3	Analyse the architecture and text processing components of Large Language Models	1,2,5	1,2
CO4	Develop GPT-based language models using attention mechanisms and Transformer architectures	3,4,5	1,2,3
CO5	Implement pretraining and fine-tuning techniques for LLM-based applications	3,4,5,11	1,2,3

INTRODUCTION TO DEEP LEARNING

[9]

Motivation for Deep Learning, Shallow vs Deep Networks, Biological neuron vs artificial neuron, Architecture of Artificial Neural Networks (ANN), Activation functions (Sigmoid, Tanh, ReLU, SoftMax), Loss functions and optimization overview.

TRAINING DEEP NEURAL NETWORKS

[9]

Forward and backward propagation, Gradient descent and variants (SGD, Momentum, Adam), Weight initialization techniques, Overfitting and underfitting, Regularization methods (L1, L2, Dropout), Batch normalization.

FOUNDATIONS OF LARGE LANGUAGE MODELS AND TEXT PROCESSING

[9]

Introduction to Large Language Models (LLMs), Transformer and GPT architectures, tokenization, vocabulary creation, Byte Pair Encoding (BPE), token and positional embeddings, and text dataset preparation for language model training.

ATTENTION MECHANISMS AND GPT MODEL DEVELOPMENT

[9]

Self-attention, causal attention, multi-head attention, Transformer blocks, feed-forward networks, layer normalization, residual connections, and implementation of a basic GPT model for text generation.

PRETRAINING AND FINE-TUNING LARGE LANGUAGE MODELS

[9]

Language model pretraining concepts, training and optimization, text generation strategies, fine-tuning for text classification, instruction tuning, and development of instruction-following conversational AI applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Ian Goodfellow, Yoshua Bengio & Aaron Courville,” Deep Learning (Adaptive Computation and Machine Learning)”, MIT Press, 2016.
- [2] Sebastian Raschka,” Build a Large language Model”, Manning Publishers,2024.

REFERENCE BOOKS:

- [1] François Chollet,” Deep Learning with Python”, 2nd ed., Manning Publications, 2021.
- [2] Denis Rothman,” Transformers for Natural Language Processing: Build BERT, GPT”, 2nd ed., Packt Publishing, 2022.
- [3] William L. Hamilton, Morgan & Claypool., Graph Representation Learning, 2020(graph neural networks)

WEB REFERENCES

- [1] "Deep Learning, 2021," <https://nptel.ac.in/courses/106105215>
- [2] Machine Learning and Deep Learning - Fundamentals and Applications, 2021," <https://nptel.ac.in/courses/108103192>
- [3] D. A. Dey, "What is Deep Learning? A Tutorial for Beginners," DataCamp, 2020, <https://www.datacamp.com/tutorial/tutorial-deep-learning-tutorial>

25CS257	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles, phases, and methodologies of the software development life cycle (SDLC).	1, 2	1
CO2	Extract software requirements using formal and agile techniques to develop, validate, and manage requirement specifications, ensuring traceability and alignment with stakeholder needs across the project lifecycle.	1, 2, 3, 4	1,3
CO3	Apply software modeling, architectural design principles, and standardized notations (such as UML) to translate requirements into structured design models that support maintainability, scalability, and DevOps integration.	1, 2, 3, 4, 5	1,3
CO4	Evaluate software project planning, estimation, scheduling, and risk management strategies using models such as COCOMO, CPM, and PERT, and assess their effectiveness in delivering projects within scope, time, and resource constraints.	1, 2, 3, 4	1,3
CO5	Utilize appropriate coding standards, testing techniques, and maintenance practices—supported by modern tools for development, testing, and CI/CD—to ensure software quality, reliability, and sustainable evolution.	1, 2, 3, 4, 5	1,3

SOFTWARE PROCESS MODELS

[9]

Introduction – Software Development Life Cycle (SDLC) – Traditional Models: Waterfall, V-Model, Spiral – Alternative Techniques: Rapid Application Development (RAD), Agile Development Models – Scrum Framework – Agile Tools: JIRA (backlog management, sprint planning), Product Discovery, Team Collaboration – Extreme Programming (XP) – Comparison and Suitability of Models.

SOFTWARE PROJECT MANAGEMENT

[9]

Role and responsibilities of a Software Project Manager – Project Planning – Metrics for Project Size Estimation – COCOMO (Basic, Intermediate & Detailed) – Scheduling Techniques: CPM & PERT – Risk Management: Identification, Assessment, Mitigation – Resource Allocation and Tracking – Modern Tools for Project Management (MS Project, Trello, Asana).

REQUIREMENTS ANALYSIS

[9]

Requirements Gathering Techniques – Functional and Non-functional Requirements – Software Requirements Specification (SRS) – Formal Specification – Executable Specifications – Validating Requirements – Achieving Requirements Traceability – Managing Changing Requirements – Reviews, Walkthroughs, Inspections – Tools: Jama Software, IBM Rational DOORS, JIRA.

SOFTWARE MODELLING AND DESIGN

[9]

Elements of Software Modeling and Design – Translating Requirement Models into Design Models – Design Notations: DFDs, Structured Flowcharts, Decision Tables – UML: Use Case, Class, Sequence,

Activity Diagrams – Data Modeling – Design Concepts and Principles – Architectural Mapping using Data Flow – Design Tools: Sparx Enterprise Architect – DevOps: Concepts, Lifecycle, Adoption, DevOps Tools.

CODING, TESTING, AND MAINTENANCE

[9]

Coding Standards and Guidelines – Code Reviews – IDEs: Eclipse, IntelliJ IDEA, XCode, Atom – Testing Techniques: Black-box, White-box, Unit, Integration, System Testing – Testing Tools: JUnit, Selenium – Software Maintenance: Characteristics, Process Models, Reverse Engineering – Estimation of Maintenance Cost – Modern Practices: Continuous Integration and Continuous Deployment (CI/CD).

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Roger S. Pressman & Bruce R. Maxim. Software Engineering: A Practitioner's Approach, 9/E. McGraw-Hill, 2020.

REFERENCE BOOKS:

- [1] Ian Sommerville. Software Engineering, 10/E. Pearson, 2019.
- [2] K. K. Aggarwal & Yogesh Singh. Software Engineering, 3/E, New Age International, 2019.
- [3] Pankaj Jalote. Software Project Management in Practice, 2/E, Pearson, 2017.
- [4] Bertrand Meyer. Software Engineering with Applications, 2/E, Prentice Hall, 2018

WEB REFERENCES

- [1] "Software Engineering," https://onlinecourses.nptel.ac.in/noc21_cs13
- [2] "Software Engineering Concepts," <https://ocw.mit.edu/courses/16-355j-software-engineering-concepts-fall-2005/>

25IT254	PROGRAMMING IN JAVA	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply fundamental Java programming concepts.	1,2	1
CO2	Apply inheritance, interfaces, packages, and exception handling to develop modular and robust programs.	1, 2, 4	1
CO3	Apply multithreading, concurrency, and Java I/O mechanisms to manage parallel execution and data streams.	1,2,3,5	1
CO4	Apply generics, collections, and functional programming (lambda expressions and the Stream API) to write efficient, reusable code.	1,2,3,5	1
CO5	Develop interactive Java applications using GUI components and JDBC for database connectivity.	1,2,3,5	1
CO6	Integrate modern Java features such as text blocks, records, switch expressions, and sealed classes into applications to enhance readability, scalability, and performance.	1,2,3,5	1

JAVA FUNDAMENTALS & OBJECT-ORIENTED CONCEPTS

[6]

Introduction to Java – JDK, JRE, JVM, platform independence – Data types, variables, operators, expressions – Control statements (if, switch, loops) – Arrays, Strings, StringBuilder – Classes, objects, constructors, methods, this, static, access modifiers – Encapsulation and packages.

INHERITANCE, INTERFACES & EXCEPTION HANDLING

[6]

Inheritance: super/subclasses, method overriding, dynamic dispatch, final classes/methods – Abstract classes and interfaces (default/private methods) – Nested and inner classes – Packages and access control – Exception handling: try/catch/finally, throw/throws, custom exceptions, assertions.

MULTITHREADING, CONCURRENCY & I/O

[6]

Threads: Thread vs Runnable, lifecycle, priorities, synchronization, inter-thread communication – Concurrency utilities: ExecutorService, Future, concurrent collections – Java I/O: byte/character streams, buffered streams, Files API, serialization/deserialization.

GENERIC, COLLECTIONS & FUNCTIONAL PROGRAMMING

[6]

Generics: parameterized types, wildcards, bounded types – Collections framework: List, Set, Map, Queue, iterators, comparators – Lambda expressions, method references, functional interfaces – Stream API: filtering, mapping, reducing, parallel streams.

GUI, JDBC & MODERN JAVA FEATURE

[6]

GUI development using Swing: frames, panels, layout managers, event handling – JDBC: architecture, CRUD operations, transactions – Modern Java features: text blocks, records, switch expressions, sealed classes.

LAB EXPERIMENTS

1. Java basics: data types, operators, control statements, arrays, and Strings.
2. Object-oriented programming: classes, objects, constructors, encapsulation, inheritance, and polymorphism.
3. Exception handling and interfaces/abstract classes.
4. Multithreading and file I/O operations.
5. Generics, collections, lambda expressions, and Stream API operations.
6. GUI development and JDBC CRUD application (e.g., Student Record Management).

7.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Herbert Schildt. Java: The Complete Reference, 12/E. McGraw-Hill, 2021.

REFERENCE BOOKS:

[1] Cay S. Horstmann. Core Java, Volume I: Fundamentals, 13/E. Pearson, 2024.

[2] P. Deitel and H. Deitel. Java: How to Program, 12/E, Pearson, 2025.

[3] Joshua Bloch. Effective Java, 3/E, Addison-Wesley, 2018.

WEB REFERENCES

[1] "Programming in Java, 2025," https://onlinecourses.nptel.ac.in/noc21_cs04/

[2] "Learning Java Programming, 2025," <https://docs.oracle.com/javase/tutorial/>

25CS261	DATA COMMUNICATION AND NETWORKING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of data communication, transmission media, signals, and layered network architectures.	1,2	1
CO2	Apply data link layer mechanisms such as error detection, flow control, and medium access control in wired and wireless networks.	1,2,3,5	1
CO3	Analyse IP addressing, subnetting, routing algorithms, and packet forwarding techniques in internetworked environments.	1,2,3,4,5	1
CO4	Evaluate transport and application layer protocols for reliable, secure, and efficient communication.	1,2,4,5, 11	1
CO5	Design and simulate computer networks using modern networking tools and technologies, considering security and emerging networking paradigms.	2,3,4,5, 11	1,3

FUNDAMENTALS OF DATA COMMUNICATIONS

[6]

Introduction to data communication and networking – network types and topologies – OSI reference model – TCP/IP protocol suite – transmission modes – signals and data transmission – bandwidth and throughput – transmission media – line coding and modulation techniques – multiplexing – switching techniques

DATA LINK LAYER AND LOCAL AREA NETWORKS

[6]

Framing techniques – error detection and correction methods – flow control protocols – medium access control – Ethernet (IEEE 802.3) – Wireless LAN (IEEE 802.11) – LAN switching – VLAN concepts – network devices and interconnection.

NETWORK LAYER AND INTERNETWORKING

[6]

IP addressing – subnetting and CIDR – routing principles – distance vector and link state routing algorithms – router architecture – packet forwarding – ARP – ICMP – NAT – introduction to mobile and wireless networking.

TRANSPORT AND APPLICATION LAYERS

[6]

Transport layer services – UDP and TCP protocols – connection management – reliable data transfer – flow control and congestion control – QoS concepts – application layer protocols: HTTP, DNS, SMTP, FTP, DHCP – client-server communication.

NETWORK SECURITY AND EMERGING NETWORKS

[6]

Network management concepts – SNMP – fundamentals of cryptography – SSL/TLS – firewalls –

VPNs – intrusion detection basics – Software Defined Networking (SDN) – Network Function Virtualization (NFV) – Internet of Things (IoT) networking overview.

LABORATORY EXPERIMENTS

[30]

1. Study and simulation of network topologies using Cisco Packet Tracer.
2. IPv4 addressing and subnetting exercises.
3. Configuration of switches and routers in Packet Tracer.
4. Implementation of error detection techniques (CRC, Checksum).
5. Simulation of flow control protocols.
6. Implementation of Distance Vector Routing Algorithm.
7. Implementation of Link State Routing Algorithm.
8. Configuration of VLANs and Inter-VLAN Routing.
9. TCP Client–Server communication using Socket Programming.
10. UDP Client–Server communication using Socket Programming.

Total Notional Hours: 90

L	T	P	TW&SL	C
30	-	30	30	3

TEXT BOOKS:

- [1] Behrouz A. Forouzan, Data Communications and Networking, 6th ed., McGraw-Hill Education, 2023.
- [2] Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 6th ed., Morgan Kaufmann, 2022.

REFERENCE BOOKS:

- [1] James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 8th ed., Pearson Education, 2021.
- [2] William Stallings, Data and Computer Communications, 10th ed., Pearson Education, 2020.
- [3] Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5th ed., Pearson Education, 2017.

WEB REFERENCES

- [1] "Cisco Networking Academy," <https://www.netacad.com/>
- [2] "MIT Open Courseware – Computer Systems and Networking," <https://ocw.mit.edu/>
- [3] "Internet Engineering Task Force (IETF)," <https://www.ietf.org/standards/>
- [4] "Wireshark Documentation," <https://www.wireshark.org/docs/>
- [5] "Kurose & Ross Companion Website," https://gaia.cs.umass.edu/kurose_ross/index.html
- [6] "Open Networking Foundation (ONF)," <https://opennetworking.org/>
- [7] "NIST Computer Security Resource Center," <https://csrc.nist.gov/>

25CS258	COMPILER DESIGN AND PROGRAM TRANSLATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the phases of a compiler, the role of lexical and syntax analysis, and the translation process from source code to intermediate and target code.	1, 2	1
CO2	Apply formal language theory to design and implement lexical analyzers and parsers using tools such as LEX and YACC.	1, 2, 3, 4, 5	1
CO3	Distinguish between top-down (LL) and bottom-up (LR) parsing techniques, evaluate grammar for parsing suitability, and construct parsing tables (LL(1), SLR, CLR, LALR) to resolve syntactic structures.	1, 2, 3, 4	1
CO4	Utilize intermediate code representations and attribute grammar to translate programming language constructs and implement basic code generation for a target machine.	1, 2, 3, 4, 5	1,3
CO5	Evaluate code optimization techniques to improve the efficiency of generated code while preserving semantics.	1, 2, 3, 4, 5	1,3

INTRODUCTION & LEXICAL ANALYSIS

[6]

Compilers- Phases of Compiler- Cousins of the Compiler - Grouping of Phases - Compiler construction tools- Need and Role of Lexical Analyzer - Input Buffering - Specification of Tokens - Lexical Errors - Expressing Tokens by Regular Expression - Finite Automata: NFA- DFA - Converting NFA to DFA - Minimization of DFA- Converting Regular Expression to DFA. LEX Tool: Structure of LEX Program – Predefined Variables – Library routines – Design of Lexical Analyzer for a Sample Language.

TOP DOWN PARSING

[6]

Role of Parser-Grammars-Error Handling-Context-Free Grammars-Writing a grammar- Elimination of Ambiguity-Left Recursion- Left Factoring-Top Down Parsing — Recursive Descent Parser- Predictive Parser- LL(1) Parser- Computation of FIRST-Computation of FOLLOW-Construction of a predictive parsing table-Predictive Parsers LL(1) Grammars- Predictive Parsing Algorithm- Problems related to Predictive Parser - Error Recovery in Predictive Parsing.

BOTTOM UP PARSING

[7]

Bottom Up Parsing-Reductions-Handle Pruning-Shift Reduce Parser-Problems related to Shift Reduce Parsing-Operator Precedence Parser, LEADING, TRAILING -LR Parser- LR Parsers- Need of LR Parsers-LR (0) Item-Closure of Item Sets- Construction of SLR Parsing Table -Problems related to SLR- Construction of Canonical LR(1)- Problems related to CLR - LALR Parser—Problems related to LALR- Error Handling and Recovery in Syntax Analyzer – YACC Tool: Structure of YACC Program – Design of a Syntax Analyzer for a Sample Language.

CODE GENERATION

[6]

Intermediate Code Generation- prefix – postfix notation - Quadruple - triple - indirect triples Representation- Syntax tree- Evaluation of expression - Three-address code- Synthesized attributes – Inherited attributes - Intermediate languages – Declarations- Assignment Statements- Boolean Expressions- Case Statements- Type Checking- Back patching – Procedure calls- Code Generation-

Issues in the design of code generator- The target machine – Runtime Storage management- A simple Code generator- Code Generation Algorithm- Register and Address Descriptors.

CODE OPTIMIZATION

[5]

Code optimization -Principal Sources of Optimization- Function Preserving Transformation- Loop Optimization- Peephole optimization — DAG- Basic Blocks- Flow Graphs- Global Data Flow Analysis — Efficient Data Flow Algorithm- Runtime Environments- Source Language issues- Storage Organization- Activation Records- Storage Allocation strategies.

LAB EXPERIMENTS

11. Using the LEX tool, Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
12. Implement a Lexical Analyzer using LEX Tool
13. Generate YACC specification for a few syntactic categories.
 - a. Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
 - b. Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
 - c. Program to recognize a valid control structures syntax of C language (For loop, while loop, if-else, if-else-if, switch-case, etc.).
 - d. Implementation of calculator using LEX and YACC
14. Generate three address code for a simple program using LEX and YACC.
15. Implement type checking using Lex and Yacc.
16. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
17. Implement back-end of the compiler for which the three address code is given as input and the 8086 assembly language code is produced as output.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman and Sorav Bansal. Compilers: Principles, Techniques, and Tools, 2/E. Pearson, 2024.

REFERENCE BOOKS:

- [1] S. Godfrey Winster, S. Aruna Devi, R.Sujatha. Compiler Design, 2/E. Yesdee Publishing Ltd., 2019.
[2] V. Raghavan. Principles Of Compiler Design, Tata McGraw-Hill, 2016.
[3] K. Muneeswaran. Compiler Design, 4/E, Oxford Higher Education, 2014.
[4] Bertrand Meyer. Software Engineering with Applications, 2/E, Prentice Hall, 2018

WEB REFERENCES

- [1] "Compiler Design," https://onlinecourses.nptel.ac.in/noc21_cs07
[2] "Compiler Design," <https://nptel.ac.in/courses/106104123>
[3] "Principles of Compiler Design," <https://nptel.ac.in/courses/106108113>

25CS260	AUGMENTED, VIRTUAL AND MIXED REALITY (XR)	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental concepts of Virtual Reality (VR), Augmented Reality (AR), immersion, presence, virtual worlds, and human communication in immersive environments.	1	1,2
CO2	Explain the architecture and components of Virtual Reality systems, including human perception, input technologies, output devices, and sensory feedback mechanisms.	1,2	1,2
CO3	Analyze virtual world representation, rendering systems, interaction techniques, navigation methods, and user interface metaphors used in VR environments.	2,3	1,2
CO4	Apply Unity development tools and XR concepts to create basic virtual and augmented reality applications and interactive 3D environments.	3,5	1,2,3
CO5	Develop immersive VR/AR experiences incorporating object manipulation, navigation, user interaction, and multimedia feedback.	3,5	1,2,3
CO6	Develop XR-based solutions for applications in education, healthcare, industry, and gaming.	3,5,6	1,2,3

INTRODUCTION TO AUGMENTED REALITY AND VIRTUAL REALITY [6]

Virtual Reality – Augmented Reality – Five Key Elements of Virtual Reality – History – Evolution – Foundations of Immersion and Presence – VR Medium – Communication through a medium – Virtual Worlds – Human Communication in VR - Interactive Narratives - Form and Genre - Experience vs Information

VIRTUAL REALITY SYSTEMS [6]

The Human in the Loop - Human Perceptual System - Presence and Embodiment: Self Perception Within the Virtual world - Interface to the Virtual World – Input Technologies – Using Inputs within the Virtual Reality systems - Interface to the Virtual World – Output – Visual, Aural, Haptic, Vestibular and other sensory Displays

RENDERING AND INTERACTING WITH VIRTUAL WORLD [6]

Representation of the Virtual World – Rendering Systems – Interacting with the Virtual World – Interaction Design Basics – User Interface Metaphors – Manipulating a Virtual World – Navigating in a Virtual World

UNDERSTANDING THE BASICS OF XR AND UNITY [6]

Introduction to XR (AR, VR and MR) and Unity – Unity Editor and Scene Creation – Setting up the unity development environment – Unity Editor and Interface – Game Objects and components - Creating a basic scene in unity and adding objects – VR Development in Unity – AR Development in Unity

CURRENT AND FUTURE TRENDS IN XR TECHNOLOGY AND APPLICATIONS [6]

Learning in new realities – XR in Education – XR in Industrial settings and smart manufacturing – Bridging the gap from real bodies to virtual worlds – XR in healthcare – Gaming across realities – XR trends in Gaming.

LABORATORY EXPERIMENTS [30]

1. Study and setup of VR development environment using Unity
2. Create a basic virtual world with simple 3D objects and environment elements.
3. Design and implement a virtual scene demonstrating immersion and presence.
4. Develop a VR application using basic input devices (keyboard, mouse, controller, or hand tracking).
5. Implement object selection and manipulation techniques in a virtual environment.
6. Create a navigation system for movement within a virtual world (teleportation/walkthrough).
7. Design a simple user interface (UI) for a VR application using virtual menus and buttons.
8. Implement visual and audio feedback to enhance user interaction in VR.
9. Develop a basic Augmented Reality application for displaying virtual objects on real-world surfaces.
10. Mini Project: Design and develop a simple AR/VR application integrating interaction, navigation, and multimedia elements.

Total Notional Hours: 90

L	T	P	TW&SL	C
30	-	30	30	3

TEXT BOOK:

- [1] Sherman, W. R., & Craig, A. B. Understanding Virtual Reality: Interface, Application, and Design. Morgan Kaufmann, 2nd ed., 2018.

REFERENCE BOOKS:

- [1] Braun, A., & Rizzo, R., XR Development with Unity: A Beginner's Guide to Creating Virtual, Augmented, and Mixed Reality Experiences Using Unity, 1st ed., Birmingham, UK: Packt Publishing, 2023.
- [2] Jerald, J. The VR Book: Human-Centered Design for Virtual Reality. ACM Books, 2015.
- [3] LaValle, S. M. Virtual Reality. Cambridge University Press, 2017.
- [4] Schmalstieg, D., & Hollerer, T. Augmented Reality: Principles and Practice. Addison-Wesley, 2016.
- [5] Vohra, Manisha. Introduction to Extended Reality (XR) Technologies. Wiley, 1st ed., 2025.

WEB REFERENCES

- [1] "Foundation for Virtual and Augmented Reality Systems - By Prof. Samit Bhattacharya IIT Guwahati," https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs03
- [2] "Extended Reality (XR) Technologies - By Dr. P. Malliga," https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr24_ed76

25IT257	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational concepts, architecture models (NIST), service and deployment models of cloud computing, along with its key characteristics, benefits, and challenges in modern IT infrastructure.	1	1
CO2	Apply principles of virtualization, containerization, and web service architectures to design, configure, and manage virtualized cloud environments using appropriate platforms and tools.	1, 2, 3,5	1
CO3	Recommend cloud storage solutions, interoperability standards, and deployment strategies to evaluate performance, cost, and suitability for different application scenarios across major cloud platforms.	1, 2, 3, 4, 5	1
CO4	Utilize cloud security frameworks, identity and access management (IAM) policies, and governance models to implement secure, compliant, and resilient cloud-based systems.	1, 2, 3, 4, 5	1
CO5	Evaluate the architectural trade-offs, security threats, and operational governance of virtualized and containerized cloud environments to recommend solutions that balance performance, cost, and risk.	1, 2, 3, 4, 5	1

CLOUD ARCHITECTURE & INFRASTRUCTURE

[6]

Introduction to Cloud Computing – Need and Evolution of Cloud – Cloud Architecture – NIST Reference Model – Service Models (IaaS, PaaS, SaaS) – Deployment Models (Public, Private, Hybrid, Community Cloud) – Characteristics and Benefits of Cloud – Cloud Infrastructure Components – Cloud Challenges and Applications.

WEB SERVICES & VIRTUALIZATION BASICS

[6]

Service-Oriented Architecture – SOAP & REST – Basics of Virtualization – Virtual Machine Concepts – Hypervisors (Type 1 & Type 2) – Virtualization Techniques: Full, Para and Hardware Virtualization – CPU, Memory and I/O Virtualization – Resource Allocation and Performance Considerations.

CLOUD STORAGE & CONTAINERIZATION

[6]

Cloud Storage Fundamentals – Storage Provisioning – Managed vs Unmanaged Storage – Cloud Backup Strategies – Cloud Storage Interoperability (CDMI, OCCI) – Introduction to Containers – Docker Architecture – Docker Images, Containers and Repositories – Basics of Kubernetes.

CLOUD PLATFORMS & DEPLOYMENT

[6]

Google App Engine – Amazon AWS – Microsoft Azure – OpenStack Overview and Architecture – Eucalyptus and OpenNebula – Programming on EC2 and S3 – Application Deployment Models – Performance Evaluation Parameters – Cost Optimization Concepts.

CLOUD SECURITY & GOVERNANCE

[6]

Security Challenges in Virtualized Environments – VM Attacks: VM Escape, Guest Hopping, VM Migration Attacks – Hypervisor Threats – Data Security and Storage Security – Identity and Access

Management (IAM) – IAM Architecture, Policies and Best Practices – Cloud Compliance and Governance.

LAB EXPERIMENTS

18. Study of Cloud Models – Demonstration of IaaS / PaaS / SaaS and Deployment Models
19. Creation and Management of Virtual Machines using VMware / VirtualBox
20. Study and Comparison of Hypervisors and Virtualization Types
21. Docker Installation and Basic Container Operations
22. Docker Image Building and Application Deployment
23. Implementation of Cloud Storage & Basic IAM Configuration on AWS / Azure.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Application Programming. Elsevier, 2021.

REFERENCE BOOKS:

- [1] Kai Hwang, Jack Dongarra, Geoffrey Fox. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things. Morgan Kaufmann, 2022.
- [2] Thomas Erl, Ricardo Puttini, Zaigham Mahmood. Cloud Computing: Concepts, Technology & Architecture. Pearson, 2020.
- [3] Chris Dotson. Practical Cloud Security, O'Reilly, 2019.

WEB REFERENCES

- [1] "Cloud Computing," <https://nptel.ac.in/courses/106105167>
- [2] "Cloud Computing and Distributed Systems," <https://nptel.ac.in/courses/106104182>

25CS262	CYBER SECURITY PRACTICES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental principles of cybersecurity and classify common cyber threats, attacks, and system vulnerabilities.	1,2,11	1
CO2	Apply appropriate security controls, cryptographic techniques, and protection mechanisms to protect systems, networks, and data.	1,2,3,5,11	1,3
CO3	Explain traditional and modern forms of cybercrime, their classification, causes, and the evolving role ICT in cybercriminal activities.	1,2,6,7,9,11	1,3
CO4	Apply standard digital forensic investigation procedures including evidence identification, acquisition, preservation maintaining legal compliance.	1,2,6,7,9,11	1,3
CO5	Design and Evaluate cybersecurity solutions, incident response strategies, and risk management practices for protecting organizational assets and critical infrastructure.	2,3,4,5,9,11	1,3

INTRODUCTION TO CYBER SECURITY

[6]

Definition and scope of cybersecurity-The CIA triad (Confidentiality, Integrity, Availability)-Security principles (least privilege, defense in depth, etc.)-Security architecture and design-Risk management and Assessment-Security policies and procedures.

NETWORK & DATA SECURITY

[6]

Network protocols and vulnerabilities-Firewalls and intrusion detection/prevention systems (IDS/IPS)-Virtual Private Networks (VPNs)-Wireless Security-Network segmentation and access control-Denial-of-service (DoS) attacks and defenses Data encryption and decryption-Data integrity and hashing-Access control models (e.g., RBAC, ABAC)-Database Security-Data loss prevention-Data privacy regulations (e.g., GDPR, CCPA).

APPLICATION SECURITY

[6]

Software development lifecycle (SDLC) and security-Common application vulnerabilities (e.g., SQL injection, cross-site scripting)-Secure coding practices -Web application security-Mobile application security-Security testing (e.g., penetration testing, fuzzing)

CYBER CRIME & DIGITAL FORENSICS

[6]

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Role of ECD and ICT in Cybercrime – Classification of Cyber Crime. The Present and future of Cybercrime – Cyber Forensics-Steps in Forensic Investigation – Forensic Examination Process Types of CF techniques – Forensic duplication and investigation – Forensics Technology and

EVIDENCE COLLECTION AND FORENSICS TOOLS

[6]

Processing Crime and Incident Scenes – Digital Evidence – Sources of Evidence -Working with File Systems. – Registry – Artifacts – Current Computer Forensics Tools: Software/ Hardware Tools – Forensic Suite – Acquisition and Seizure of Evidence from Computers and Mobile Devices Chain of Custody- Forensic Tools

LABORATORY EXPERIMENTS

[30]

1. Implementation of security threat identification using the CIA (Confidentiality, Integrity, and Availability) Triad.
2. Implementation of risk analysis by mapping threats, vulnerabilities, and impacts with mitigation strategies.
3. Implementation of network traffic capture and analysis to detect common network attacks.
4. Implementation of packet inspection techniques using network monitoring tools to identify suspicious patterns.
5. Implementation of web application vulnerability detection for SQL Injection and Cross-Site Scripting (XSS).
6. Implementation of secure input validation and attack impact demonstration in web applications.
7. Implementation of digital forensic imaging and evidence acquisition techniques.
8. Implementation of data integrity verification using cryptographic hashing algorithms.
9. Implementation of file system analysis to recover deleted files and artifacts.
10. Implementation of forensic analysis reporting and chain of custody documentation.

Total Notional Hours: 90

L	T	P	TW&SL	C
30	-	30	30	3

TEXT BOOK:

- [1] Computer Security: Principles and Practice by William Stallings & Lawrie Brown, 5th ed., Pearson, 2024 (Reprint 2025).

REFERENCE BOOKS:

- [1] W. Stallings, Network Security Essentials: Applications and Standards, 6th ed. Pearson, 2022.
[2] CEH Official Certified Ethical Hacking Review Guide, Version 11. Wiley India, 2021.
[3] P. W. Singer and A. Friedman, Cybersecurity and Cyberwar: What Everyone Needs to Know. Oxford University Press, 2014.
[4] M. T. Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd ed. Prentice Hall, 2013.

WEB REFERENCES

- [1] "Cyber Security and Privacy, 2025," https://onlinecourses.nptel.ac.in/noc25_cs116/preview

25IT256	WEB TECHNOLOGIES AND FULL STACK DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the structure and components of modern web applications.	1	1
CO2	Apply HTML5 semantic elements, forms, and multimedia, along with CSS3 styling, responsive layouts, and visual effects, to create accessible, SEO-friendly, and visually engaging web interfaces.	1, 2, 3, 5	1
CO3	Implement client-side interactivity, form validation, and dynamic content updates using JavaScript, DOM manipulation, event handling, and asynchronous programming techniques (AJAX/fetch API).	1, 2, 3, 5	1
CO4	Develop server-side functionality using PHP to handle form data, manage sessions and cookies, perform CRUD operations with MySQL, and apply security best practices in web programming.	1, 2, 3, 4, 5	1
CO5	Integrate front-end and back-end technologies to design, build, test, and deploy a full-stack web application, incorporating version control (Git) and deployment on local or cloud platforms.	1, 2, 3, 4, 5	1

HTML5: WEB PAGE STRUCTURE AND ELEMENTS

[6]

Introduction to web technologies – client–server architecture – structure of HTML document – headings, paragraphs, lists, tables, and hyperlinks – forms and input types – semantic tags: header, nav, section, article, footer – multimedia elements (audio, video, canvas) – metadata and accessibility – SEO-friendly markup.

CSS3: STYLING AND RESPONSIVE DESIGN

[6]

Introduction to CSS3 – syntax and selectors – box model – borders, margins, padding, positioning – display properties – Flexbox and CSS Grid – typography and color schemes – gradients, shadows, transitions, animations – responsive design using media queries – mobile-first design principles.

JAVASCRIPT: CLIENT-SIDE PROGRAMMING

[6]

Introduction to JavaScript – variables, data types, operators – control structures – functions, arrays, and objects – DOM manipulation – event handling (click, mouse, form) – form validation – ES6 features (let, const, arrow functions, template literals) – asynchronous JavaScript (AJAX, fetch API) – debugging and developer tools.

PHP: SERVER-SIDE SCRIPTING AND DATABASE CONNECTIVITY

[6]

Introduction to PHP – syntax and variables – control structures and arrays – functions and file handling – form handling using GET and POST – session and cookie management – error handling and input validation – connecting PHP with MySQL using MySQLi/PDO – CRUD operations – security practices in web programming.

FULL STACK INTEGRATION AND DEPLOYMENT

[6]

Integration of front-end and back-end – combining HTML, CSS, JavaScript, PHP, and MySQL – designing a full stack architecture – client–server communication and data flow – user authentication

and session tracking – testing and debugging – version control using Git – deployment on XAMPP/WAMP or cloud platforms – documentation and maintenance.

LAB EXPERIMENTS

24. Design a personal portfolio webpage using HTML5 structure and semantic tags.
25. Create a responsive web layout using CSS3 Flexbox and Grid system.
26. Develop a form with various HTML5 input types and validate it using JavaScript.
27. Implement JavaScript DOM manipulation to dynamically change web page content.
28. Use JavaScript events to create an interactive image gallery or slideshow.
29. Write a PHP program to process a feedback form using POST method.
30. Develop a PHP script for performing CRUD operations in MySQL (student database).
31. Implement user login and session management using PHP and MySQL.
32. Build an integrated mini web application combining HTML, CSS, JS, PHP, and MySQL.
33. Deploy the mini full stack web application on a local or cloud-based web server (e.g., XAMPP/WAMP/000webhost).

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Philip Ackermann. Full Stack Web Development: The Comprehensive Guide. Wiley, 2022.

REFERENCE BOOKS:

- [1] Luke Welling & Laura Thomson. PHP and MySQL Web Development. Pearson, 2020.
[2] Robin Nixon. Learning PHP, MySQL & JavaScript, 5/E, O'Reilly, 2022.
[3] Jon Duckett. Web Design with HTML, CSS, JavaScript and jQuery. Wiley, 2021.

WEB REFERENCES

- [1] "W3Schools Online Web Tutorials," <https://www.w3schools.com>
[2] "Mozilla Developer Network," <https://developer.mozilla.org>

25CS259	INTERNET OF THINGS AND SMART SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply networking principles and addressing strategies to configure IoT systems using layered models and TCP/IP protocols.	1,5	1
CO2	Implement sensor and actuator modules in IoT devices, considering characteristics, deviations, and interfacing requirements.	1,5	1,2
CO3	Develop IoT applications using Raspberry Pi and Python, integrating cloud and fog computing platforms for data processing.	1,5	1,2,3
CO4	Utilize appropriate communication protocols and semantic frameworks to enable interoperability across diverse IoT devices.	1, 5	1,2
CO5	Design and deploy IoT solutions for real-world domains such as agriculture, healthcare, and smart environments, addressing security and privacy challenges.	1, 5	1,2,3

INTRODUCTION

[6]

Basics of Networking - Introduction – Network Types- Layered Networks Models- Addressing- TCP/IP Transport layer– Predecessors of IoT-Wireless sensor Networks-M2M communications- Cyber Physical Systems-Emergence of IoT- Evolution of IoT-Enabling IoT and complex independence of Technologies-IoT Networking Components-Addressing Strategies in IoT – IoT sensing and actuation –Sensors-Sensor characteristics-Sensorial Deviations-Sensing Types-Sensing Considerations-Actuators- Actuator Types-Actuator Characteristics.

INTERNET OF THINGS

[6]

IoT processing and topologies and types-Data Format-Importance of Processing in IoT-Processing Topologies-IoT Device Design and Selection Considerations-Processing Offloading – IoT connectivity Technologies.

COMMUNICATION TECHNOLOGIES

[6]

IoT communication Technologies –Introduction-Infrastructure Protocols-Discovery Protocols-Data Protocols-Identification Protocols-Device Management-Semantic Protocols- IoT interoperability – Introduction-Standards-Frameworks

ASSOCIATED IOT TECHNOLOGIES

[6]

Cloud computing – Virtualization-Cloud Models-Service-Level Agreement in Cloud Computing- Cloud Implementation-Sensor-Cloud: Sensors as service-Fog computing and its applications- Introduction-View of Fog Computing Architecture-Fog Computing in IoT-Selected Applications of

fog computing- -Beginning IoT Hardware Projects –IoT Analytics

IOT CASE STUDIES AND FUTURE TRENDS

[6]

Agriculture IoT –Vehicular IoT – Healthcare IoT –Paradigms, challenges and Future.

LABORATORY EXPERIMENTS

[30]

1. Installation and Configuration of Raspberry Pi
2. Python Programming Basics on Raspberry Pi
3. GPIO Programming with LED Interfacing
4. Push Button Interfacing
5. Temperature and Humidity Monitoring using DHT11/DHT22
6. Ultrasonic Sensor Interfacing
7. PIR Motion Sensor Interfacing

Total Notional Hours: 90

L	T	P	TW&SL	C
30	-	30	30	3

TEXT BOOK:

- [1] Sudip Misra, Anandarup Mukherjee – Arijit Roy – “Introduction to IoT – Cambridge University Press,2022.

REFERENCE BOOKS:

- [1] Arshdeep Bahga, Vijay Madisetti, Internet of Things-A hands-on approach, Universities Press, 2015.
- [2] Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key applications and Protocols, Wiley Publications 2nd ed., 2013.
- [3] Raj Kamal, Internet of Things – Architecture and Design Principles, Mc Graw Hill Education Pvt. Ltd., 2017.
- [4] Internet of Things and Data Analytics, HwaiyuGeng, P.E, Wiley Publications, 2017.

WEB REFERENCES:

- [1] " S. Misra, “Introduction to Internet of Things,” NPTEL, IIT Kharagpur, 2022.
<https://nptel.ac.in/courses/106105166>

25CS211	DISCRETE MATHEMATICS	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand propositional logic, predicates, quantifiers, inference rules, and proof strategies to evaluate logical statements and construct formal proofs.	1,2,5	1
CO2	Apply combinatoric methods to count, organize, and solve problems involving permutations, combinations, recurrence relations, and the pigeonhole principle.	1,2,5	1
CO3	Solve problems involving graphs and their properties, including graph representation, connectivity, and special types like Eulerian and Hamiltonian paths.	1,2,5	1
CO4	Analyze the concepts of algebraic systems such as groups, rings, and fields, including their properties and operations, and apply them to solve algebraic problems.	1,2,5	1
CO5	Analyze the properties and applications of lattices and Boolean algebra, including minimization of Boolean expressions and their role in digital logic design.	1,2,5	1

MATHEMATICAL LOGIC

[9]

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs.

COMBINATORICS

[9]

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions.

GRAPH THEORY

[9]

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

ALGEBRAIC STRUCTURES

[9]

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism ‘s – Normal subgroup and cosets – Lagrange ‘s theorem – Rings and Fields (Definitions and examples).

LATTICES AND BOOLEAN ALGEBRA

[9]

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Minimization of Boolean Expression.

Total Notional Hours: 90

L	T	P	TW&SL	C
30	15	-	45	3

LIST OF EXPERIMENTS USING MATLAB

1.Truth Table Generator for Propositional Logic

2. Predicate Logic Evaluator
3. Permutations and Combinations Calculator
4. Recurrence Relation Solver
5. Graph Representation using Adjacency Matrix
6. Euler & Hamiltonian Graph Simulation
7. Group Operation Table Generator
8. Cosets and Subgroups Visualizer
9. Hasse Diagram Generator for Lattices
10. Boolean Expression Minimization and Logic Gate Simulation

TEXT BOOKS:

- [1] Rosen, K.H., Discrete Mathematics and its Applications, 7th ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
- [2] 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.

REFERENCE BOOKS:

- [1] Grimaldi, R.P. Discrete and Combinatorial Mathematics: An Applied Introduction, 4th ed., Pearson Education Asia, Delhi, 2007.
- [2] Lipschutz, S. and Mark Lipson., Discrete Mathematics, Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd ed., 2010.
- [3] Koshy, T. Discrete Mathematics with Applications, Elsevier Publications, 2006.

WEB REFERENCES

- [1] "Discrete Mathematics – IIT Ropar," <https://nptel.ac.in/courses/111/106/111106086>
- [2] "Discrete Mathematics – IIT Madras," <https://nptel.ac.in/courses/111/106/111106130>
- [3] "Graph Theory – IIT Kharagpur," <https://nptel.ac.in/courses/111/105/111105035>
- [4] "Group Theory – IIT Madras," <https://nptel.ac.in/courses/111/106/111106112>
- [5] "Mathematics for Computer Science (6.042J)," <https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-spring-2015/>
- [6] Discrete Mathematics Specialization – UC San Diego Introduction to Discrete Mathematics for Computer Science
- [7] "Introduction to Logic – Stanford University," <https://www.coursera.org/learn/logic-introduction>
- [8] "Algorithms on Graphs – UC San Diego," <https://www.coursera.org/learn/algorithms-on-graphs>
- [9] "Introduction to Group Theory – University of Sydney," <https://www.coursera.org/learn/introduction-to-group-theory>
- [10] "Discrete Math and Logic Concepts," <https://www.khanacademy.org/computing/computers-and-internet/xcae6f4a7ff015e7d:computers/xcae6f4a7ff015e7d:logic-gates-and-circuits/a/logic-gates>
- [11] "Permutations, Combinations & Counting," <https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations>
- [12] "Intro to Graph Theory," <https://www.khanacademy.org/computing/computer-science/algorithms/graph-representation>

25CS208	QUANTUM ALGORITHMS AND COMPUTING SYSTEMS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamentals of classical and quantum information, including bits, qubits, superposition, and measurement.	1,2	1
CO2	Represent quantum states and gates using linear algebra and analyze single-qubit circuit behavior.	1,5	1
CO3	Explain multi-qubit systems, entanglement, and basic quantum error correction.	2,6	1,3
CO4	Explain entanglement-based protocols (superdense coding, teleportation, BB84) and core quantum algorithms (Deutsch-Jozsa, Grover's, Shor's).	1,2	1,3

CLASSICAL AND QUANTUM INFORMATION BASICS

[6]

Bits and encoding information – Logic gates and universal gate sets – Reversible logic gates and the Toffoli gate – Introduction to the qubit: superposition and measurement in the Z-basis.

LINEAR ALGEBRA AND QUANTUM GATES

[6]

Quantum states as vectors – Inner products and orthonormality – Quantum gates as matrices – Common single-qubit gates (X, Y, Z, H) – Unitarity and reversibility of quantum gates.

MULTIPLE QUBITS AND ERROR CORRECTION

[6]

Tensor products and multi-qubit states – Product states vs. entangled states – Common two-qubit gates (CNOT) – No-cloning theorem – Basic quantum error correction: the bit-flip code (as a representative example).

ENTANGLEMENT AND QUANTUM PROTOCOLS

[6]

Entangled states and the EPR idea – Superdense coding – Quantum teleportation – Quantum key distribution: classical public-key idea vs. the quantum solution (BB84).

QUANTUM ALGORITHMS

[6]

Quantum oracles – Deutsch's algorithm and its generalization: the Deutsch-Jozsa algorithm – Grover's search algorithm – Shor's factoring algorithm (conceptual overview: what it solves and why it matters, without full derivation).

Total Notional Hours: 60

L	T	P	TW&SL	C
30	-	-	30	2

TEXTBOOK:

[1] Thomas G. Wong, Introduction to Classical and Quantum Computing, Rooted Grove, 2022.

REFERENCE BOOKS:

- [1] Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010.
- [2] N. David Mermin, Quantum Computer Science: An Introduction, Cambridge University Press, 2007.
- [3] Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
- [4] Ronald de Wolf, Quantum Computing: Lecture Notes, QuSoft, CWI and University of Amsterdam, 2019 (updated 2023). Freely available on arXiv (arXiv:1907.09415) and the author's CWI homepage.

WEB REFERENCES

- [1] "Introduction to Quantum Computing: Quantum Algorithms and Qiskit — Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan (IIT Madras, IBM Research, IBM Systems)," https://onlinecourses.nptel.ac.in/noc21_cs103/preview
- [2] "Quantum Computing — Prof. Debabrata Goswami (IIT Kanpur)," https://onlinecourses.nptel.ac.in/noc19_cy31/preview
- [3] "Quantum Algorithms and Cryptography — Prof. Shweta Agrawal (IIT Madras)," https://onlinecourses.nptel.ac.in/noc25_cs61/preview
- [4] "Introduction to Quantum Computing (NOC) — Prof. Prabha Mandayam et al," <https://nptel.ac.in/courses/106106232>

25CS209	MOBILE COMPUTING AND WIRELESS TECHNOLOGIES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand mobile computing architecture, standards, and technologies.	1,3,5	1
CO2	Learn and apply various mobile communication concepts and wireless network mechanisms.	1,3,5	1
CO3	Understand the architecture and protocols of wireless networks and transport layers	1,3,5	1
CO4	Analyze and apply the principles of designing and managing secure mobile systems and networks.	1,3,5	1,3
CO5	Explore emerging mobile technologies including IoT, Edge, and 5G networks.	1,3,5	1,3

INTRODUCTION TO MOBILE COMPUTING & WIRELESS SYSTEMS

[6]

Evolution of Mobile Computing - Characteristics and Limitations - Mobile Computing Architecture - Wireless Communication Principles: Frequency Reuse, Multiplexing, Modulation - Wireless Medium Access Control: Hidden/Exposed Terminal Problems, CSMA/CA - Overview of Cellular Standards – GSM, GPRS, UMTS, LTE, 5G and 6G trends.

MOBILE TELECOMMUNICATION SYSTEMS AND NETWORK PROTOCOLS

[6]

GSM: System Architecture, Protocol Stack, Services, Handover, and Security - GPRS: Architecture, Procedures, and Applications - Mobile IP: Agent Discovery, Registration, and Tunneling - Routing Protocols for Mobile Ad hoc Networks (AODV, DSR, DSDV) - Quality of Service (QoS) and Handoff Management in 4G/5G Networks.

WIRELESS NETWORKS AND TRANSPORT LAYER

[6]

Wireless LANs: IEEE 802.11 Architecture, Protocol Stack, and MAC Mechanisms - Bluetooth, ZigBee, and Wi-Fi Technologies - Wireless TCP: Indirect TCP, Snooping TCP, M-TCP - Congestion Control, Error Recovery, and Power Management - Delay-Tolerant Networks (DTN) and Mobile Cloud Connectivity.

MOBILE PLATFORMS AND SECURITY

[6]

Mobile operating systems: Android and iOS architectures - Mobile device management (MDM) and security mechanisms - Authentication, encryption, and data protection techniques.

EMERGING MOBILE TECHNOLOGIES

[6]

Edge and fog computing in mobile environments - Integration of mobile systems with IoT and cloud platforms - 5G core network, network slicing, and virtualization concepts - Cross-platform

frameworks: Flutter, React Native, Kotlin Multiplatform.

Total Notional Hours: 60

L	T	P	TW&SL	C
30	-	-	30	2

TEXT BOOKS:

- [1] Jochen Schiller, Mobile Communications, 2nd ed., Pearson, 2019.
- [2] Raj Kamal, Mobile Computing, 3rd ed., Oxford University Press, 2020.

REFERENCE BOOKS

- [1] William Stallings, Wireless Communications and Networks, 2nd ed., Pearson, 2018.
- [2] Asoke K. Talukder & Roopa R. Yavagal, Mobile Computing – Technology, Applications, and Service Creation, 2nd ed., McGraw Hill, 2017.
- [3] Neil Smyth, Android Studio Development Essentials – Android 14 Edition, 2024.

WEB REFERENCES

- [1] "Wireless Communication (Hindi), IIIT Delhi," nptel.ac.in/courses/108106370

25CS210	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand blockchain architecture and cryptographic foundations.	1,2	1
CO2	Analyze Bitcoin protocol and cryptocurrency mechanisms.	1,5	1
CO3	Develop and deploy smart contracts using Solidity.	2,6	1,3
CO4	Evaluate blockchain applications and enterprise platforms.	1,2	1,3
CO5	Assess security issues and emerging blockchain trends.	2,4	1,3

BLOCKCHAIN FUNDAMENTALS

[6]

Introduction to Blockchain – Decentralization concepts – Types of blockchain. Cryptographic Primitives – Hash functions – Digital signatures – Public key cryptography. Distributed Systems – Consensus mechanisms – Peer-to-peer networks – Byzantine Fault Tolerance.

BITCOIN AND CRYPTOCURRENCY

[6]

Bitcoin Architecture – Block structure – Transactions and UTXO model – Bitcoin scripting. Mining and Consensus – Proof-of-Work – Mining process – Network security. Bitcoin Network – Wallets – Payments – Bitcoin limitations.

ETHEREUM AND SMART CONTRACTS

[6]

Ethereum Platform – Ethereum Virtual Machine (EVM) – Accounts – Gas mechanism. Smart Contracts – Solidity programming – Development tools (Remix, Truffle) – Contract deployment. Token Standards – ERC-20 and ERC-721 – DApps development – Web3.js basics.

ENTERPRISE BLOCKCHAIN

[6]

Hyperledger Fabric – Architecture – Chaincode development – Channels and MSP. Alternative Consensus – Proof-of-Stake – PBFT – DPoS. Other Platforms – Corda – Polkadot – Overview of emerging platforms.

APPLICATIONS AND SECURITY

[6]

Blockchain Applications – Supply chain – Healthcare – Finance and DeFi – Digital identity – E-governance. Security – Smart contract vulnerabilities – Best practices – Privacy solutions. Emerging Trends – NFTs – CBDCs – Interoperability – Scalability solutions.

Total Notional Hours: 60

L	T	P	TW&SL	C
30	-	-	30	2

TEXTBOOKS:

- [1] Gulshan Shrivastava, Dac-Nhuong Le, and Kavita Sharma, Eds., Cryptocurrencies and Blockchain Technology Applications, Scrivener Publishing LLC, 2020.
- [2] Bashir, Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks 2nd ed., 2017
- [3] Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

REFERENCE BOOKS:

- [1] A. Narayanan, J. Bonneau, E. Felten, A. Miller, and S. Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.
- [2] B. Singhal, G. Dhameja, and P. S. Panda, Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions. Apress, 2018.
- [3] N. Prusty, Building Blockchain Projects. Packt Publishing, 2017..

WEB REFERENCES

- [1] "Blockchain and its Applications, 2022," https://onlinecourses.nptel.ac.in/noc22_cs44/preview

25CS214	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts, characteristics, and architecture of Big Data systems.	1,2,3	1
CO2	Analyze distributed storage frameworks and NoSQL databases used for large-scale data management.	2,3	1,2
CO3	Apply big data processing frameworks such as MapReduce, Hive, and Pig to process large datasets.	2,3	1
CO4	Evaluate big data analytics and reporting techniques, including introductory machine learning for large-scale data.	2,3	1,2,3
CO5	Assess key Big Data platform comparisons, applications, and emerging trends to identify suitable solutions for real-world scenarios.	1,2,3	1,2,3

INTRODUCTION TO BIG DATA

[9]

Classification of Digital Data - Characteristics and Definition of Big Data - Evolution and Challenges of Big Data - Traditional BI vs. Big Data - Typical Data Warehouse vs. Hadoop Environment - Classification of Analytics - Overview of the Big Data Technology Landscape (NoSQL and Hadoop).

DISTRIBUTED STORAGE AND NOSQL DATABASES

[9]

Why Hadoop, RDBMS vs. Hadoop, Distributed Computing Challenges - HDFS Architecture and Hadoop YARN - Hadoop Ecosystem Overview - MongoDB Basics: Document Model and Simple Queries - Cassandra Basics: Column-Family Model and Simple CRUD Operations.

BIG DATA PROCESSING FRAMEWORKS

[9]

MapReduce Programming Model: Mapper, Reducer, Combiner, Partitioner - Hive: Architecture and Basic HiveQL - Pig: Pig Latin Basics and a Simple ETL Use Case - When to Use Pig vs. Hive.

BIG DATA ANALYTICS AND REPORTING

[9]

Basics of Reporting/Visualization Tools Connecting to NoSQL Databases (JasperReports with MongoDB/Cassandra) - Introduction to Machine Learning for Big Data: Common Algorithm Types and their Role in Analytics.

COMPARISONS, APPLICATIONS, AND TRENDS

[9]

Key Comparisons: Data Warehouse vs. Data Lake, RDBMS vs. HDFS, HDFS vs. HBase, MapReduce vs. Pig, MapReduce vs. Spark, Pig vs. Hive - Emerging Trends: IoT Streaming, Edge Computing, Containerization, and the Growing Role of Chatbots and Visualization in Big Data.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

[1] Seema Acharya and Subhashini Chellappan, Big Data and Analytics, 2nd ed., Wiley India, 2019.

REFERENCE BOOKS

[1] Tom White, Hadoop: The Definitive Guide, 5th ed., O'Reilly Media, 2015.

[2] Rajkumar Buyya and Amir V. Dastjerdi, Big Data: Principles and Paradigms, Morgan Kaufmann (Elsevier), 2016.

[3] Han Hu et al., Big Data Platforms and Applications, Springer.

[4] Viktor Mayer-Schonberger and Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Houghton Mifflin Harcourt, 2013.

WEB REFERENCES

[1] "Big Data Computing - Prof. Rajiv Misra (IIT Patna)," https://onlinecourses.nptel.ac.in/noc25_cs131/preview

[2] "Introduction to Data Analytics - Prof. Nandan Sudarsanam, Prof. Balaraman Ravindran (IIT Madras)," <https://nptel.ac.in/courses/1101060>.

25EE203	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the constructional features and operating principles of DC machines and transformers based on magnetic circuit concepts.	1	1
CO2	Analyze the performance characteristics of DC generators and motors under varying load and speed control conditions.	1,2	1
CO3	Evaluate the losses, efficiency, and regulation of DC machines and transformers using standard testing procedures.	1,2,3	1
CO4	Examine the parallel operation, connections, and applications of DC machines and transformers in practical power systems.	1	1
CO5	Apply design principles to select and size suitable DC machines and transformers for given industrial applications.	1,3	1

MAGNETIC CIRCUITS & ELECTROMECHANICAL ENERGY CONVERSION [9]

Introduction to magnetic circuits –Laws governing magnetic circuits- Magnetically induced EMF– AC operation of magnetic circuits – Energy in magnetic systems – Field energy & Co energy – Force and torque equations- Single and Multiple excited systems– Magnetic fields in rotating machines.

DC GENERATOR [9]

Constructional features of DC machines – armature, field system, commutator, brushes - EMF equation of DC generator – types of DC generators - Armature reaction and its compensation methods - Commutation – causes of poor commutation and its remedies - Applications of DC generators.

DC MOTORS [9]

Working principle of DC motors – back EMF – torque equation - Types of DC motors – characteristics of shunt, series, and compound motors - Speed control of DC motors – armature and field control methods - Starting of DC motors – necessity of starters – three-point and four-point starters - Applications of DC motors. Design of DC Machines – Calculation of Main Dimensions.

TESTING AND PERFORMANCE OF DC MACHINES [9]

Losses and efficiency of DC machines - Direct and indirect methods of testing – Brake test, Swinburne's test, Hopkinson's test, Retardation test, and Field's test - Separation of losses and efficiency calculations - Parallel operation of DC generators - IEEE 113 and IS 2635 Standards.

TRANSFORMERS [9]

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Transformer on No load and Load – Phasor diagram - Equivalent circuit – Regulation - Three phase transformer connections -Parallel operation of single phase and three phase transformer- Special transformers – welding, instrument, isolation, Zigzag and Foil wound transformers - IEC 60076 and IEEE C57 Standards. Design of Transformers – Calculation of main dimensions and cooling tubes.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Kothari D. P., and Nagrath I. J., Electric Machines, Tata McGraw-Hill Publishing Company Limited, New Delhi, 5th ed., 2017.
- [2] P.S. Bhimbra, Electrical Machinery, Khanna Publishers, 7th ed., 2023.

REFERENCE BOOKS:

- [1] Gupta J B, Theory and Performance of Electrical Machines, S K Kataria & Sons, 14th ed., 2024.
- [2] PC Sen, Principles of Electric Machines and Power Electronics, Wiley Publishers, 3rd ed., 2013.
- [3] Fitzgerald A.E., Charles Kingsley Jr, Stephen.D. Umans, Electric Machinery, McGraw Hill Education, 7th ed., 2013.
- [4] Deshpande M V, Electrical Machines, PHI Learning Pvt. Ltd., New Delhi, 2015.

WEB REFERENCES

- [1] "Electrical Machines - I," https://onlinecourses.nptel.ac.in/noc25_ee124/
- [2] "Electrical Machines," <https://nptel.ac.in/courses/108102146>
- [3] "Electrical Machines - I," <https://nptel.ac.in/courses/108105017>
- [4] "Electrical Machines - I," <https://nptel.ac.in/courses/108105155>
- [5] "Electrical Machines I," <https://nptel.ac.in/courses/108106071>

25EE251	SENSORS AND TRANSDUCERS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Interpret key instrument parameters such as sensitivity, accuracy, and static errors.	1,2	1
CO2	Differentiate various types of transducers and their working principles, and select appropriate transducers based on measurement requirements.	1,2,3	1
CO3	Analyze the construction and characteristics of temperature measuring devices like thermistors, thermocouples, and bimetallic thermometers for industrial applications.	1,2,3,4	1
CO4	Apply knowledge of mechanical and electrical devices such as diaphragms, bellows, Bourdon tubes, and LVDTs for accurate pressure measurement.	1,2,3,4	1
CO5	Evaluate suitable level measurement methods and compare direct and indirect techniques, including ultrasonic and radiation-based systems.	2,3,4	1

MEASUREMENTS

[6]

Classification of Instruments - Functional elements of an instrument — Static and dynamic characteristics — Errors in measurement — Statistical evaluation of measurement data — Standards and calibration- Principle and types of analog and digital voltmeters, ammeters.

TRANSDUCERS

[6]

Principles and classification of transducers, Electrical, Mechanical and Thermal Characterization. Strain gauge, Inductive sensors, Capacitive sensors, Ultrasonic sensors.

TEMPERATURE MEASUREMENT

[6]

Thermistors: -Construction, Characteristics, applications, and salient features; Thermocouples: - Thermoelectric laws and construction, Bimetallic thermometers.

PRESSURE MEASUREMENT

[6]

Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement; variable inductance and capacitance transducers, piezoelectric transducers, L.V.D.T. for measurement of pressure.

LEVEL MEASUREMENT

[6]

Factors influencing level measurement, Direct level measuring systems: the dip stick, the sight glass, floats; resistive, inductive and capacitive techniques for level measurement; ultrasonic and radiation methods.

LIST OF EXPERIMENTS

[30]

1. AC Bridges
2. DC Bridges
3. Load measurement using strain gauge.
4. Temperature measurement using thermocouple.

5. Pressure measurement.
6. Strain measurement.
7. Signal conditioning
8. Power and Energy measurement.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] A.K. Shawney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co, Jan 2023.
- [2] D. Patranabis, Sensors and Transducers, 2nd ed., PHI Learning, 2013.
- [3] B.C. Nakra & K. K. Chaudary, Instrumentation Measurement & Analysis, Tata McGraw Hill Publishing Ltd, 2004.

REFERENCE BOOKS:

- [1] S.K. Singh, Industrial Instrumentation and Control, Tata McGraw-Hill, 3rd ed., 2009.
- [2] D.P. Eckman, Industrial Instrumentation, Wiley Eastern Ltd, Reprint, 2004.
- [3] W. Buchanan, Industrial Instrumentation and Control, Butterworth- Heinemann, Rev. ed., 2015.

WEB REFERENCES

- [1] "Industrial Instrumentation," <https://nptel.ac.in/courses/108105064>

25EE204	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the fundamental concepts of digital systems in engineering problems.	1,2,3,5	1
CO2	Sketch the logic circuits for digital applications.	1,2,3,5	1
CO3	Infer combinational and sequential logic circuits for complex engineering problems.	1,2,3,5	1,2
CO4	Select the logic circuits for programmable logic devices	1,2,3,5	1,2
CO5	Apply 8051 microcontroller programming for embedded system applications.	1,2,3,5	1,2

BOOLEAN ALGEBRA AND INTRODUCTION TO VHDL

[9]

Binary system, Boolean algebra, logic gates, Canonical and standard forms, Minimization using K-maps, NAND and NOR implementation. Introduction to VHDL: Features, Structure, Data types, Operators, Signal assignments, Modelling Styles.

COMBINATIONAL CIRCUITS

[9]

Arithmetic Comparison Circuits, Code Converters, Encoders, Decoders, Multiplexers and Demultiplexers. VHDL Programs for Combinational Circuits (Adders, Encoders, Decoders, Multiplexers, Demultiplexers)

SEQUENTIAL CIRCUITS

[9]

Flip-flops - SR, D, JK and T, shift registers, counters- Ring Counter, Twisted Ring Counter, Sequence Generator, Modulus Counter, Ripple (Asynchronous) Counters, and Synchronous Counters. Finite State Machine. VHDL Programs for Sequential Circuits (flip-flops, counters).

PROGRAMMABLE LOGIC DEVICES AND CMOS FAMILY

[9]

Introduction and Implementation of digital functions using PLDs – PROM, PAL, PLA, CPLD, FPGA. Hazards & Errors in digital circuits. Characteristics of Digital ICs, Transistor – Transistor Logic (NOT, NAND, NOR), Complementary MOS Logic (NOT, NAND, NOR), Comparison of TTL and CMOS family.

8051 MICROCONTROLLER

[9]

Functional block diagram, Pin Configuration, Memory Organization, Special Function Registers. Instruction format and addressing modes, Interrupt structure, Timer, I/O ports, Serial communication. Usage of IDE for assembly language programming.

Total Notional Hours: 90 hours

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] M. Morris Mano, Digital Logic and Computer Design, Pearson India Education Services Pvt. Ltd., New Delhi, 2016.
- [2] Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D Mckinlay The 8051Microcontroller and Embedded Systems, Pearson Education India, New Delhi, 2022.
- [3] A. Anand Kumar, Fundamentals of Digital Circuits, 4th ed., Prentice Hall India, 2016.

REFERENCE BOOKS:

- [1] Soumitra Kumar Mandal, Digital Electronics: Principles and Applications, Tata McGraw-Hill Education Pvt Ltd, 2010.
- [2] Thomas L. Floyd, Digital Fundamentals, 11th ed., Pearson Education Limited, 2014.
- [3] Raj Kamal, Digital Systems: Principles and Design, 3rd ed., Pearson Education Limited, 2009.
- [4] John M. Yarbrough, Digital Logic: Applications and Design, West Publishing Company, 2002.
- [5] David J. Comer, Digital Logic & State Machine Design, Oxford University Press, 2012.

WEB REFERENCES:

- [1] "Digital Circuits," https://onlinecourses.nptel.ac.in/noc25_ee125/preview
- [2] "Digital Electronics,"
https://onlinecourses.swayam2.ac.in/ntr25_ed125/preview
- [3] "Digital Logic and Circuits Simulations,"
https://onlinecourses.swayam2.ac.in/ini25_ec01/preview
- [4] "Digital Electronic and System Design,"
https://onlinecourses.swayam2.ac.in/nou25_ec10/preview

25EE272	DC MACHINES AND TRANSFORMER LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the working of DC Machines, transformers and their starting methods.	-	-
CO2	Determine the open circuit and load characteristics of separately excited and shunt DC generators through experimentation.	1,2,4,5	1,2
CO3	Analyze the characteristics and estimate the performance of DC motors under load conditions.	1,2,4,5	1,2
CO4	Apply indirect testing methods to estimate efficiency and losses in DC machines and transformers without direct loading.	1,2,4,5	1,2
CO5	Analyze the behavior and characteristics of transformers and estimate their performance under steady-state operating conditions.	1,2,4,5	1,2

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of a separately excited DC Generator and DC Shunt Generator.
2. Load test on DC shunt motor and DC series motor.
3. Load test on DC Compound motor.
4. Swinburne's test and speed control of DC shunt motor.
5. Hopkinson's test on DC Machine.
6. Load test on single-phase transformer.
7. Open circuit and short circuit tests on single phase transformer.
8. Sumpner's test on single phase transformers.
9. Separation of no-load losses in single phase transformer.
10. Study of starters and 3-phase transformers connections.

Total Notional Hours: 30

L	T	P	TW+SL	C
15	0	0	15	1

REFERENCE BOOKS:

- [1] Kothari D. P, and Nagrath I. J., Electric Machines, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th ed. 2004.
- [2] Dr. P.S. Bhimbra, Electrical Machinery, Khanna Publishers, 7th ed., 2017.
- [3] Gupta J B, Theory and Performance of Electrical Machines, S K Kataria & Sons, 14th ed., 2015.
- [4] Deshpande M V, Electrical Machines, PHI Learning Pvt. Ltd., New Delhi, 2011.
- [5] Fitzgerald A.E., Charles Kingsley Jr, Stephen D. Umans, Electric Machinery, McGraw Hill Education, 6th ed., 2003.

WEB REFERENCES:

- [1] "Electrical Machines (Simulation) – Virtual Labs," <https://ems-iitr.vlabs.ac.in/>
- [2] "Virtual Labs – Electrical Engineering," <https://www.vlab.co.in/broad-area-electrical-engineering>

25EE205	ANALOG ELECTRONICS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply operational amplifier characteristics to evaluate circuit performance and implement compensation techniques.	1,2	1
CO2	Implement linear applications of operational amplifiers for analog circuit design.	1,2,4	1,2
CO3	Analyze operational amplifiers in non-linear circuit configurations to design circuits for signal conditioning.	1,2,4	1,2
CO4	Examine DAC and ADC architectures and their performance parameters for data acquisition systems.	1,2,4	1,2
CO5	Evaluate applications using special ICs and their functionality for timing, frequency generation, and power supply applications.	1,2,4	1,2

OPERATIONAL AMPLIFIER CHARACTERISTICS

[9]

Functional Block Diagram – Symbol, Characteristics of an ideal operational amplifier, transfer characteristics, Circuit schematic of μA 741, Open loop gain, input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response characteristics – stability, limitations, frequency compensation, slew rate. Transfer characteristics.

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS

[9]

Inverting and Non-inverting amplifiers, Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier, Integrator, Differentiator, Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal Oscillators. Active filters – Design of low pass, high pass, band pass filters and notch filters.

NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS

[9]

Comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic, Exponential amplifiers and Multiplier, Square and Triangular waveform generators, Need for single power supply operational amplifiers – LM324, AC Inverting and Non-Inverting amplifiers, Applications.

A-D AND D-A CONVERTERS

[9]

DAC/ADC performance characteristics – Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Flash Type, Counter ramp, Successive approximation, Single slope, Dual slope and Sigma - Delta Converter.

SPECIAL ICS

[9]

IC 555 Timer- Functional block diagram, Monostable and Astable configurations, Applications. IC 566 VCO- Block diagram, operation and applications. IC 565 PLL- Block diagram; principle of phase detection and locking; applications. IC 723- Voltage Regulators: block diagram; low/high-current configurations; fixed regulators (78XX/79XX) and LM317 with output voltage formula; introduction to switching regulators.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Adel Sedra, Kenneth C Smith, Microelectronic Circuits, 7th ed., Oxford University Press, New Delhi, 2017.
- [2] Roy Choudhury Shail Jain, Linear Integrated Circuits, 5th ed., New Academic Science, London, UK, 2018.

REFERENCE BOOKS:

- [1] Gayakwad A R, OP-Amps and Linear Integrated circuits, 4th ed., Prentice Hall India, New Delhi, 2015.
- [2] Coughlin F R, and Driscoll F F, Operational Amplifiers and Linear Integrated Circuits, 6th ed., Prentice Hall of India, New Delhi, 2010.
- [3] Michael Jacob J, Applications and Design with Analog Integrated Circuits, 2nd ed., Prentice Hall of India, New Delhi, 2010.
- [4] K. Lal Kishore, Operational Amplifiers and Linear Integrated Circuit, 1st ed., Pearson, New Delhi, 2013.
- [5] Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th ed., Tata McGraw-Hill, New Delhi, 2016

WEB REFERENCES:

- [1] "Integrated Circuits and Applications," https://onlinecourses.nptel.ac.in/noc24_ee73/preview
- [2] "Analog Circuits," https://onlinecourses.nptel.ac.in/noc26_ee23/preview
- [3] "Integrated Circuits, MOSFETs, OP-Amps and their Applications," https://onlinecourses.nptel.ac.in/noc20_ee13/preview

25EE206	NEXT-GEN ENERGY GENERATION	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply various next-generation renewable and non-renewable energy technologies for optimized power generation.	1,6	1
CO2	Analyze the working principles of solar, wind, hydrogen, and bio-energy systems.	1,6	1
CO3	Demonstrate the operation of hybrid and distributed generation systems with energy storage.	1,6	1
CO4	Evaluate smart grid technologies and their role in integrating renewable energy.	1	1
CO5	Compare futuristic trends and sustainable energy innovations for future energy generation.	1,6	1

INTRODUCTION TO NEXT GENERATION ENERGY SYSTEMS

[6]

Overview of global and Indian energy scenarios - Limitations of conventional energy generation systems - Need for next-generation energy technologies - Classification: Renewable, Non-renewable, and Emerging technologies - Smart energy transition and Carbon Footprint, Decarbonization goals.

ADVANCED RENEWABLE ENERGY TECHNOLOGIES

[6]

Solar Energy: High-efficiency PV cells, BIPV, Floating Solar Plants - Wind Energy: Offshore wind farms, Vertical axis turbines- Hydro & Ocean Energy - Biomass and Bioenergy - Hybrid Solar-Wind System Architecture.

HYDROGEN AND FUEL CELL TECHNOLOGIES

[6]

Hydrogen as an energy carrier – production, storage, and transport - IEC TC105 and ISO 14687 - Water electrolysis and photo-electrochemical methods - Fuel cells – types, working principles, and efficiency improvement.

ENERGY STORAGE AND INTEGRATION

[6]

Distributed generation (DG) systems – Grid integration of renewable sources - IEEE 1547 standard - Energy storage technologies: Batteries (Li-ion, Na-ion), Supercapacitors, Flywheel and Pumped Hydro.

EMERGING AND FUTURISTIC ENERGY TECHNOLOGIES

[6]

Nuclear fusion energy – ITER and advanced reactor designs - Waste-to-energy systems and municipal solid waste management - Artificial photosynthesis and synthetic fuels – AI in energy management.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

[1] Bent Sorensen, Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning, Academic Press, 2017.

[2] Ibrahim Dincer, Hydrogen and Fuel Cell Technologies, Springer, 2021.

REFERENCE BOOKS:

- [1] Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, 2012
- [2] S. Rao and B. B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 1994.
- [3] B. K. Hodge and W. P. Gamberi, Alternative Energy Systems and Applications, Wiley, 2017.
- [4] J. Twidell and T. Weir, Renewable Energy Resources, Taylor & Francis, 2021.

WEB REFERENCES

- [1] "Sustainable Energy Technology," https://onlinecourses.nptel.ac.in/noc23_me138/preview

25EE252	CONTROL SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply block diagram reduction techniques and signal flow graphs to derive transfer functions and state space representations of control systems.	1,2,3	1
CO2	Apply mathematical modelling methods to represent electrical, mechanical, and electromechanical systems in time domain and frequency domain forms.	1,2	1
CO3	Analyze the time domain performance and stability of control systems using Routh-Hurwitz criterion and Root Locus techniques.	1,2,3,4	1,2
CO4	Analyze the frequency response characteristics of control systems using Bode, Polar, and Nyquist plots to determine gain margin and phase margin.	1,2,4,5,8	1,2
CO5	Design and tune basic controllers and compensators (P, PI, PD, PID, lead/lag) for control systems through simulation and practical experiments.	1,2,3,4,5,8	1,2,3

SYSTEM TYPES AND REDUCTION OF MULTIPLE SUBSYSTEMS

[9]

Types of Systems, Classification of control systems, Open loop and closed loop systems - Control system components- Differential equation, Transfer function and State space - Block diagram reduction techniques - Signal flow graphs, Mason's rule, similarity transformations.

MODELLING IN TIME AND FREQUENCY DOMAIN

[9]

Transfer function – Modelling of Electrical, Mechanical and Electromechanical systems – Electrical analogous – State space representation – State space to Transfer function model, Transfer function to State space model.

TIME DOMAIN AND STABILITY ANALYSIS

[9]

Poles, Zeros System response of First and Second order system- Performance Specifications in the Time domain- Steady state error and Generalized error constants – Stability: BIBO stability, Routh Hurwitz stability criterion and Root Locus: Root-locus technique.

FREQUENCY RESPONSE ANALYSIS

[9]

Nyquist Stability criterion, Frequency Domain Specifications for second order systems, Correlation between time and frequency response - Stability, gain Margin, Phase margin via Bode plot, Polar plot, Nyquist plot.

DESIGN OF COMPENSATORS AND CONTROLLERS

[9]

Lead compensator, lag compensator, lead-lag/lag-lead compensators, Basic modes of feedback control: Proportional, Integral, Derivative- Tuning (Ziegler-Nichols tuning-Step Response).

LIST OF EXPERIMENTS**[30]**

1. System modelling and transfer function extraction.
2. Block diagram and signal flow graph reduction.
3. Step and impulse response analysis for first/second order systems.
4. Root locus plot for typical systems.
5. Frequency response analysis using Bode and Nyquist plots.
6. PID controller tuning and implementation.
7. State-space modelling, controllability and observability assessment.
8. Sensors and Transducers
9. AC and DC Bridges
10. Signal conditioning using ADC and DAC.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	0	30	45	4

TEXT BOOKS:

- [1] Nise N.S., Control System Engineering, John Wiley & Sons, 8th ed., 2024.
- [2] Nagrath I.J. and Gopal M, Control Systems Engineering, New Age International Publishers, New Delhi, 2017.

REFERENCE BOOKS:

- [1] Ogata K, Modern Control Engineering, Prentice Hall of India, New Delhi, 2013.
- [2] Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Prentice Hall Publications, 12th ed., 2010.
- [3] Benjamin C. Kuo and Farid Golnaraghi, Automatic Control Systems, John Wiley & Sons Publications, 2014.

WEB REFERENCES:

- [1] "Control Systems," <https://nptel.ac.in/courses/107106081>
- [2] "Control Engineering," https://onlinecourses.nptel.ac.in/noc22_ee31/preview

25EE207	AC MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the construction principles and working of AC machines, including starting, braking, and operational behaviour.	1,2	1
CO2	Apply suitable speed control techniques and equivalent circuit concepts to determine the performance characteristics of induction motors.	1,2	1
CO3	Analyze the voltage regulation methods, torque characteristics, and operational behaviour of synchronous machines.	1,2	1,2
CO4	Analyze the operating principles and performance of special electrical machines for industrial and renewable energy applications.	1,2	1,2
CO5	Analyze the generalized machine theory and simulate electrical machine models to assess controllability and dynamic behaviour of drive systems.	1,2,5	1,2

INDUCTION MACHINES

[9]

Construction- squirrel cage and slip ring induction motors, principle of operation, starting, braking, speed control, testing, circle diagram, equivalent circuit, characteristics, cogging and crawling, induction generators, IEEE Standards for testing and control. Design of Induction Machines- Main Dimensions.

FRACTIONAL HORSEPOWER MOTORS

[8]

Single-phase Induction Motor- Construction, types, double revolving field theory. Equivalent circuit, performance evaluation, applications in home appliances, IEEE Standards for testing of small motors.

SYNCHRONOUS MACHINES

[10]

Construction: salient-pole and non-salient-pole machines. Synchronous Motors- Starting, Torque equation, Power flow, V and Inverted V curves. Synchronous Condenser, Hunting. Synchronous Generator- EMF Equation, Equivalent circuit and phasor diagram, Armature reaction, Predetermination of Voltage Regulation by EMF, MMF, ZPF methods. Two Reaction Theory, Parallel operation, IEEE Standards for testing and modelling Practices.

SPECIAL ELECTRIC MACHINES

[9]

Motors for Electric Vehicles - Linear Induction motor, hysteresis motor, universal motor, Brushless DC motors. Self-Excited Induction Generator (SEIG), Doubly Fed Induction Generator (DFIG), Switched Reluctance Motor (SRM), Permanent Magnet Synchronous Machine for wind energy application, synchronous motor drive applications, IEEE Standards for grid-connected generators.

GENERALIZED MACHINE THEORY

[9]

Machine as a circuit - model parameters - conventions - models for DC machines, synchronous machines, induction machines and transformers. Simulation experiments- concept of rotating magnetic field (RMF), Linear to rotating machine, simulation of systems comprising machines.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] D P Kothari, and I J Nagrath, Electric Machines, McGraw-Hill Education (India) Private Limited, New Delhi, 5th ed., 2017.
- [2] P S Bimbhra, Electrical Machinery, Rev. ed., Khanna Publications, 2021.

REFERENCE BOOKS:

- [1] Mehdi Rahmani-Andebili, AC Electric Machines: Practice Problems, Methods, and Solutions, Springer, 2022.
- [2] R.K. Rajput, Electrical Machines, 6th ed., published by Laxmi Publications, 2018.
- [3] A E Fitzgerald, Charles Kingsley, Stephen D Umans, Electric Machinery, 7th ed., Tata McGraw-Hill, New Delhi, 2013.
- [4] S.K. Bhattacharya, Electrical Machines, Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th ed., 2019.

WEB REFERENCES:

- [1] "Electrical Machines II," https://onlinecourses.nptel.ac.in/noc22_ee06/preview
- [2] "Modelling and Analysis of Electric Machines," <https://nptel.ac.in/courses/108106023>
- [3] "Electrical Machines II," <https://nptel.ac.in/courses/108106072>

25EE208	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the structure of electric power systems and compare EHVAC, HVDC transmission configurations and the role of FACTS controllers.	1,2	1
CO2	Apply the concepts of resistance, inductance, and capacitance to compute the electrical parameters of single and three-phase transmission lines.	1,2	1
CO3	Analyze the performance of short, medium, and long transmission lines and evaluate efficiency, regulation, and corona effects.	1,2,3	1,2
CO4	Analyze the voltage distribution in string insulators and assess the insulation resistance, capacitance, and grading of underground cables.	1,2,3	1,2
CO5	Evaluate the impact of symmetrical and unsymmetrical faults in power distribution systems using sequence networks.	1,2,3	1,2

INTRODUCTION TO POWER SYSTEM

[6]

Structure of electric power system – overhead lines and underground cables – Comparison of conductor materials required for various overhead lines - voltage tolerances – interconnection – Need and applications of EHVAC and HVDC transmission - HVDC link – Interference with neighbouring communication circuits – Introduction to FACTS.

TRANSMISSION LINE PARAMETERS

[6]

Electrical constants: Resistance, Inductance, and capacitance of single and three phase lines – Solid, stranded and bundled conductors – symmetrical, unsymmetrical spacing and transposition – Self GMD – Skin and Proximity effects - Effects of earth on the capacitance of the transmission line.

PERFORMANCE ANALYSIS OF TRANSMISSION LINES

[6]

Classification of lines - Short, Medium and long transmission line analysis - Evaluation of ABCD constants – Equivalent circuit – Phasor Diagram - attenuation constant, phase constant, surge impedance and surge impedance loading - Nominal π and T model analysis for transmission efficiency and regulations – Tuned Power Lines – Ferranti effect - corona discharge - factors affecting corona.

INSULATORS AND CABLES

[6]

Types of insulators - voltage distribution in string insulator – string efficiency – methods of improving string efficiency – testing of insulators. Underground cables: types of cables – Insulation resistance – Potential gradient – sheath effects - capacitance of single-core and 3-core belted cable – grading of cables – Power factor and heating of cables – DC Cables

SAG ESTIMATION AND DISTRIBUTION SYSTEM

[6]

Fundamentals of symmetrical fault analysis - Computations of short circuit capacity – symmetrical fault analysis - short circuit analysis of standard IEEE test system - Symmetrical components, Sequence

impedance, Sequence networks of power system components - Solution of Single-line to ground fault, Line-line fault and Double line to ground fault

Total Notional Hours:90

L	T	P	TW+SL	C
30	15	0	45	3

TEXT BOOKS:

- [1] C L Wadhwa, Electrical Power Systems, New Age International (P) Ltd, 8th ed., 2022.
- [2] Arun Inglooe, Power Transmission and Distribution, Pearson Education, 1st ed., 2018.

REFERENCE BOOKS:

- [1] D. P. Kothari, I. J. Nagrath, Power System Engineering, Tata McGraw -Hill Publishing Company Limited, New Delhi, 3rd ed., 2019.
- [2] John J. Grainger and W.D. Stevenson Jr., Power System Analysis, 1st ed., McGraw Hill International Book Company, July 2017.
- [3] Mehta V K, Rohit Mehta, Principles of Power System, S. Chand & Co., New Delhi, 2015.

WEB REFERENCES:

- [1] "Power System Engineering," https://onlinecourses.nptel.ac.in/noc25_ee67/preview
- [2] "Power System Engineering," https://onlinecourses.nptel.ac.in/noc24_ee61/preview

25EC209	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental concepts, types, and properties of continuous-time and discrete-time signals and systems.	1,2	
CO2	Analyze signals and systems using time-domain and frequency-domain methods such as convolution, Fourier, Laplace, and Z-transform	1,2,3	
CO3	Apply sampling, transformation, and system analysis concepts to represent and process real-world signals	1,2,3	
CO4	Relate the principles of signals and systems to modern engineering applications such as communication, biomedical, and embedded sensor systems.	1,2,3,4,5	2
CO5	Use MATLAB or equivalent software tools to generate, simulate, and visualize various signals and system responses.	5	2

CLASSIFICATION OF SIGNALS AND SYSTEMS

[15]

Basic (Continuous / Discrete) signals – unit step, unit impulse, sinusoidal and complex exponential signals – Classification of signals, Continuous – Discrete time, Even / Odd signals, Periodic/ Non-periodic signals, Deterministic / Random signals, Energy / Power signals, Basic operations on signals, etc. Systems (Continuous / Discrete): Representation, Classification – Linear / Nonlinear, Causal / Noncausal, Time invariant / Time variant, with/without memory, BIBO stability, Feedback system, LTI system – Response of LTI system, Convolution, Properties (Continuous / Discrete), LTI systems. Simulation exercises for signal generation.

ANALYSIS OF CONTINUOUS TIME (CT) AND DISCRETE TIME(DT) SIGNALS

[15]

Fourier and Laplace Transforms in CT Signal Analysis – Properties, Region of Convergence (ROC) in LT, Spectrum of CT signals (Amplitude & phase spectra). Sampling theorem – Reconstruction of a signal from its samples – Aliasing, Fourier Transform of DT signals (DTFT) – Properties of DTFT – Z Transform & Properties, Region of Convergence (ROC) in ZT. Understanding the Amplitude & phase spectra using spectrum analyzer.

LINEAR TIME INVARIANT (LTI) CONTINUOUS TIME (CT) & DISCRETE TIME (DT) SYSTEMS

[15]

Differential Equation – Impulse response – convolution integrals- - Fourier and Laplace transforms in Analysis of CT systems. Difference Equations – Impulse response – Convolution sum- Discrete Fourier and Z Transform in Analysis of DT systems.

Case studies: Sensor data visualization, ECG/speech signal analysis, Introduction to signal processing on Raspberry Pi or Arduino with sensors.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXTBOOKS:

- [1] Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems, 2nd ed., Prentice Hall India, 2015.
- [2] John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, 4th ed., PHI, 2014.

REFERENCE BOOKS:

- [1] B.P. Lathi, Signal Processing and Linear Systems, 3rd ed., Oxford University Press, Incorporated, 2017.
- [2] Hwei Hsu, Signals and Systems, Schaum's Outlines, 4th ed., Tata McGraw-Hill Co Ltd, 2019.
- [3] M J Roberts, Signals and Systems, Analysis Using Transform Methods and MATLAB, 3rd ed. , Tata McGraw Hill (India), 2019.

WEB REFERENCES:

- [1] "Principles of Signals and Systems," https://onlinecourses.nptel.ac.in/noc20_ee15/preview

25EE273	AC MACHINES LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Conduct load test and no-load/blocked rotor tests on single-phase and three-phase induction motors to record and analyze performance characteristics.	1,2,4,9	1,2,3
CO2	Apply equivalent circuit parameters obtained from no-load and blocked rotor tests to plot and interpret the performance characteristics of induction motors.	1,2,4,5,9	1,2,3
CO3	Perform load test and predetermine voltage regulation of three-phase alternators using EMF, MMF, and ZPF methods.	1,2,4,5,9	1,2,3
CO4	Demonstrate synchronization of a three-phase alternator with an infinite bus bar and analyze the operating conditions under various excitation levels.	1,2,4,5,9	1,2,3
CO5	Interpret V-curves and inverted V-curves of synchronous motors and evaluate speed control behavior of three-phase induction motors.	1,2,4,9	1,2,3

LIST OF EXPERIMENTS

1. Load test on three-phase induction motor
2. No-load and blocked rotor test on three-phase induction motor
3. Load test on single-phase induction motor
4. No-load and blocked rotor test on single phase-phase induction motor
5. Load test on three-phase alternator
6. Regulation of three-phase alternator by E.M.F and M.M.F methods
7. Regulation of three-phase alternator by ZPF methods
8. Synchronization of three-phase alternator with infinite bus bar
9. V and inverted V-curves of synchronous motor
10. Speed Control on three-phase induction motor

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	30	0	1

TEXTBOOKS:

- [1] Kothari D. P, and Nagrath I. J., Electric Machines, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th ed., 2004.
- [2] P.S. Bhimbra, Electrical Machinery, Khanna Publishers, 7th ed., 2017.

REFERENCE BOOKS:

- [1] Gupta J B, Theory and Performance of Electrical Machines, S K Kataria & Sons, 14th ed., 2015.
- [2] Deshpande M V, Electrical Machines, PHI Learning Pvt. Ltd., New Delhi, 2011.
- [3] Fitzgerald A.E., Charles Kingsley Jr, Stephen.D.Umans, Electric Machinery, McGraw Hill Education, 6th ed., 2003.
- [4] PC Sen, Principles of Electric Machines and Power Electronics, Wiley Publishers, 3rd ed., 2013.

WEB REFERENCES

- [1] "Electrical Machines (Simulation) – Virtual Labs," <https://ems-iitr.vlabs.ac.in/>

25EE274	ANALOG AND DIGITAL LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Design and verify linear applications of operational amplifiers.	1,2,5	1,2,3
CO2	Design and realize op-amp based first-order active filters and oscillator circuits.	1,2,4,5	1,2,3
CO3	Analyze and implement non-linear op-amp applications.	1,2,3,5	1,2
CO4	Design and implement digital arithmetic circuits for comparison operations.	1,2,3,5	1,2,3
CO5	Design and implement sequential circuits for digital data routing applications.	1,2,3,5	1,2,3

LIST OF EXPERIMENTS:

- Design and verify the operation of linear application of op – amp as an:
 - Inverting amplifier, Non-inverting amplifier & Voltage follower
 - Summing Amplifier, Differential amplifier & Instrumentation amplifier
 - Integrator and Differentiator
- Design and realize an op – amp based first order
 - Low pass b) High pass and c) Band pass filters
- Design and verify the operation of linear application of op – amp as an:
 - Clippers and Clampers.
 - Sample and Hold Circuit, Voltage Comparator Circuit
 - Zero Crossing Detector
- OPAMP based RC –phase shift oscillator
- Square wave oscillator/ tri-angular wave oscillator
- IC 555 timer IC based Astable multi-vibrator.
- Design and implementation of Adders and Subtractors.
- Design and implementation of code converters and 2Bit Magnitude Comparator.
- Design and implementation of Multiplexer/ De-multiplexer and Encoder/ Decoder
- Design and implementation of Shift register and Counter.

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS:

- [1] Adel Sedra, Kenneth C Smith, Microelectronic Circuits, 7th ed., Oxford University Press, New Delhi, 2017.
- [2] Roy Choudhury Shail Jain, Linear Integrated Circuits, 5th ed., New Academic Science, London, UK, 2018.
- [3] M. Morris Mano, Digital Logic and Computer Design, Pearson India Education Services Pvt. Ltd., New Delhi, 2016.

REFERENCES BOOKS:

- [1] Gayakwad A R, OP-Amps and Linear Integrated circuits, 4th ed., Prentice Hall India, New Delhi, 2015.
- [2] Coughlin F R, and Driscoll F F, Operational Amplifiers and Linear Integrated Circuits, 6th ed., Prentice Hall of India, New Delhi, 2010.
- [3] Thomas L. Floyd, Digital Fundamentals, 11th ed., Pearson Education Limited, 2014.
- [4] Michael Jacob J, Applications and Design with Analog Integrated Circuits, 2nd ed., Prentice Hall of India, New Delhi, 2010.
- [5] K. Lal Kishore, Operational Amplifiers and Linear Integrated Circuit, 1st ed., Pearson, New Delhi, 2013.
- [6] Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th ed., Tata McGraw-Hill, New Delhi, 2016

WEB REFERENCES

- [1] "Electrical Machines (Simulation) – Virtual Labs," <https://ems-iitr.vlabs.ac.in/>

25EE209	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the fundamental concepts and operation of power electronic components and systems.	1,2,4	1,2
CO2	Analyze the behaviour and performance of power electronic converters under different operating conditions.	1,2,4	1,2
CO3	Apply suitable DC–DC converter topologies and analytical techniques to evaluate circuit performance in power electronic applications.	1,2,4	1,2
CO4	Examine control and modulation techniques used in power electronic converters for effective output regulation.	1,2,4	1,2
CO5	Evaluate power converter topologies by comparing their performance and suitability for specific applications.	1,2,4	1,2

POWER SEMICONDUCTOR SWITCHES

[9]

Difference between uncontrolled and controlled switches. Structure, Switching Characteristics, Triggering, Ratings, Protection and application of SCR, IGBT, and Power MOSFET. Study of Data Sheets for device selection and thermal design. Intelligent Power Modules (IPM); Wide-band gap (SiC and GaN) power devices.

CONVERTERS

[9]

Principle of phase-controlled converter for industrial rectification and motor drive applications, Semi-controlled and fully controlled converters in single-phase and three-phase configurations. Performance parameters and input-output waveforms for R, R-L loads. Inverter mode operation for regenerative and braking applications, Effect of source inductance, Input side harmonics and power factor - introduction to PFC- Input and output drive chokes.

CHOPPERS

[9]

Types of DC-DC converters (Choppers) for renewable energy, battery management, and power supply applications - Working of Buck Converter, Boost Converter, Buck-Boost DC-DC converters with R and R-L Load, Hard switched and soft switched converters, ZVS and ZCS Converter, LLC Converter, Phase Shifted full bridge converter, Bidirectional DC to DC converter, Fly back SMPS.

INVERTERS

[11]

Single Phase Square wave Inverters (VSI)- Half Bridge and Full Bridge. Three Phase Inverters – Square Wave Operation (180° and 120° mode), Voltage control of single-phase inverters - single pulse width, multiple pulse width, sinusoidal pulse width modulation, space-vector pulse-width modulation. Output filters for PWM inverters - LC filters, sine wave filters- harmonic reduction and EMI mitigation. Multilevel Inverters - Three-level neutral point clamped, Flying Capacitor, Cascaded H-bridge.

AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS

[7]

Single-phase half- and full-wave AC voltage controller with R and RL loads. Principle of cycloconverter operation for drive applications - single-phase to single-phase step-up and step-down cycloconverter, three-phase to single-phase cycloconverter.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Muhammad H. Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, 4th ed., 2017
- [2] P. S . Bhimbra, Power Electronics, Khanna Publishing, 7th Rev. ed., 2022

REFERENCE BOOKS:

- [1] Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Springer, 3rd ed., 2020.
- [2] Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, 3rd ed., 2022
- [3] Victor Becker, Power Electronics, Brilliance Publications Ltd., 1st ed., 2024

WEB REFERENCES:

- [1] "Introduction to Power Electronics," <https://www.coursera.org/learn/power-electronics>
- [2] "Power Electronics," <https://nptel.ac.in/courses/108105066>
- [3] "Basics of Power Electronics," <https://www.udemy.com/course/basics-of-power-electronics/?couponCode=PMNVD2025>
- [4] "Power Electronics (MIT 6.334)," <https://ocw.mit.edu/courses/6-334-power-electronics-spring-2007/>

25EE210	POWER SYSTEM ANALYSIS	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the concepts of power system modelling and network formation	1,2,4	1
CO2	Apply various power flow algorithms to perform symmetrical and unsymmetrical fault analysis in transmission line system.	1,2,3,4,5	1,2,3
CO3	Analyze the different symmetrical faults in power system network to prevent the equipment by using circuit breaker.	1,2,4	1,2
CO4	Analyze the different unsymmetrical faults in given power system network to prevent the equipment and human life.	1,2,4	1,2
CO5	Assess the stability of power system when subjected to a fault	1,2,4	1,2

MODELLING AND NETWORK FORMATION

[9]

Modelling of power system components – Per Unit system – Reactance diagram – Impedance Diagram – Z-bus formation using bus building algorithm – Y bus formation using direct inspection method – pi-equivalent circuit of transformer with off-nominal tap ratio – Primitive network and its representation.

POWER FLOW STUDY

[9]

Bus classification – Formulation of power flow in polar coordinates - Iterative power flow solution using Gauss-Seidel Method, Newton-Raphson Method and Fast decoupled load flow method – Comparison of GS, NR and FD methods. IEEE standards for power flow analysis.

FAULT ANALYSIS (SYMMETRICAL)

[9]

Types of faults - Assumptions in short circuit analysis - Computations of short circuit capacity – short circuit analysis of standard IEEE test system - Post fault voltages and currents for balanced fault by using Thevenin's theorem

FAULT ANALYSIS (UNSYMMETRICAL)

[9]

Symmetrical components, Sequence impedance, Sequence networks of power system components - Solution of Single-line to ground fault, Line-line fault and Double line to ground fault.

POWER SYSTEM STABILITY

[9]

Classification of power system stability – Rotor angle stability – transient stability - Single Machine Infinite Bus (SMIB) system - Development of swing equation - Equal area criterion - determination of critical clearing angle and time - Multi Machine stability analysis - Solving swing Equation by Modified Euler method and Runge-Kutta method.

Total Notional Hours:90

L	T	P	TW+SL	C
30	15	0	45	3

TEXT BOOKS:

- [1] D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi; 5th ed., 2022
- [2] Olle. I. Elgerd, "Electric Energy Systems Theory - An Introduction, Tata McGraw-Hill Publishing Company Ltd, New Delhi; 2nd ed., 2017.

REFERENCE BOOKS:

- [1] C. L. Wadhwa, Electrical Power Systems, New Age International (P) Ltd, 8th ed., 2022.
- [2] D. P. Kothari, I. J. Nagrath, Power System Engineering, Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd ed., 2019.
- [3] John J. Grainger and W.D. Stevenson Jr., Power System Analysis, 1st ed., McGraw-Hill International Book Company, July 2017.
- [4] Hadi Saadat, Power System Analysis, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 3rd ed., 2011.

WEB REFERENCES

- [1] "Power System Engineering," https://onlinecourses-archive.nptel.ac.in/noc19_ee02/preview
- [2] "Power System Analysis," https://onlinecourses.nptel.ac.in/noc22_ee120/preview

25EE253	EMBEDDED SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the architecture and design methodology of embedded systems for real-world control applications.	1,2,4	1,2
CO2	Analyze communication protocols used in embedded networking applications.	1,2,4	1,2
CO3	Analyze RTOS concepts and task scheduling mechanisms for multi-threaded embedded system design.	1,2,4	1,2
CO4	Analyze ARM architecture and develop efficient assembly and embedded C programs for real-world applications.	1,2,4	1,2
CO5	Design and implement embedded applications on ARM LPC2148 platform to solve real-world engineering problems.	1,2,3,4,5	1,2,3

INTRODUCTION

[6]

Embedded systems – characteristics, applications, design flow – structural units in embedded processor – processor and memory selection – DMA, memory management, Real Time Clock (RTC). In-circuit emulator, target hardware debugging – embedded development tools overview – case study on embedded control system.

EMBEDDED NETWORKING

[6]

Communication basics- RS232, RS485, UART communication standards. Protocols- CAN, SPI, USB and I²C protocols. Introduction to LIN, FLEXRAY, MOST, Modbus.

RTOS BASED EMBEDDED SYSTEM DESIGN

[6]

RTOS concepts – kernel, tasks, processes, threads – interrupt routines and task scheduling. Preemptive and non-preemptive scheduling – multiprocessing, multitasking – inter-task communication. Shared memory, message queues, semaphores, mutex – process synchronization – Free RTOS case study.

THE ARM RISC ARCHITECTURE AND ARM INSTRUCTIONS

[6]

Introduction to ARM processors – Evolution. Advanced ARM Architecture – Core Architecture, Programmers Model, Exception Model, Memory Model, Instruction Set, Addressing modes. Assembly Language Programming.

ARM LPC2148 PROGRAMMING

[6]

Writing and optimizing the embedded C Code. Peripherals – Ports, Timers, PWM, ADC, UART, SPI, I²C. Case studies with real-world applications.

Programming Tool: KEIL IDE.

LIST OF EXPERIMENTS

[30]

1. Program using Arithmetic operations
2. Program using logic operations
3. LED programming

4. Analog to digital conversion
5. PWM control
6. Timer programming
7. Interrupt programming
8. Interfacing with LCD
9. Interfacing with seven-segment display
10. Study on communication protocols

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Raj Kamal, Embedded Systems – Architecture, Programming and Design, McGraw-Hill Education (India), 3rd ed., 2022
- [2] Trevor Martin, The Designer's Guide to the Cortex-M Processor Family, Elsevier Science, 3rd ed., 2022

REFERENCE BOOKS:

- [1] Morgan Kaufmann, ARM System Programming: Concepts and Techniques, Elsevier, 2nd ed., 2021
- [2] Colin Walls, Embedded Software: The Works, Newnes, 2nd ed., 2012
- [3] Andrew Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide - Designing and Optimizing System Software, Elsevier Science, 2004
- [4] Joseph Yiu, The Definitive Guide to ARM Cortex M3 and Cortex M4 Processors, 3rd ed., Elsevier India P Ltd, New Delhi, 2019.
- [5] K. V. Shibu, Introduction to Embedded Systems, 2nd ed., McGraw-Hill Education (I) P. Ltd., Chennai, 2020.

WEB REFERENCES:

- [1] "Real Time Operating System," https://onlinecourses.nptel.ac.in/noc20_cs16/preview
- [2] "Embedded Systems," <https://nptel.ac.in/courses/108102045>
- [3] "Embedded Systems," <https://nptel.ac.in/courses/108105057>

25EE211	INDUSTRIAL IOT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the concepts of Industry 4.0, its drivers, enablers, and the evolution of industrial revolutions in real-world contexts.	1,2	1,2
CO2	Implement IoT, IIoT, and Internet of Services fundamentals in industrial application contexts.	1,2,3	1,2
CO3	Analyze cyber-physical systems (CPS) and cyber-physical production systems (CPPS), and their applications and design elements.	1,2,4	1,2
CO4	Examine the role of cloud manufacturing, virtualization, and connected factory platforms, including issues of big data and security.	1,2	1,2
CO5	Evaluate business challenges, opportunities, and strategies for workforce adaptation in the era of Industry 4.0.	1,2,4	1,2

INTRODUCTION TO INDUSTRY 4.0

[9]

Definition of Industry 4.0, The Various Industrial Revolutions, Digitalization, and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

INTERNET OF THINGS (IOT)

[6]

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems, IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture, Building Management Systems.

CYBER-PHYSICAL SYSTEMS (CPS) AND CYBER-PHYSICAL PRODUCTION SYSTEMS (CPPS)

[12]

Cyber-physical systems (Definitions, demarcation to embedded systems, ubiquitous computing, etc.), Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory, and real-time requirements, Self-organization principles ("Self-X", autonomy, negotiations), Communication in cyber-physical systems, Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development), Applications for cyber-physical systems.

CLOUD MANUFACTURING AND THE CONNECTED FACTORY

[9]

Virtualization, Cloud Platforms, Big data in production, Cloud-based ERP and MES solutions, Connected factory applications, IT security for cloud applications.

BUSINESS ISSUES IN INDUSTRY 4.0

[9]

Opportunities and Challenges, Future of Work and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, Apress, 2019.
- [2] Industrial Internet of Things: Cyber Manufacturing Systems by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer, 2017.

REFERENCE BOOKS:

- [1] Internet of Things by Jeeva Jose, Khanna Publishing House, 2018.
- [2] Embedded System for Internet of Things by Jeeva Jose, Khanna Publishing House, 2025.
- [3] Introduction to Security of Cyber-Physical Systems by Jeeva Jose, Khanna Publishing House, 2023.
- [4] Handbook of Industry 4.0 and SMART Systems by Diego Galar, Pascual Pasquale Daponte, Uday Kumar, CRC Press, 2019.

WEB REFERENCES:

- [1] "Introduction to Industry 4.0 and Industrial Internet of Things,"
https://onlinecourses.nptel.ac.in/noc20_cs69/preview

25EE275	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Demonstrate and compare the operating principles and firing characteristics of SCR-based triggering circuits.	1,2,3,4	1,2
CO2	Experimentally evaluate the V–I characteristics of power semiconductor devices under different operating conditions.	1,2,	1,2
CO3	Analyze and verify the input–output waveforms performance parameters of single-phase power electronic converters, inverters and AC controllers.	1,2,3,4	1,2
CO4	Evaluate the open-loop and closed-loop performance of DC–DC converters.	1,2,3	1,2
CO5	Analyze gate pulse logic, modes of operation, and simulate single-phase and three-phase power electronic converters and inverters.	1,2,3,5	1,2

LIST OF EXPERIMENTS

- Study and observe the performance of the following SCR firing circuits:
 - Resistance firing circuit
 - Resistance –Capacitance firing circuit
 - UJT firing circuit.
- Study and observe the VI characteristics of TRIAC and SCR.
- Study and observe the VI characteristics of MOSFET and IGBT.
- Evaluate and verify the input and output waveforms of the single-phase AC-DC controlled converter
- Evaluate the open-loop and closed-loop performance of DC-DC buck converter.
- Evaluate the open-loop and closed-loop performance of DC-DC boost converter.
- Evaluate and verify the input and output waveforms of the single-phase PWM inverter
- Evaluate and verify the input and output waveforms of the single-phase AC-AC voltage controller.
- Analyse gate pulse logic, modes of operation and simulate the three-phase inverter.
- Analyze gate pulse logic, modes of operation and simulate a cycloconverter.

Total Notional Hours:30

L	T	P	TW+SL	C
0	0	30	0	1

TEXT BOOKS:

- [1] Ned Mohan, Siddharth Raju, Power Electronics, a First Course: Simulations and Laboratory Implementations , Wiley, 2nd ed., 2023
- [2] P. S . Bhimbra, Power Electronics, Khanna Publishing, 7th Rev. ed., 2022

REFERENCE BOOKS:

- [1] O.P. Arora, Power Electronics Laboratory: Theory, Practice & Organisation, Narosa Publications, 1st ed., 2020.
- [2] Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, 3rd ed., 2022

WEB REFERENCES

- [1] "Power Electronics – Virtual Labs," <https://pe-iitr.vlabs.ac.in/>

25EE254	ELECTRIC DRIVES AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze torque-speed characteristics, operating modes, load dynamics, and stability aspects of electric drive systems.	1,2	1,2
CO2	Apply various speed control methods and converter configurations for DC and AC motor drive systems.	1,2	1
CO3	Evaluate and compare different drive topologies and control strategies for specific drive applications.	2,3	1,2
CO4	Analyze the operation of special motors and assess energy conservation techniques in electric drives.	1,2,6	1,2
CO5	Apply simulation tools and conduct experiments to verify the performance of electric drive systems.	1,2,5	1,2

INTRODUCTION

[6]

Elements of Drives, Choice of Drives and Advantages. Fundamental torque equation, speed-torque convention, Multiquadrant operation. Types of load torques and steady-state stability. Thermal Model, Classification of Motor Duty and Determination of Motor rating.

DC MOTOR DRIVES

[8]

DC motor drives: Basic characteristics, Operating modes, Single phase and three phase-controlled rectifier fed DC drives, Dual converter drives, Chopper drives – Motoring and Braking, Closed loop control schemes.

AC MOTOR DRIVES

[8]

Review of induction motor speed and torque characteristics, Variable Stator voltage control, V/f control, VSI fed induction motor, CSI fed induction motor, Closed loop control of induction motor drives. Synchronous Motor Drives-Review of speed and torque characteristics Separate Control Mode; Self-Control Mode.

SPECIAL MOTOR DRIVES

[8]

Stepper Motor Basics- Drive Circuits, Switched and Synchronous Reluctance Motor Basics- Converter Circuits for Speed Control. Solar Powered Drives, Energy Conservation in Electric Drives. Scope of Artificial Intelligence in Electric Drives.

LIST OF EXPERIMENTS

[30]

1. Three-phase full converter-fed separately excited DC motor speed control.
2. Open and closed loop speed control of BLDC Drives
3. Speed Control Synchronous Reluctance motor drives.
4. Simulation of single-phase semi /full converter-fed DC motor speed control.
5. Simulation of three-phase semi/full converter-fed DC motor speed control.
6. Simulation of chopper-fed DC motor speed control.
7. Simulation of V/f controlled Induction Motor Drive.
8. Simulation of Solar PV-based DC drive.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Dubey. G.K., Fundamentals of Electric Drives, Narosa Publishers, 5th ed., 2020.

REFERENCE BOOKS:

- [1] Pillai. S.K., A first course in Electrical Drives, Wiley Eastern, 4th ed., 2022.
[2] J. S. Katre, Electric Drives, Techknowledge Publications, 1st ed.,2021
[3] Ned Mohan, Siddharth Raju, Analysis and Control of Electric Drives: Simulations and Laboratory Implementation, Wiley,1st ed., 2020
[4] Austin Hughes, Bill Drury, Electric Motors and Drives: Fundamentals, Types and Applications, Newnes, 5th ed., 2020
[5] R. Krishnan, 'Electric Motor Drives, Modelling, Analysis and Control', Prentice Hall, NJ, 3rd ed., 2016

WEB REFERENCES

- [1] "Fundamentals Of Electric Drives," https://onlinecourses.nptel.ac.in/noc22_ee94/preview
[2] "Building Robots: Electrical Drives," <https://www.edx.org/learn/engineering/delft-university-of-technology-building-robots-electrical-drives>
[3] "Introduction to Inverters and Electric Drive," <https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-inverters-and-electric-drive>
[4] "Fundamentals of Electric Drives," <https://www.online.vtu.ac.in/course-details/Fundamentals-of-Electric-Drive>

25EE255	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply load forecasting techniques to analyze the economic operation of power systems.	1,2	1
CO2	Apply load frequency control to model single-area and two-area power systems.	1,2	1
CO3	Analyze automatic voltage regulation and excitation control mechanisms for power system stability.	1,2,3	1,2
CO4	Analyze unit commitment and economic dispatch problems using optimization methods.	1,2,4	1,2
CO5	Evaluate SCADA and Energy Management Systems for power system security and control.	1,2,3,5,11	1,2

INTRODUCTION

[6]

System load variation, Reserve requirements, Load forecasting techniques, Economics of power generation, Electrical tariff and its types, Basic control in power system

AUTOMATIC LOAD FREQUENCY CONTROL

[6]

Fundamentals of speed governing mechanism and modelling, Speed-load characteristics, Load sharing between two synchronous machines in parallel, concept of control area, LFC control of a single area system and two area system, Static and dynamic analysis of uncontrolled and controlled cases, state variable model.

AUTOMATIC VOLTAGE REGULATOR

[6]

Automatic Voltage Regulator (AVR) and Excitation control, Modelling, Static and dynamic analysis of uncontrolled and controlled cases, Power system stabilizer.

UNIT COMMITMENT AND ECONOMIC DISPATCH

[6]

Statement of Unit Commitment (UC) problem, constraints in UC, solution methods: Priority list methods, forward dynamic programming approach. Economic dispatch, solution by direct method and λ iteration method. Base point and participation factors, Economic dispatch controller added to LFC control.

COMPUTER CONTROL OF POWER SYSTEM

[6]

Energy control Centre, System hardware configuration, SCADA and EMS functions, state estimation, security analysis and control. Various operating states.

LIST OF EXPERIMENTS

[30]

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.

3. Load Flow Analysis: Solution of load flow and related problems using Gauss-Seidel and Newton Raphson Method.
4. Fault Analysis-Symmetrical and Unsymmetrical faults.
5. Solution to Unit commitment problem. 6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
6. Transient Stability Analysis of Multi machine Power Systems
7. Study of Electromagnetic Transients in Power Systems
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. Economic Dispatch in Power Systems

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Olle. I. Elgerd, “Electric Energy Systems Theory – An Introduction, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2nd ed., 2003
- [2] Allen J. Wood and Bruce F. Wollenberg, Power Generation, Operation and Control, John Wiley & Sons, Inc.,2003.

REFERENCE BOOKS:

- [1] D.P. Kothari and I.J. Nagrath, Modern Power System Analysis, 3rd ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
- [2] L.L. Grigsby, “The Electric Power Engineering Handbook, CRC Press & IEEE Press, 2001.
- [3] Kundur, Power System Stability & Control, McGraw Hill Publications, USA,2007

WEB REFERENCES:

- [1] "Power Systems Operation and Control,"
<https://archive.nptel.ac.in/courses/108/104/108104052/#>

25EE212	INTELLIGENT POWER GRID	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply smart grid concepts to compare conventional and modern power grid architecture.	1,2,3	1
CO2	Apply AMI, PMU and SCADA technologies for monitoring and control of smart grids.	1,2,3	1
CO3	Analyze IoT communication protocols for intelligent decision-making in smart grids.	1,2,4	1,2
CO4	Analyze cybersecurity risks in distributed generation and advanced metering infrastructure.	1,2,4	1,2
CO5	Evaluate energy management strategies and smart grid pilot projects for power quality improvement.	1,2,3,4	1,2

INTRODUCTION TO SMART GRID

[6]

Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – Smart grid market drivers – Smart grid features and benefits, Smart Grid road map for India – Smart Grid Architecture.

SMART GRID TECHNOLOGIES

[6]

Overview - Metering Technologies: SCADA, Wide Area Measurement Systems (WAMS), Phasor Measurement Unit (PMU), Advanced metering infrastructure (AMI) - Energy Management System, Distribution system: Fault location, isolation and service restoration (FLISR), Demand Side management

IoT in SMART GRID

[6]

Communication Technologies: LAN, HAN, WAN, interoperability and Scalability. Power Line Communication, IoT Architecture, IoT Messaging Protocols - MQTT, CoAP. IoT Hardware and Software; Data Analytics in the Smart Grid, Application of artificial intelligence and machine learning in Smart Grid, Standards for Information Exchange - Data Security methods; Application of cloud computing, edge computing, multi-agent technology in Smart Grid, Embedded web servers, Protocols for internet connectivity and interoperability- IPV6 and IPV4 protocols.

SMART GRID APPLICATIONS AND CYBER SECURITY

[6]

Overview and concept of Renewable Integration – Introduction to distributed generation - Role of Protective Relaying in Smart Grid – House Area Network – Plug – in Hybrid electric Vehicles, V2G and G2V - Cyber Security: Security issues in DG, Distribution Automation, AMI, Approach to assessment of smart grid cyber security risks – Methodologies. Cyber Security requirements – Smart Grid Information Model.

ENERGY MANAGEMENT AND SMART GRID PROJECTS IN INDIA

[6]

Power quality issues: concept of active filtering – concept of reactive power compensation – Energy management system configuration. Pilot projects : Functionalities, benefits, key facts and project status – Case study of Smart grid demonstration project in Assam, Haryana, Puducherry, Mysore.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	3

TEXT BOOKS:

- [1] Muhammad Kamran, Fundamentals of Smart Grid Systems, Academic Press, Elsevier, 1st ed., 2023.
- [2] James Momoh, Smart Grid - Fundamentals of Design and Analysis, IEEE Press, John Wiley & Sons, INC., New Jersey, 2012

REFERENCE BOOKS:

- [1] Ersan Kabalci, Yasin Kabalci, From Smart Grid to Internet of Energy, 1st ed., Elsevier Science, 2019.
- [2] Shady S. Refaat, Omar Ellabban, Sertac Bayhan, Haitham Abu-Rub, Frede Blaabjerg and Miroslav M. Begovic, Smart Grid and Enabling Technologies, Wiley, 2021.
- [3] Bernd M. Buchholz, Zbigniew A. Styczynski Smart Grids Fundamentals and Technologies in Electric Power Systems of the Future, Springer Heidelberg, 2020
- [4] Chun Sing Lai, Loi Lei Lai, Qi Hong Lai, Smart Grids and Big Data Analytics for Smart Cities, Springer International Publishing, 2021

WEB REFERENCES:

- [1] "Introduction to Smart Grid," https://onlinecourses.nptel.ac.in/noc23_ee60/preview
- [2] "Big Data Analytics For Smart Grid," https://onlinecourses.swayam2.ac.in/arp19_ap60/preview
- [3] "Electric Utilities Fundamentals and Future," <https://www.coursera.org/lecture/electric-utilities/5-2-smart-grid-YUPgW>

25EE213	ELECTRIC VEHICLE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the principles of electric and hybrid electric vehicle architecture to compare their performance and environmental impact.	1,2,3	1
CO2	Apply vehicle dynamics and tractive force equations to analyze propulsion, braking and regenerative braking in EVs.	1,2,3	1
CO3	Analyze the selection and control of motors and converters for EV charging and powertrain applications.	1,2,3	1,2
CO4	Analyze battery characteristics and thermal management systems for EV energy storage.	1,2,3	1,2
CO5	Evaluate emerging trends in vehicle electrification and AI-based energy management strategies.	1,2,3	1,2

INTRODUCTION TO EV

[6]

History of EV – Major Components in EV and working - Hybrid Electric Vehicles – Wiring harness Components - Environmental impacts on EVs and HEVs – Social impacts on EVs and HEVs – Economic impacts on EVs and HEVs - Operating fuel economy - Recent EVs and HEVs – efficiency comparison – pollution comparison – Government policies and Regulatory Body – Various Testing - Safety System.

VEHICLE MECHANICS AND ELECTRICAL BRAKING

[6]

Laws Governing Vehicle Movement – Forces acting on Vehicle – Rolling Resistance force, Aerodynamic force, Hill climbing force, and acceleration force - Total Tractive Effort – Roadway Fundamentals – Propulsion Power – Force vs Velocity characteristics – Velocity vs Acceleration. Electrical Braking – Regenerative Braking, Dynamic Braking and Plugging.

MOTORS AND CONVERTERS FOR CHARGING

[6]

Induction Motor and Control for EVs – PMSM and Control for EVs - BLDC Motor and Control for EVs – Switched Reluctance Motor and Control for EVs. Methods of Charging - Selection and Sizing of Charging Station - AC-DC converter with PFC for Charging - DC-DC converter with controls for Charging – RES integration for Charging – Design of Z-converter for battery charging - Wireless Charging.

ENERGY STORAGE SYSTEM AND MANAGEMENT SYSTEM FOR EVs

[6]

Battery Basics – Classifications - Ragone Plots - Battery Modelling – Battery Capacity - Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction and Working – Ultracapacitor working – ECU – Battery Management System – Thermal Management System - Introduction to Energy Management Strategies with Optimization Techniques.

EMERGING TRENDS AND ADVANCEMENT IN ELECTRIFIED VEHICLES

[6]

Battery swapping - V2G - G2V- V2V - V2H - integration of EVs in smart grid – Role of AI in Vehicular Electrification – Policy Standards and Guidelines for EV - Policy Standards and Guidelines for EV

charging station - Going Beyond Solar, Wind, Li Ion and Chilled Water Storage, Engineering Considerations and Future Frontiers.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Iqbal Hussain, Electric and Hybrid Vehicles – Design fundamentals, 3rd ed., CRC press, 2023.
- [2] James D Halderman and Curt Ward, Electric and Hybrid Electric Vehicles, 1st ed., Pearson Education Limited, 2023.

REFERENCE BOOKS:

- [1] Eshani M, Goa Y, Longo S, Ebrahimi K, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, 2018.
- [2] Tariq Muneer and Irene Illescas García, The Automobile, in Electric Vehicles: Prospects and Challenges, Elsevier, 2017.
- [3] Sheldon S. Williamson, Energy Management Strategies for Electric and Plug- in Hybrid Electric Vehicles, Springer, 2013.
- [4] Larminie, James, and John Lowry, Electric Vehicle Technology Explained, John Wiley and Sons, 2012

WEB REFERENCES:

- [1] "Fundamentals of Electric Vehicles: Technology and Economics,"
<https://nptel.ac.in/courses/108106170>
- [2] "Electric Vehicles - Part 1," https://onlinecourses.nptel.ac.in/noc22_ee53/preview
- [3] "Electric Vehicles," https://onlinecourses.swayam2.ac.in/ntr25_ed127/preview
- [4] "Electric Vehicles and Renewable Energy," https://onlinecourses.nptel.ac.in/noc21_ee112/preview

25EE214	POWER SYSTEM PROTECTION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Examine the need for protection and protective relays	1,2,3	1,2
CO2	Analyze the characteristics of Protective relays	1,2,3	1,2
CO3	Apply suitable protective schemes for electrical apparatus	1,2,3	1
CO4	Develop suitable digital algorithms for digital protection schemes	1,2,3	1,2,3
CO5	Analyze the performance of different types of circuit breakers	1,2,3	1,2
CO6	Apply artificial intelligence techniques to power system protection	1,2,4	1

FUNDAMENTALS AND COMPONENTS OF PROTECTIVE SYSTEMS [9]

Need for Protective Systems- Causes and Effects of Faults - Classification of Protective Relays- Components of Protection System - Zones of Protection, Primary and Backup Protection. Components: Construction and Operation of Instrument Transformers (PT, CT), Digital Relay, ICT, CVT, Circuit Breakers and Isolators.

PROTECTIVE RELAYS [9]

Switchgears: essential features and equipment – types of faults - short circuit MVA – Protective scheme -Universal relay torque equation - IDMT characteristics –Overcurrent relay – directional relay –R-X diagram - Distance and Differential protection scheme - Negative sequence relays - Pilot (Translay) relay – Carrier current protection scheme

PROTECTION OF MACHINES, TRANSFORMERS AND BUSZONE [9]

Causes of Overvoltages- Lightning Phenomenon - Devices for protection against lightning and Travelling waves -Lightning Arresters: Types and Limitations - Surge Absorber - Fuses. Overcurrent Protection - Distance Protection-Pilot Relaying Schemes-Differential Protection-Rotating Machines Protection, Transformer and Bus zone Protection. SCADA-based protection - Introduction of synchrophasor.

STATIC RELAYS AND NUMERICAL PROTECTION [9]

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection, transformer differential protection, distant protection of transmission lines – Microprocessor-based Protective schemes.

CIRCUIT BREAKERS AND DIGITAL PROTECTION [9]

Arc phenomenon – principles and methods of arc extinction - Recovery and Restriking voltages – Types of circuit breakers- Principle of Operation: Air blast, Oil, Vacuum and SF6 Circuit breakers– Problems and solution of circuit interruption – circuit breaker ratings - curves– selection of circuit breakers – IEC standards for MCB, MCCB, Application of Artificial Intelligence to Power System Protection- Application of Big Data analytics in power system component protection.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Badri Ram and D. N. Vishwakarma, Power System Protection and Switchgear, 2nd ed., Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2022.
- [2] Paul M. Anderson, Charles Henville, Rasheek Rifaat, Brian Johnson and Sakis Meliopoulos, Power System Protection, IEEE Press, Wiley, 2nd ed., 2022.

REFERENCE BOOKS:

- [1] J. B. Gupta, A Course in Power Systems, S.K. Kataria & Sons, New Delhi, 11th ed., 2020.
- [2] Vladimir Gurevich, Digital Protective Relays, Problems and Solutions, 2020, CRC Press, Delhi
- [3] Sunil S. Rao, Switchgear Protection and Power Systems (Theory, Practice & Solved Problems), Khanna Publishers; 14th ed., January 2022
- [4] C L Wadhwa, Electrical Power Systems, 8th ed., New Academic Science Limited, London, 2022.

WEB REFERENCES

- [1] "Power System Protection and Switchgear," https://onlinecourses.nptel.ac.in/noc21_ee110/preview
- [2] "Digital Protection of Power System," https://onlinecourses.nptel.ac.in/noc25_ee22/preview
- [3] "Power System Protection," <https://nptel.ac.in/courses/108/101/108101039/>
- [4] "Power System Protection," <https://nptel.ac.in/courses/108/105/108105167/>

25EC205	ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Apply the fundamental laws of electromagnetics to determine electric and magnetic fields.	1,8,9	-
CO2	Apply Maxwell's equations and the Poynting vector to determine the parameters of electromagnetic waves in various media.	2, 8,9	2,3
CO3	Evaluate the performance parameters of transmission lines for specified conditions.	2, 8,9	2,3
CO4	Evaluate the performance parameters of TE, TM, and TEM waves for a given waveguide.	2, 8,9	2,3
CO5	Apply the Smith Chart to analyze RF and microwave transmission lines.	1,8,9	2,3

STATIC ELECTRIC AND MAGNETIC FIELD

[11]

Introduction to coordinate systems, Coulomb's law, Gauss's law, gradient, electric scalar potential. Biot-Savart law, Ampere's law, curl, magnetic vector potential. Boundary conditions.

MAXWELL'S EQUATIONS AND PLANE WAVE

[11]

Maxwell's equations, Wave equations, plane waves in dielectric media, Plane waves in conducting media, skin effect, Poynting theorem, reflection of plane waves: Normal and oblique incidences.

TRANSMISSION LINE THEORY

[12]

Primary and secondary constants, transmission line equations, input impedance, RF lines, reflection coefficient, and VSWR. Quarter-wave, half-wave, and One eighth wave lines. Smith chart—Impedance matching with single and double stubs.

WAVEGUIDES

[11]

Waves between parallel planes, TE and TM waves, Characteristics of TE and TM waves, TEM waves, Velocities of propagation, Wave impedance, Rectangular wave guides, TE and TM modes in wave guides, Velocity, wavelength, wave impedance.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] William H.Hayt, John A.Buck, Jaleel M.Akhtar, *Engineering Electromagnetics*, 9th ed., McGraw Hill, 2020.
- [2] Matthew N.O. Sadiku, S.V.Kulkarni *Principles of Electromagnetics*, 6th ed., Oxford University Press, 2015.

REFERENCE BOOKS:

- [1] Edward C.Jordon, Keith G.Balmain, *Electromagnetic Waves and Radiating Systems*, 2nd ed., Pearson, 2016.
- [2] David J. Griffiths, *Introduction to Electrodynamics*, 4th ed., Pearson, 2017.
- [3] Nannapaneni Narayana Rao, *Elements of Engineering Electromagnetics*, 6th ed., Illinois ECE Series, 2004.
- [4] R.Shevgaonkar, *Electromagnetic Waves*, 1st ed., McGraw-Hill, 2017.
- [5] John Kraus, Daniel Fleisch *Electromagnetics with Applications*, 5th ed., McGraw-Hill, 2017.

WEB REFERENCES:

- [1] “Embedded Sensing, Actuation and Interfacing Systems,”
https://onlinecourses.nptel.ac.in/noc24_ee68
- [2] “Transmission lines and electromagnetic waves,” https://onlinecourses.nptel.ac.in/noc24_ee42

25EC206	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Understand the operation and characteristics of BJT amplifiers, including small-signal, differential, and power amplifier configurations.	1	1
CO2	Analyze the performance parameters of single-stage MOSFET amplifiers and current mirror circuits.	1,2	1
CO3	Evaluate the properties, topologies, and stability aspects of negative feedback amplifiers.	2	2,3
CO4	Analyze the principles and operation of LC, RC, and crystal oscillators based on oscillation criteria.	2	2,3
CO5	Analyze wave-shaping circuits and multivibrator circuits to understand their behavior and applications.	2	2,3

BJT AMPLIFIERS

[9]

Small signal analysis of voltage divider biased common emitter, Differential amplifiers – CMRR – Darlington Amplifier. Introduction to large signal Amplifiers – Class A, Class B and Class C Power Amplifiers.

MOSFET AMPLIFIERS

[9]

Analysis of Single stage discrete MOSFET amplifiers – small signal voltage and current gain, input and output impedance of Basic Common Source amplifier, Common Drain amplifier, Common Gate amplifier. Current mirrors: Basic current mirror, Cascade current mirror.

FEEDBACK AMPLIFIERS

[8]

Properties of negative feedback – Basic Feedback Topologies – Feedback amplifiers – Series- Shunt, Series-Series, Shunt-Shunt and Shunt-Series Feedback – Determining the Loop Gain – Stability Problem – Nyquist Plot.

OSCILLATOR

[9]

Classification, Barkhausen Criterion – Mechanism for start of oscillation and stabilization of amplitude, General form of an Oscillator, Analysis of LC oscillators – Hartley, Colpitts, Clapps, Tuned collector oscillators, RC oscillators – phase shift – Wienbridge, Quartz Crystal oscillator.

WAVE SHAPING AND MULTIVIBRATOR CIRCUITS

[10]

RC & RL Integrator and Differentiator circuits, Speed-up Capacitor. Collector coupled, Astable multivibrator – Monostable multivibrator – Bistable multivibrator – Triggering methods for Bistable multivibrator – Schmitt trigger circuit (Analyze Multivibrators using Spice).

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Robert Boylestad and Louis Nashelsky, *Electron Devices and Circuit Theory*, 14th ed., Pearson, 2021.
- [2] Salivahanan and N. Suresh Kumar *Electronic Devices & Circuits*, 5th ed., McGraw Hill Publishing Limited, 2022.

REFERENCE BOOKS:

- [1] Jacob. Millman, Christos C. Halkias, *Electronic Devices and Circuits*, 4th ed., Tata McGraw Hill Publishing Limited, New Delhi, 2015.
- [2] David A. Bell, *Electronic Devices and Circuits*, 5th ed., Oxford Higher Education, 2018.
- [3] Neamen Donald, *Semiconductor Physics and Devices- Basic Principles*, 4th ed., McGraw Hill Publishing Limited, 2021.

WEB REFERENCES:

- [1] “Fundamentals of semiconductor devices,” https://onlinecourses.nptel.ac.in/noc25_ee39/preview
- [2] “Analog Electronic Circuits,” https://onlinecourses.nptel.ac.in/noc25_ee05/preview
- [3] “Electronic Devices and Circuit Theory,”
<https://ia801603.us.archive.org/0/items/ElectronicDevicesAndCircuitTheory/Electronic%20Devices%20and%20Circuit%20Theory.pdf>

25EC207	DIGITAL CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the digital fundamentals and concepts of combinational & sequential logic circuits and Programmable Logic Devices (PLDs).	1	-
CO2	Apply digital logic to develop combinational and sequential logic circuits for the given specifications.	1,2,8,9	1
CO3	Apply synchronous sequential logic circuits in digital system	1,2,8,9	1
CO4	Apply combinational logic circuits in memory and PLDs.	1,2,8,9	1
CO5	Apply asynchronous sequential logic circuits in digital systems	1,2,8,9	1

DIGITAL FUNDAMENTALS

[9]

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

COMBINATIONAL LOGIC

[9]

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

SEQUENTIAL CIRCUITS

[12]

Latches- Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization and state assignment– Design of Counters- Ripple Counters, Ring Counter, Johnson Counter, Shift registers, Universal Shift Register, Design of Asynchronous sequential circuits ,cycles and races, Hazards.

MEMORY AND PROGRAMMABLE LOGIC

[9]

Basic memory structure – ROM –PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – CPLD, FPGA

CASE STUDY

[6]

FSM, Systematic approach for design of Synchronous counter

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Morris Mano M. and Michael D. Ciletti, *Digital Design*, 6th ed., Pearson Education, 2018.
- [2] Donald P Leach, Albert Paul Malvino, Goutam Saha, *Digital Principles and Applications*, McGraw-Hill Education, 8th ed., 2014

REFERENCE BOOKS:

- [1] John F. Wakerly, *Digital Design Principles and Practices*, 5th ed., Pearson Education, 2018.
- [2] Charles H. Roth, Larry L Kinney, *Fundamentals of Logic Design*, 7th ed. – CL Engineering, 2019.
- [3] Donald D. Givone, *Digital Principles and Design*, Tata McGraw Hill, 2017.

WEB REFERENCES:

- [1] “Digital Circuits,”https://onlinecourses-archive.nptel.ac.in/noc18_ee33/course
- [2] “Digital Electronic Circuits,” https://onlinecourses-archive.nptel.ac.in/noc19_ee09/course

25EC272	DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Test the functionality of Boolean expressions using logic gates through simulation.	1,2,3	1
CO2	Design combinational logic circuits such as arithmetic circuits, code converters, multiplexers, demultiplexers, parity generators/checkers, encoders, and decoders.	1,2,4,8,9	1
CO3	Apply multiplexers and logic gates to realize specified Boolean functions.	1,2,5,8,9	1
CO4	Construct sequential logic circuits including flip-flops, shift registers, ripple counters, and synchronous counters.	1,2,9,10,11	1
CO5	Validate the functionality of combinational and sequential circuits using HDL.	1,2,8,9	1

LIST OF EXPERIMENTS

1. Implementation and Simulation of Boolean expressions using logic gates.
2. Design and Implementation of arithmetic circuits using logic gates
3. Design and implementation of Code Converters using Logic Gates.
(i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
4. Design and implementation of Multiplexers and De-multiplexers using logic gates.
5. Implementation of Boolean function using Multiplexer
6. Design and implementation of parity generator/ checker using logic gates.
7. Implementation and Simulation of D & T flip-flops.
8. Design and implementation of Shift registers.
9. Implementation and Simulation of 4-bit ripple counter and Synchronous counter
10. Simulation of Encoder and Decoder using HDL

Total Notional Hours:30

25EC273	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Analyze the input and output characteristics of a BJT in common-emitter configuration.	1,2,3	1
CO2	Analyze the frequency response characteristics of BJT and MOSFET amplifiers.	2,3,4	1
CO3	Analyze the switching characteristics of BJT and MOSFET circuits for signal and load applications.	1,2,5	1
CO4	Analyze the performance of power amplifiers, clipper, and clamper circuits in terms of voltage gain, efficiency, and waveform shaping behaviour.	2,5,8	1,3
CO5	Design and simulate amplifier and oscillator circuits to study their operation and evaluate key performance parameters.	3,5,9,10,11	2,3

LIST OF EXPERIMENTS

Hardware Experiments

1. Input-Output characteristics of BJT CE Configuration.
2. Design and test of a Single-Stage Voltage Amplifier using BJT and Analysis of its Frequency Response Characteristics.
3. Design and test of MOSFET Switching Performance in LED Load Applications.
4. Design and test of differential amplifier using FET and determine its CMRR and also perform the frequency response analysis.
5. Design and test of Class B Complementary Symmetry Audio Amplifier.
6. Design and test of Astable Multivibrator using BJT Timer

Simulation Experiments

1. Simulation of Clippers & Clampers.
2. Simulation to analyze the frequency response of a Darlington amplifier using BJT.
3. Simulation of RC phase shift Oscillators using BJT.
4. Simulation of LC Oscillators using BJT.

Total Notional Hours:30

25EC208	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Identify the basic components of computer architecture, processor organization, and memory systems.	1,2	1,2
CO2	Explain the role of instructions, processors, and memory in computer operation.	1,2	1,2
CO3	Apply processor instructions, arithmetic operations, and memory access methods to solve processor-level problems in real-time systems.	1,2,3,5	1,2
CO4	Analyze processor performance, pipelining behavior and memory access mechanisms in modern computing architectures.	1,2,3,4	1,2
CO5	Analyze the impact of CPU, memory, and I/O organization on embedded and parallel system performance.	1,2,3,4	1,2
CO6	Develop architecture-based solutions for modern computing applications.	1,2,3,4,5,9,10,11	1,2

SYSTEM ARCHITECTURE & PROGRAMMING BASICS

[12]

Evolution of computers and performance trends – Functional units of a computer system - System buses and interconnection structures - Von Neumann architecture - Types of instructions, Instruction sets: Instruction formats - Addressing modes - Register transfer language (RTL) - Assembly language, Stacks, Queue, Subroutines

Case study: ARM vs x86 → Compare power efficiency vs performance

ARITHMETIC OPERATIONS

[9]

Number representation (fixed & floating point) - Integer arithmetic operations – Addition, subtraction, multiplication, division algorithms IEEE 754 floating point formats.

Case study: RISC-V Open-source ISA revolution and customization

PROCESSOR AND CONTROL UNIT

[12]

CPU organization and data path design - Instruction sequencing, Control unit design - Hardwired control - Microprogrammed control, Pipelining - Pipeline hazards and solutions

Case study: Pipeline Optimization in Modern CPUs

MEMORY AND I/O SYSTEMS

[12]

Memory organization - Memory hierarchy, RAM, ROM, Memory management, Cache memory organization and mapping techniques -Virtual memory, Main memory organization - Secondary storage devices, System organization, Input - Output systems, Programmed I/O - Interrupt-driven I/O, DMA, Standard I/O interfaces, Concept of parallel processing, Multicore processors and multiprocessors

Case study: GPU Architecture for High-Performance Computing

Total Notional Hours: 90

L	T	P	TW+SL	C
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45	0	0	45	3
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TEXT BOOKS:

- [1] David A. Patterson and John L. Hennessey, *Computer Organization and Design*, 6th ed., Morgan Kauffman, 2021.
- [2] V.Carl Hamacher, Zvonko G. Varanasic and Safat G. Zaky, *Computer Organisation*, 6th ed., McGraw-Hill Inc., 2012.

REFERENCE BOOKS:

- [1] William Stallings, *Computer Organization and Architecture: Designing for Performance*, 11th ed., Pearson, 2019.
- [2] Vincent P. Heuring and Harry F. Jordan, *Computer System Architecture*, 2nd ed., Pearson Education, 2005.
- [3] Govindarajalu, *Computer Architecture and Organization: Design Principles and Applications*, 2nd ed., McGraw Hill Education, 2013.
- [4] John L. Hennessy, David A. Patterson, *Computer Architecture: A Quantitative Approach*, 7th ed., 2025.

WEB REFERENCES:

- [1] "Computer Organisation and Architecture," <https://nptel.ac.in/courses/106104073>
- [2] "Computer Architecture," <https://nptel.ac.in/courses/106102062>
- [3] "Computer Architecture and Organisation," https://onlinecourses.nptel.ac.in/noc20_cs64/preview
- [4] "Computer System Architecture," <https://ocw.mit.edu/courses/6-823-computer-system-architecture-fall-2005>

25EC209	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Understand the fundamental concepts, types, and properties of continuous-time and discrete-time signals and systems.	1	-
CO2	Analyze signals and systems using time-domain and frequency-domain methods such as convolution, Fourier, Laplace, and Z-transform	2	3
CO3	Apply sampling, transformation, and system analysis concepts to represent and process real-world signals	1	3
CO4	Relate the principles of signals and systems to modern engineering applications such as communication, biomedical, and embedded sensor systems.	1,2,3,4,5	3
CO5	Use MATLAB or equivalent software tools to generate, simulate, and visualize various signals and system responses.	1,2,3,5	3

CLASSIFICATION OF SIGNALS AND SYSTEMS

[15]

Basic (Continuous / Discrete) signals – unit step, unit impulse, sinusoidal and complex exponential signals – Classification of signals, Continuous – Discrete time, Even / Odd signals, Periodic/ Non-periodic signals, Deterministic / Random signals, Energy / Power signals, Basic operations on signals, etc.

Systems (Continuous / Discrete): Representation, Classification – Linear / Nonlinear, Causal/ Noncausal, Time invariant / Time variant, with / without memory, BIBO stability, Feedback system, LTI system – Response of LTI system, Convolution, Properties (Continuous / Discrete), LTI systems Simulation exercises for signal generation.

ANALYSIS OF CONTINUOUS TIME(CT) AND DISCRETE TIME(DT) SIGNALS [15]

Fourier and Laplace Transforms in CT Signal Analysis – Properties, Region of Convergence (ROC) in LT, Spectrum of CT signals (Amplitude & phase spectra). Sampling theorem – Reconstruction of a signal from its samples – Aliasing, Fourier Transform of DT signals (DTFT) – Properties of DTFT – Z Transform & Properties, Region of Convergence (ROC) in ZT. Understanding the Amplitude & phase spectra using Spectrum Analyzer.

LINEAR TIME INVARIANT (LTI) CONTINUOUS TIME (CT) & DISCRETE TIME (DT) SYSTEMS [15]

Differential Equation – Impulse response – convolution integrals- - Fourier and Laplace transforms in Analysis of CT systems. Difference Equations – Impulse response – Convolution sum- Discrete Fourier and Z Transform in Analysis of DT systems.

Case studies:

Sensor data visualization, ECG/speech signal analysis, Signal Analysis and Processing for Sensor-Based Applications

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, *Signals and Systems*, 2nd ed., Prentice Hall India, 2015.
- [2] John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing, Principles, Algorithms, and Applications*, 4th ed., PHI, 2014.

REFERENCE BOOKS:

- [1] B.P. Lathi, *Signal Processing and Linear Systems*, 3rd ed., Oxford University Press, Incorporated, 2017.
- [2] Hwei Hsu, *Signals and systems*, Schaum's outlines, 4th ed., Tata McGraw-Hill Co Ltd, 2022.
- [3] M.J.Roberts, *Signals and Systems, Analysis Using Transform Methods and MATLAB*, 3rd ed., Tata McGraw Hill (India), 2019.

WEB REFERENCES:

- [1] "Principles of Signals and Systems," https://onlinecourses.nptel.ac.in/noc20_ee15/preview
- [2] "Principles of Signals and Systems," https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee70

25EC252	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Describe the fundamental concepts, characteristics, and parameters of operational amplifiers.	1,2	-
CO2	Analyze the characteristics of operational amplifiers to design linear and Non linear applications.	1,2,5	1
CO3	Analyze the performance of operational amplifiers to design advanced integrated circuits.	1,2	1
CO4	Apply operational amplifier-based circuits for the implementation of special function ICs in engineering applications.	1,2,5	1
CO5	Apply special function ICs effectively in real-time and practical engineering applications.	1,2,5	1

OPERATIONAL AMPLIFIER AND ITS APPLICATIONS

[9]

Fundamentals of opamp - Ideal Operational Amplifier Characteristics - DC and AC characteristics - frequency response – Stability, Applications of operational Amplifier: Scale Changer, Voltage Follower, Adder, Subtractor, Differential Amplifier, Instrumentation amplifier, V-to-I and I-to-V converters, Integrator, Differentiator, Comparators, Zero crossing detector, clipper and clamper, Schmitt trigger.

ACTIVE FILTERS AND PHASE LOCKED LOOP

[9]

Basics of active filters and First order LPF and HPF, BPF and BRF, Basic principles of PLL, VCO IC566 and Applications of PLL IC 565.

ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

[9]

D/A converter - weighted resistor type, R-2R Ladder type, Voltage Mode and Current Mode types – switches for DAC, A/D Converters - Flash, Successive Approximation, Single Slope, Dual Slope.

WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs

[9]

Sine-wave generators – RC Phase shift oscillator and Wien bridge oscillator, Multivibrators and Triangular wave generator, Timer IC 555 – functional diagram, Monostable and Astable operation, IC723 general purpose voltage regulator.

CASE STUDY

[9]

Study of LM324 & LM358, Audio Amplifier, SMPS controllers, Sensor based Applications.

LIST OF EXPERIMENTS

[30]

Hardware / Software Experiments:

1. Design of Inverting and Non Inverting Amplifier for signal amplification.
2. Design of Schmitt Trigger and RC Phase shift Oscillator for signal processing applications.
3. Design of voltage regulator for applications in automotive electronics, electric cars, and communication equipment.

Software Experiments (using simulation tools):

1. Design of Integrator and Differentiator for waveform generation.
2. Design of multivibrator used in timer circuits.
3. Design of active filters for communication systems.

Total Notional Hours:120

L	T	P	TW+SL	C
45	0	30	45	4

TEXT BOOKS:

- [1] D. Roy Choudhury & Shail Bala Jain, *Linear Integrated Circuits*, 6th ed., New Age International Publishers, New Delhi, 2022.
- [2] Ramakant A. Gayakwad, *OP-AMPs and Linear Integrated Circuits*, 4th ed., Prentice Hall / Pearson Education, 2020.

REFERENCE BOOKS:

- [1] Michael Jacob J, *Analog Integrated Circuits and Applications*, 1st ed., Prentice Hall of India, New Delhi, 2019.
- [2] R.F. Coughlin & Fredrick F. Driscoll, *Operational Amplifiers & Linear Integrated Circuits*, PHI, 6th ed., 2000
- [3] S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits (3/e)* TMH, 2003.
- [4] G B Clayton, *Operational Amplifiers*, Elsevier science, 5th ed., 2003.

WEB REFERENCES:

- [1] "Integrated Circuits and Applications," https://onlinecourses.nptel.ac.in/noc25_ee43/preview
- [2] "Linear Integrated Circuits," https://onlinecourses.swayam2.ac.in/ntr25_ed139/preview
- [3] "Analog and Digital Electronics," <https://ade2-iitr.vlabs.ac.in/List%20of%20experiments.html>

25EC210	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamental principles of analog communication and various types of modulation and demodulation techniques.	1,2	-
CO2	Analyze the performance of amplitude, frequency, and phase modulation techniques in terms of power and bandwidth efficiency.	2,3,5	3
CO3	Analyze the generation and detection methods of AM, FM, and PM signals and their spectral characteristics.	2,4,10	3
CO4	Evaluate the effect of noise on various modulation schemes and calculate signal-to-noise ratio (SNR) in communication systems.	2,4,3,11	3
CO5	Apply sampling and waveform coding techniques to convert analog signals into digital form and analyze digital modulation techniques	3,4,5,9	3

AMPLITUDE MODULATION

[9]

Basic blocks of Communication System – Need for Modulation – Amplitude Modulation – Time and Frequency domain description, power relations in AM waves– Methods of generation and detection of AM, DSB-SC, SSB-SC and VSB-SC signals – Comparison of AM systems – FDM – AM Broadcast transmitter – Super heterodyne Receiver and its characteristics.

Case Studies: Performance comparison of DSB-FC, DSB-SC, and SSB systems in practical AM broadcasting. Real-world application of AM in aircraft communication systems

ANGLE MODULATION

[9]

Frequency and Phase modulation – Single tone, narrow band and wideband FM – Transmission Bandwidth – Generation and detection of FM signal – FM Radio Receiver.

Case Studies: Case study on FM stereo broadcasting and pilot tone generation. Demodulation of FM signals using slope detector and quadrature detector — a practical analysis

NOISE PERFORMANCE OF MODULATION SCHEMES

[9]

Noise sources and types – Noise figure and noise temperature – Noise equivalent bandwidth –Friis formula –Noise in cascaded systems- Narrow Band Noise and its representations - Threshold effect – Noise in FM receivers – FM threshold effect – Capture effect – Pre-emphasis and De-emphasis in FM.

SAMPLING & WAVEFORM CODING

[9]

Sampling theorem: Low pass and band pass sampling, and quantization - Pulse Code Modulation (PCM): Differential Pulse Code Modulation (DPCM), Delta Modulation (DM).Coding schemes: Adaptive Delta Modulation, and Linear Predictive Coding (LPC).

DIGITAL MODULATION TECHNIQUES

[9]

Geometric representation of digital modulation schemes. Generation and detection of coherent BPSK, QPSK, BFSK and M-QAM signals. Power spectral density and BER analysis over AWGN channels. Performance over fading channels. Non-coherent detection principles. Differential modulation schemes.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Simon Haykin and Moher, *Communication Systems*, 5th ed., 2022, Wiley.
- [2] John G. Proakis and Masoud Salehi, (2/e), *Communication Systems Engineering*, Pearson, 2015
- [3] Herbert Taub, Donald L Schilling and GoutamSaha, *Principles of Communication Systems*, McGraw Hill, 4th ed., 2025.
- [4] Andrea Goldsmith, *Wireless Communications*, 1st ed. (Indian Reprint), Cambridge University Press, 2020.

REFERENCE BOOKS:

- [1] K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley, 1994.
- [2] George Kennedy and Bernard Davis, *Electronics & Communication System*, TMH 2009.
- [3] R.P. Singh, SP Sapre, *Communication Systems*, 2nd ed. –TMH, 2008.
- [4] Analog & Digital Communication – K.Sam Shanmugam, Wiley 2006.
- [5] John G. Proakis, Masond, Salehi., *Fundamentals of Communication Systems* – 2nd ed., Pearson, 2014.

WEB REFERENCES:

- [1] “Analog Communication,” https://onlinecourses.nptel.ac.in/noc25_ee131/preview
- [2] “Fundamentals of Communication system and its applications,”
https://onlinecourses.swayam2.ac.in/nou25_ec12/preview

25EC211	CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Determine the mathematical model for the physical systems.	1,2,3	-
CO2	Solve complex engineering control system problems using relevant techniques.	1,2,3	3
CO3	Analyze the systems with respect to time and frequency-domain.	1,2,3	2,3
CO4	Estimate appropriate stability analysis to improve the system performance.	1,2,3	2,3
CO5	Evaluate control strategies for developing compensators for control system applications.	1,2,3	2,3

MATHEMATICAL MODELLING OF PHYSICAL SYSTEMS

[10]

Open and closed loop systems – Transfer function – Characteristics Equation - Electrical analogy of mechanical systems and rotational systems – Block diagram reduction techniques – Signal flow graphs – Modelling of DC motor control systems in industrial applications.

TIME DOMAIN AND STABILITY ANALYSIS

[10]

Time response: Types of test input – I and II order system response- Time domain specifications – Steady state error – Routh Hurwitz criterion – Root Locus.

FREQUENCY DOMAIN ANALYSIS

[10]

Frequency response: Frequency Domain Specifications – Bode plot – Polar plot – Nyquist plot – correlation between time and frequency response.

COMPENSATOR DESIGN

[5]

Effect of Lag, lead and lag-lead compensation on frequency response.

STATE VARIABLE ANALYSIS

[10]

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability using Kalman's test

Case Studies: Compare traditional and intelligent controllers for temperature control for chemical reactor, AI based speed control of an electric motor, Adaptive Cruise Control System for Automobiles

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Nagarath, I.J. and Gopal, M., *Control Systems Engineering*, 6th ed., New Age International Publishers, 2017.
- [2] Benjamin C. Kuo, *Automatic Control Systems*, 9th ed., Wiley Publishers, 2014.

REFERENCE BOOKS:

- [1] Katsuhiko Ogata, *Modern Control Engineering*, 5th ed., Pearson, 2015.
- [2] Richard C.Dorf and Bishop, R.H., *Modern Control Systems*, 12th ed., Pearson Education, 2011.
- [3] John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, *Linear Control System Analysis and Design with MATLAB*, 6th ed., CRC Taylor& Francis, 2009.

WEB REFERENCES:

- [1] “Control Systems,” <https://nptel.ac.in/courses/107106081>
- [2] “Control Systems,” https://onlinecourses.nptel.ac.in/noc20_ee90/preview
- [3] “Control Engineering,” <https://nptel.ac.in/courses/108102043>
- [4] “Advanced Control Systems,” <https://nptel.ac.in/courses/108103007>
- [5]] “Control Engineering,” <https://nptel.ac.in/courses/108102043>

25EC253	SMART SYSTEMS WITH EMBEDDED & IOT	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamental concepts, architecture, components, and design methodology of embedded systems.	1,2	-
CO2	Describe the architecture, communication models, enabling technologies, and applications of IoT.	1,2	2
CO3	Apply embedded system concepts to interface sensors, actuators, and display devices.	1,2,3,5	2
CO4	Implement IoT connectivity using wireless communication technologies and cloud platforms.	1,2,3,4,5	2
CO5	Analyze the architecture and operation of smart systems integrating embedded and IoT technologies.	1,2,3,4,5	2

EMBEDDED SYSTEMS AND DESIGN

[15]

Embedded Systems – Definition and Characteristics – Applications of Embedded Systems – Processors and Hardware Units in Embedded Systems – Microcontroller and microprocessor overview – Embedded Software – Embedded System Design Methodology – Embedded System Architecture – Introduction to System-on-Chip (SoC) – Embedded Hardware Design and Development

IOT FUNDAMENTALS AND ARCHITECTURE

[15]

Definition and evolution of IoT – Characteristics and applications of IoT – IoT architecture: device, gateway, cloud, and application layers – IoT enabling technologies – Sensors, actuators, and data acquisition – IoT communication models: device-to-device, device-to-cloud, and cloud-to-device communication – Overview of embedded devices used in IoT.

CONNECTIVITY, CLOUD AND IOT APPLICATIONS

[15]

Introduction to IoT communication protocols: HTTP, MQTT – Wireless communication technologies overview: Wi-Fi, Bluetooth, and LPWAN (introductory) – Cloud platforms for IoT – Data storage and visualization – IoT applications in smart homes, smart cities, healthcare, agriculture, and industry – Industrial IoT (IIoT) overview – Cyber-physical systems – Basic security considerations in IoT – Future trends in embedded systems and IoT.

LIST OF EXPERIMENTS:

[30]

1. Introduction to Embedded Development Environment
2. LED Blinking and Digital Output Control
3. Push Button, Buzzer and Actuator Control
4. Analog Sensor Interfacing
5. Temperature and Humidity Monitoring
6. OLED/LCD Display Interfacing
7. Wi-Fi Enabled IoT Node using ESP32
8. Cloud-Based IoT Data Monitoring
9. MQTT-Based IoT Communication

10. Smart System - Mini Project

Total Notional Hours:120

L	T	P	TW+SL	C
45	0	30	45	4

TEXT BOOKS:

- [1] Raj Kamal, *Embedded Systems: Architecture, Programming and Design*, 3rd ed., McGraw Hill Education, New Delhi, 2017.
- [2] Arshdeep Bahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*, 1st ed., Universities Press, Hyderabad, 2015.

REFERENCE BOOKS:

- [1] Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017.
- [2] Frank Vahid and Tony Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, 2nd ed., Wiley India Pvt. Ltd., New Delhi, 2018.
- [3] David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton and Jerome Henry, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, 1st ed., Cisco Press, 2017.
- [4] Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, 2nd ed., Wiley, 2014.
- [5] Simon Monk, *Programming Arduino: Getting Started with Sketches*, 2nd ed., McGraw Hill Education, New York, 2016.

WEB REFERENCES:

- [1] "Introduction to Embedded System Design," https://onlinecourses.nptel.ac.in/noc26_cs22/preview
- [2] "Embedded System Design with ARM," <https://nptel.ac.in/courses/106105193>
- [3] "AutoDesk, TinkerCAD," <https://www.tinkercad.com/circuits>

25EC254	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSOs
CO1	Analyze discrete-time signals and systems using Discrete Fourier Transform (DFT) and implement efficient algorithms such as FFT for spectrum analysis and linear filtering.	1,2,3	1,3
CO2	Realize Infinite Impulse Response (IIR) filters using techniques such as Impulse Invariance and Bilinear Transformation, and evaluate their frequency responses.	1,2,4	1,3
CO3	Realize Finite Impulse Response (FIR) filters using windowing and frequency sampling techniques, and analyze their characteristics.	1,2,4,5	1,3
CO4	Evaluate the effects of finite word length in digital systems, including quantization, overflow, and limit cycle oscillations, and apply appropriate scaling techniques to minimize errors.	1,2,3	1,3
CO5	Explain and implement multirate signal processing concepts such as decimation, interpolation, polyphase structures, and filter banks, and analyze their applications in DSP systems.	2,3,4,5	3

DISCRETE FOURIER TRANSFORM

[9]

Introduction to Digital Signal Processing: Components of a DSP system, Advantages and limitations of DSP - Review of discrete-time signals and systems - DFT and its properties, FFT algorithm- Decimation in Time Algorithm - Decimation in Frequency - Computation of Inverse DFT using FFT and its application to convolution. Linear filtering using DFT and FFT.

INFINITE IMPULSE RESPONSE DIGITAL FILTERS

[9]

Design of analog Butterworth and Chebyshev Filters – Frequency transformation in analog domain - Design of IIR digital filters - Impulse invariance technique, Bilinear transformation – Realization of IIR filters - Direct, cascade and parallel forms

FINITE IMPULSE RESPONSE FILTERS

[9]

Characteristics of FIR Digital Filters, types and frequency response - Design of FIR digital filters using window techniques (Rectangular, Hamming and Hanning) and frequency sampling technique - basic structures and lattice structure for FIR systems.

.FINITE WORD LENGTH EFFECTS

[9]

Fixed point and floating-point number representations – Comparison – Quantization Error - Quantization Noise Power - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow

MULTIRATE SIGNAL PROCESSING

[9]

Introduction to multirate DSP, decimation and interpolation, polyphase decomposition, uniform DFT filter banks, quadrature mirror filters and perfect reconstruction

LIST OF EXPERIMENTS:

[30]

1. Computation of FFT and IFFT of a signal
2. Convolution and Correlation of signals
3. Design of IIR filters – Butterworth, Chebyshev using – Impulse invariance and Bilinear Transformation
4. Design of FIR filters –windowing technique (Rectangular, Hamming and Hanning)
5. Multirate Signal Processing
6. Analysis of Quantization and Overflow Errors in Fixed-Point DSP Systems Using MATLAB
7. Study of Fixed-Point and Floating-Point Arithmetic in DSP Using MATLAB
8. Study of architecture of DSP Processor, Waveform generation and Convolution using DSP Processor

Total Notional Hours:120

L	T	P	TW+SL	C
45	0	30	45	4

TEXT BOOKS:

- [1] John G Proakis and Manolakis, *Digital Signal Processing Principles, Algorithms and Applications*, Pearson, 4th ed., 2014.
- [2] Alan V. Oppenheim and Ronald W. Schaffer, *Discrete-Time Signal Processing*, Prentice Hall, 3rd ed., 2010.

REFERENCE BOOKS:

- [1] Sanjit Mitra, *Digital Signal Processing - Computer Based Approach*, 4th ed., McGraw-Hill, New York, 2013.
- [2] P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice Hall, 2004.
- [3] Emmanuel C. Ifeache, Barry W. Jervis, *Digital Signal Processing: A Practical Approach*, 2nd ed., Pearson Education, 2004.

WEB REFERENCES:

- [1] “Digital Signal Processing and its Applications ,” <https://nptel.ac.in/courses/108101174>
- [2] “Digital Signal Processing,” <https://nptel.ac.in/courses/108106151>

25EC212	CMOS VLSI DESIGN AND VERIFICATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Apply MOS circuit design principles to create CMOS-based systems and analyze the factors affecting their transistor performance.	1	1
CO2	Analyze CMOS logic to design various digital modules for VLSI system design	1,2	1
CO3	Analyze various testing techniques used to evaluate the functionality and performance of VLSI circuits.	1,2	1,2
CO4	Apply suitable architectural strategies to design transistor-level circuits for realizing various arithmetic building blocks	2,3	1,2
CO5	Apply logic synthesis, timing analysis, and low-power design techniques to optimize VLSI circuits.	1,2	1,2

VLSI DESIGN OVERVIEW AND MOSFET THEORY

[8]

VLSI Design Flow, MOSFET: Device Structure, Electrical behaviour of MOS transistors, Capacitance-Voltage Characteristics, Layout design rules, Stick Diagrams.

CMOS CIRCUITS PERFORMANCE ANALYSIS

[11]

CMOS Inverter: DC Transfer Characteristics, Static and Dynamic Behaviour, Delay Estimation, Performance Estimation - Static & Dynamic Power Dissipation, CMOS Basic Gates, Realization using NAND and NOR logics (Analyze using Tanner Tool), CMOS Sequential Logic Design – Latches and Flip Flops (Analyze using Verilog HDL).

CMOS LOGIC CIRCUIT

[8]

Pass Transistor Logic, Transmission Gates based Logic Design, pseudo NMOS, Cascode Voltage Switch Logic Dynamic and domino logic, clocked CMOS (C²MOS) logic and np – CMOS logic.

TESTING OF VLSI CIRCUITS

[9]

Importance of testing, Challenges in VLSI Testing, Faults in digital circuits, Fault models in CMOS, Test pattern generation methods: Path sensitization, Boolean Difference, Built in self test.

IMPLEMENTATION STRATEGIES

[9]

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Xilinx and Artix and Altera FPGA.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Neil.H. E Weste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th ed., Pearson Addison Wesley, 2015.
- [2] Pucknell A, Kamran Eshraghian, *Basic VLSI Design*, 3rd ed., Prentice Hall of India, 2016.

REFERENCE BOOKS:

- [1] John P. Uyemura, Introduction to VLSI circuits and systems, John Wiley, 2016.
- [2] Rabaey, Chandrakasan and Nikolic, Digital Integrated Circuit: A design Perspective, PHI, 2nd ed., 2016.
- [3] Abramovici .M, Breuer M.A and Friedman A.D, Digital Systems and Testable Design, Jaico Publishing House, 2002.
- [4] Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, VLSI Test Principles and Architectures, The Morgan Kaufmann. 2013
- [5] Smith, M.J. *Application Specific Integrated Circuits*, Pearson Education, 2011.

WEB REFERENCES

- [1] "Analog VLSI Design - Course," https://onlinecourses.nptel.ac.in/noc25_ee111/preview
- [2] "VLSI Design Flow: RTL to GDS," https://onlinecourses.nptel.ac.in/noc25_ee106/preview

25EC274	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	2	1

COs	COURSE OUTCOMES	POs	PSO
CO1	Analyze and simulate combinational and sequential logic circuits .	1, 2, 5	1,2
CO2	Design, implement, and verify basic digital modules such as adders, comparators, encoders/decoders, and counters.	1, 3, 5,8	1,2
CO3	Develop FSM-based applications (e.g., vending machine and traffic light controller) and implement them on FPGA.	3, 5,9, 10	1,2
CO4	Perform DC and transient analysis of CMOS logic gates and analog sub circuits using SPICE for performance evaluation.	2, 4, 5	1
CO5	Apply design methodologies for low-power and high-performance VLSI circuits suitable for real-time systems.	3,5,11	1,2

SIMULATION EXPERIMENTS:

[30]

1. Design and simulation of Full Adder and Full Subtractor
2. Design and simulation of Multiplexer and Demultiplexer.
3. Behavioural modelling for Encoder with and without priority and Decoder.
4. Design and simulation of 4-Bit Comparator.
5. Realization and simulation of a 4-bit Combinational Multiplier.
6. Design and simulation of Latch and Flip Flops.
7. Design and simulation of Shift Registers.
8. Design and simulate a synchronous BCD (0–9) counter implemented as a Moore FSM, verify counting sequence, and synthesize for FPGA.
9. Design, simulate and implement a vending machine controller using a Finite State Machine (FSM) that accepts 5 and 10 coins to dispense a product worth 15 on an FPGA.
10. Design of 5 -TAP FIR Filter.
11. DC and Transient Analysis of CMOS Inverter Logic Gates and D-Latch.
12. DC and Transient Analysis of CMOS NAND and NOR Logic Gates.
13. Design of Differential Amplifier and cascade amplifier.
14. Design of Flip-flops.

Total Notional Hours:30

TEXT BOOKS:

- [1] M. Morris R. Mano Michael D. Ciletti, *Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog*, Pearson Education, Inc., 2018.
- [2] Weste and Harris: *CMOS VLSI Design: A Circuits and Systems Perspective* Pearson Education India, 4th ed. 2015.

REFERENCE BOOKS:

- [1] Samir Palnitkar, *Verilog HDL-A guide to Digital Design and Synthesis* 2nd ed., Pearson Education in South Asia 2015.
- [2] J. Bhaskar, *A Verilog Primer*, Prentice Hall, 2015.

WEB REFERENCES

- [1] “Digital Design with Verilog,” https://onlinecourses.nptel.ac.in/noc24_cs61/preview
- [2] “System Design through Verilog https://onlinecourses.nptel.ac.in/noc25_ee180/preview
- [3] “CMOS Digital VLSI Design,” https://onlinecourses.nptel.ac.in/noc21_ee09/preview

25EC275	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Demonstrate the generation and detection of analog modulation techniques such as Amplitude and Frequency Modulation and analyze their characteristics.	1,2,4,5	3
CO2	Implement and examine various digital modulation schemes (ASK, FSK, PSK) and sampling techniques to understand time and frequency domain signal behavior.	3,4,5,8	3
CO3	Design and perform experiments on Pulse Modulation, Time Division Multiplexing, and Line Coding schemes for efficient digital communication.	2,3,5,11	3
CO4	Apply source coding and error control coding techniques such as Shannon–Fano, Huffman, Linear Block, and Convolutional Codes to improve communication reliability and efficiency.	1,2,5,9	3
CO5	Simulate and analyze equalization algorithms (Zero Forcing and LMS) to minimize channel distortion and enhance signal performance using computational tools.	2,3,5,10	3

HARDWARE EXPERIMENTS

[30]

1. Amplitude Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Frequency Response Analysis of Pre-Emphasis and De-Emphasis Filters
4. ASK, FSK, PSK schemes
5. Natural sampling and Flat top sampling
6. Time Division Multiplexing
7. Pulse Modulation schemes
8. Pulse Code Modulation and Demodulation
9. Delta and Adaptive Delta Modulation and Demodulation
10. Line coding schemes.
11. Frequency Response of Single Tuned Amplifier

SIMULATION EXPERIMENTS

12. Error control coding using Linear Block Codes and Convolutional codes
13. Shannon Fano coding and Huffman coding
14. Equalization – Zero Forcing & LMS algorithms

Total Notional Hours:30

TEXT BOOKS:

- [1] W. Tomasi, Electronics Communication Systems: Fundamentals Through Advanced, 5/e, Pearson, 2007.
- [2] J. G. Proakis, M. Salehi, and G. Bauch, Contemporary Communication Systems using MATLAB, Cengage Learning, 3rd Edition, 2013.
- [3] Simon Haykin, Digital Communication Systems, 1st Edition, John Wiley, 2014 reprint.

REFERENCE BOOKS:

- [1] L.W. Couch, Digital and Analog Communication Systems, 8/e, Pearson, 2013.
- [2] K. Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt Ltd., (Indian edition), 2006.
- [3] Upamanyu Madhow, Fundamentals of Digital Communication, Cambridge University, Press, 1st Ed. (ISBN 978-0-521-87414-4),2012.

25EC213	MACHINE LEARNING TECHNIQUES FOR 5G COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamental concepts of wireless communication system and multiple access techniques.	1,2	-
CO2	Analyze radio wave propagation mechanisms, path loss models, and fading characteristics in wireless channels.	2,3	3
CO3	Analyze signal transmission for Machine Learning.	1,2,4,5	3
CO4	Elaborate the key technologies, architecture, and applications of emerging 5G communication systems.	2,3,5	3
CO5	Apply wireless communication concepts to analyze real-world scenarios for mobility management, handoff, and capacity planning.	1,2	3

WIRELESS CHANNELS

[15]

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

MACHINE LEARNING TECHNIQUES

[15]

Signal Estimation and Detection: AL/ML based Parameter estimation, IF estimation, symbol rate estimation, STO and CFO estimation, MIMO/OFDM/OTFS detectors, Denoising signals. Spectrum sharing and resource allocation: Resource allocation, Spectrum sharing, Power allocation using reinforcement learning (RL) and deep RL.

MULTIPLE ANTENNA TECHNIQUES

[15]

MIMO systems – spatial multiplexing – System model – Pre-coding – Beam forming – transmitter diversity, receiver diversity – Channel state information-capacity in fading and non-fading channels. Case Study: Design of a Link Budget for a 5G Small Cell Network, Propagation Challenges in Hilly Terrain for Wireless Communication, coverage improvement through microcell deployment and antenna sectoring, Massive MIMO Deployment in 5G Networks – A Practical Perspective

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Theodore S Rappaport, *Wireless Communication Principles and Practice*, PHI, 2022.
- [2] Stefania Sesia and Issam Toufik *LTE:From Theory to Practice*, 2nd ed., Wiley, 2011.
- [3] Afif Osseiran and Jose F Monserrat, *5G Mobile and Wireless Communication Technology*, Cambridge University Press, 2016.

REFERENCE BOOKS:

- [1] William Stallings, *Wireless Communications and Networks: Principles and Practice*, 2nd ed., Pearson, 2008.
- [2] Andrea Goldsmith, *Wireless Communications*, 2nd ed. Cambridge University Press, 2021.
- [3] John G. Proakis, *Digital Communication* McGraw Hill, 4th ed., 2008
- [4] Andreas.F. Molisch, “Wireless Communications”, John Wiley, India, 2015.
- [5] KamiloFeher, “Wireless Digital Communications”, First Edition, Pearson, 2015.
- [6] Mariyam Ouaisa, Mariya Ouaisa, Hanane Lamaazi, Khadija Slimani, “ Machine Learning for Radio Resource Management and Optimization in 5G and Beyond”, CRC Press, First edition, 2025.

WEB REFERENCES

- [1]”Introduction to Wireless and Cellular Communications,”
https://onlinecourses.nptel.ac.in/noc25_ee109/preview
- [2] “5G Wireless Standard Design,” https://onlinecourses.nptel.ac.in/noc25_ee172/preview
- [3] “Wireless-communications for Every day ,” <https://www.coursera.org/learn/wireless-communications>
- [4] “6G for a Connected Future Specialization,’ <https://www.coursera.org/specializations/6g-for-a-connected-future>

25EC214	ARM BASED EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the architecture, programmer's model, modes, and addressing methods of ARM processors.	1	-
CO2	Develop and analyze ARM assembly programs using instruction sets, directives, and subroutines.	1, 2	2
CO3	Implement optimized embedded C programs by integrating C and assembly, and use debugging tools like Keil and Proteus.	1, 2, 3	2
CO4	Interface and control peripherals such as GPIO, ADC, DAC, UART, SPI, and I2C using ARM Cortex-M4.	1, 2, 3	2
CO5	Design real-time embedded applications using RTOS concepts like multitasking, scheduling, and synchronization.	1, 2, 3, 4	2

ARM ARCHITECTURE AND ASSEMBLY PROGRAMMING [12]

Introduction to Embedded Systems - Introduction to ARM Architecture - ARM Programmer's Model - ARM Processor Modes and States- Addressing Modes – Conditional Execution – Assembler Rules and Directives – Simple Assembly Language Programs – Subroutines and Parameter Passing
Introduction to Program debugging ARM Development Tools (Keil µVision, Proteus, QEMU).

EMBEDDED C PROGRAMMING AND CODE OPTIMIZATION TECHNIQUES [9]

Assembly Code Optimization – Mixing C & Assembly – Instruction Scheduling – Inline Assembly – Embedded C for Peripherals (GPIO, Timers) – Cross-Compilation & Flashing.

ARM PERIPHERAL INTERFACING AND APPLICATION DESIGN [12]

Overview of Cortex-M4 Architectures – Memory Map – Memory & I/O Mapped Peripherals – Timers, ADC, DAC– PWM & GPIO Control – UART, SPI & I2C Communication. Case studies: Stepper Motor, DC motor, Temperature Control, Remote control. Firmware Design & Bootloader Concepts – Real-Time Embedded Application using FreeRTOS.

EMBEDDED SYSTEM DESIGN USING RTOS [12]

Introduction to RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, scheduling, Task communication context switching, interrupt latency and deadline shared memory, message passing-, Inter process Communication – synchronization between processes- semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Andrew N. Sloss, Dominic Symes, and Chris Wright, *ARM System Developer's Guide*, Morgan Kaufmann Publishers, 1st ed., 2004.
- [2] Computer Organization and Architecture – Carl Hamacher, Zvonko Vranesic, McGraw Hill, 1st ed., 2001.
- [3] Steve Furber, *ARM System-on-Chip Architecture*, Addison Wesley, 2nd ed., 2000.
- [4] Muhammad Ali Mazidi and Janice Gillispie Mazidi, *ARM Assembly Language and C Programming*, Pearson Education, 1st ed., 2015.
- [5] K.V.K.K. Prasad, *Embedded/Real-Time Systems: Concepts, Design and Programming*, Dreamtech Press, 2nd ed., 2014.

REFERENCE BOOKS:

- [1] T. Noergaard, *Embedded Systems Architecture A Comprehensive Guide for Engineers and Programmers*, Newnes, 2nd ed., 2013
- [2] Computer Organisation & Architecture”, William Stallings, 2nd ed., PHI, 2010.
- [3] James K. Peckol, *Embedded Systems: A Contemporary Design Tool*, Wiley, 2nd ed., 2014.
- [4] William Hohl, *ARM Assembly Language – Fundamentals and Techniques* –CRC Press, Taylor & Francis, 1st ed., 2009.

WEB REFERENCES

- [1] “Embedded Systems,” https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed112
- [2] “Embedded System Design with ARM, ” <https://nptel.ac.in/courses/106105193>

25EC255	COMPUTER VISION AND IMAGE PROCESSING	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the concepts of machine vision, image fundamentals and the related image processing operations.	1	-
CO2	Apply various Image processing and Computer vision algorithms to solve real time problems	1, 2	2
CO3	Analyze the importance of various image pre-processing algorithms to determine their suitability for specific tasks	1, 2, 3	2
CO4	Analyze the image processing operations using spatial and frequency domain techniques for a given problem	1, 2, 3	2
CO5	Apply machine learning models in conjunction with image processing techniques to enhance performance.	1, 2, 3, 4	2

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING [12]

Introduction to image processing and computer vision - Image formation, sampling, and quantization - Pixel relationships and image representation - Image enhancement in spatial domain - Image filtering: smoothing and sharpening - Noise models and basic restoration techniques

FREQUENCY DOMAIN & IMAGE TRANSFORMATIONS [12]

Fourier Transform and its properties - Frequency domain filtering (low-pass, high-pass filters) - Discrete Cosine Transform (DCT) - Wavelet Transform basics - Image compression techniques (lossless & lossy, JPEG concept) - Image restoration in frequency domain.

IMAGE SEGMENTATION AND FEATURE EXTRACTION [12]

Edge detection - Thresholding techniques - Region-based segmentation - Morphological operations (erosion, dilation, opening, closing) - Feature extraction (shape, texture, color features) - Feature descriptors and representation.

COMPUTER VISION AND APPLICATIONS [9]

Introduction to computer vision concepts - Object detection and recognition - Motion detection and tracking - Basics of deep learning in vision (CNN concepts)

Applications: Autonomous vehicles, Medical image analysis, Robot vision, Face recognition, Industrial inspection, Artificial Intelligence & Smart Systems

Typical computer vision system - OpenCV (Open Source Computer Vision Library)

Total Notional Hours: 120

L	T	P	TW+SL	C
45	0	30	45	4

LIST OF EXPERIMENTS: [30]

1. Image acquisition and image display using MATLAB/Python (OpenCV).
2. Image enhancement using point processing techniques (brightness and contrast adjustment).
3. Histogram computation and histogram equalization.
4. Image smoothing using mean, Gaussian, and median filters.
5. Edge detection using Sobel, Prewitt, Roberts, and Canny operators.
6. Image sharpening using Laplacian filtering.
7. Region-based image segmentation and region growing.
8. Color image processing and color space conversion

TEXT BOOKS:

- [1] Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd ed., Springer, 2022.
- [2] Rafael C. Gonzales and Richard E. Woods, *Digital Image Processing*, 4th ed., Pearson Education, 2018.

REFERENCE BOOKS:

- [1] Anil K Jain. *Fundamentals of Digital Image Processing*, PHI Learning Pvt. Ltd, 2nd ed. 2011.
- [2] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, *Digital Image Processing Using MATLAB*, Tata McGraw Hill Pvt. Ltd., 3rd ed., 2011.
- [3] William K Pratt, *Digital Image Processing*, John Willey, . 2nd ed. ,2010.
- [4] Malay K. Pakhira, *Digital Image Processing and Pattern Recognition*, 1st ed., PHI Learning Pvt. Ltd., 2011.

WEB REFERENCES

- [1] “Digital image processing ,”<https://nptel.ac.in/courses/117105135>
- [2] “Digital Image Processing ,”https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee116

25EC256	MICROWAVE THEORY AND ANTENNA	L	T	P	C
		3	0	2	4

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Evaluate the performance parameters of microwave passive and active devices.	2, 8,9	3
CO2	Design matching networks, microwave amplifiers, and oscillators.	2, 8,9	3
CO3	Determine the radiated fields of antennas and arrays.	2, 8,9	3
CO4	Synthesize antennas and arrays for specified conditions.	2, 8,9	3
CO5	Design antennas and arrays using EM simulation tools.	2, 8,9	3
CO6	Measure antenna parameters using a laboratory setup.	2, 8,9	3

MICROWAVE NETWORK THEORY AND MICROWAVE DEVICES

[9]

Microwave frequency bands, S matrix representation of Multi-Port Networks, Properties of the S-matrix, Waveguide multiport junctions: E plane and H plane Tees, Magic Tee, Directional coupler, Isolator and Circulator. Microwave Semiconductor Devices: Gunn Diode, PIN diode, Microwave tubes: Reflex Klystron, TWT and Magnetron oscillators.

MICROWAVE DESIGN PRINCIPLES

[9]

Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design: two-port power gain, stability, LNA, Microwave Oscillator Design.

FUNDAMENTALS OF ANTENNA

[9]

Radiation mechanism, radiation from Hertz dipole: near field, far field, radiated power, radiation resistance Radiation parameters of antenna: half power beam width, directivity, gain, beam solid angle, effective height, radiation efficiency, half-wavelength dipole antenna, quarter wave monopole antenna, Yagi-Uda antenna, Log Periodic antenna, Friis transmission equation, Link budget.

ANTENNA ARRAYS

[9]

Two element array; Uniform Linear Array: direction of maximum radiation, broadside and end-fire directions, directions of nulls, directions of side lobes, half power beam width, directivity of uniform array, grating lobe, array synthesis; Special Types of Arrays: binomial array, Dolph-Chebyshev array

PRACTICAL ANTENNAS AND MEASUREMENT

[9]

Horn antenna, Parabolic reflector antenna, Microstrip patch Antennas, Millimeter wave antenna, UWB antenna, Metamaterial, FSS, Radiation pattern measurements, Measurement of gain, Polarization and VSWR.

LIST OF EXPERIMENTS:

[30]

1. Design and simulation of Impedance Matching Network: L-Matching, Stub Matching, Quarter wave line matching.
2. Design and Simulation of Rectangular Microstrip Antenna, Microstrip array antenna, metamaterial antenna.
3. Mode Characteristics of Reflex Klystron Oscillator.

4. Measurement of radiation pattern and gain of antenna: Horn Antenna, Dipole antenna.
5. Measurement of VSWR and Frequency using slotted line method.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	0	30	45	4

TEXT BOOKS:

- [1] Constantine A. Balanis, Antenna Theory-Analysis and Design, Wiley-India, 4th ed., 2016.
- [2] Pozar, D.M., *Microwave Engineering*, John Wiley & Sons, 4th ed., 2013.

REFERENCE BOOKS:

- [1] Annapurna Das, Sisir K Das, *Microwave Engineering*, 3rd ed., McGraw-Hill, 2nd ed., 2017.
- [2] Matthew M Radmanesh, *Radio Frequency and Microwave Electronics*, Pearson, 1st ed. 2015.
- [3] John D Kraus, Ronald J Marhetka, Ahmad S Khan, *Antennas and Wave Propagation*, 5th ed., Tata McGraw Hill, 2017.
- [4] Samuel Y Liao, *Microwave Devices and Circuits*, 3rd ed., Pearson, 2021.
- [5] Jordan and Balmain: *Electromagnetic waves and radiating systems*, Pearson, 2nd ed., 2015.

WEB REFERENCES

- [1] “Analysis and Design Principles of Microwave Antennas,” [Online]. Available: <https://nptel.ac.in/courses/108105114>
- [2] “Microwave Theory and Techniques,” <https://nptel.ac.in/courses/108101112>

25EC215	SYSTEM VERILOG FOR DESIGN AND VERIFICATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the behavior of different digital blocks using System Verilog.	1,2	-
CO2	Apply System Verilog verification features for efficient and effective verification.	2,3,5	1
CO3	Analyze the system using coverage-driven techniques.	3,4,5	1
CO4	Analyze the system using assertion-based verification techniques.	1,2	1
CO5	Design and implement a verification environment for digital systems.	5,11	1

INTRODUCTION TO SYSTEM VERILOG AS A VERIFICATION LANGUAGE [12]

System Verilog standards, System Verilog key enhancements for hardware design. Advantages of System Verilog over Verilog, System Verilog data types, Integer Data Type: 2 - State Data types, 4 - State data types, Non-Integer Type, Enumerated data types, User Defined data types, Struct data types, Interfaces, Packages.

SYSTEM VERILOG DATA MANIPULATION AND PROCEDURAL CONSTRUCTS [12]

Type Conversion: Dynamic casting, Static Casting, Strings, Memories: Arrays, Dynamic Arrays, Multidimensional Arrays, Packed Arrays, Associative Arrays, Queues, Array Methods, Tasks and Functions: Verilog Tasks and Functions, Enhancements in S.V, Void Functions, Return Statement, Passing Arguments, Arguments Passing by Name, Default Arguments, Passing Arguments by Value, Passing Arguments by Reference.

SYSTEM VERILOG INTERFACES AND TEST BENCH DESIGN [12]

Signals, SystemVerilog interfaces, SystemVerilog port connections, Interface instantiation, Interfaces, Arguments, Interface Modports, Interface References, Tasks and functions in interface, Verilog Event, Scheduler, SystemVerilog Event Scheduler, Clocking Block, Input and Output Skews, Typical Test bench Environment

SYSTEM VERILOG COVERAGE AND ASSERTIONS [9]

Covergroups, Coverpoints, bins, cross coverage, Assertion types and properties, Assertion-based verification with examples.

Case Study: Simple FIFO (First-In-First-Out) Design, 4-Bit Synchronous Counter, 8-Bit Arithmetic Logic Unit (ALU).

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] J Bhaskar, *A System Verilog Primer*, Star Galaxy Publishing, 2nd ed., 2013.
- [2] Simon Davidmann and Peter Flake, *System Verilog for Design - A Guide to Using SystemVerilog for Hardware Design and Modeling*, Stuart Sutherland, 2nd ed., Springer Science, 2013.

REFERENCE BOOKS :

- [1] Chris Spear, Greg Tumbush, *SystemVerilog for Verification, A Guide to Learning the Testbench Language Features*, Springer Nature Link, 1st ed. 2012.
- [2] Sasan Iman Si , *Step-by-Step Functional Verification with SystemVerilog and OVM* , 2nd ed., CA Spring 2008, ISBN: -0981656212.

WEB REFERENCES:

- [1] “VLSI Design Verification and test” <https://nptel.ac.in/courses/117103125>

25EC276	ARM PROCESSOR AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Develop programs in Embedded C and Assembly to configure and control ARM Cortex-M4 peripherals using industry-standard development tools	1,2,5	1
CO2	Implement GPIO, Timer, and Interrupt-based applications to handle real-time tasks and external events in ARM-based systems	3,4,5,8	2
CO3	Interface analog and digital peripherals such as sensors, DACs, and RTCs using on-chip ADC, SPI, and I2C communication protocols	3,4,9	2
CO4	Design and evaluate embedded application integrating ARM peripherals, ensuring code efficiency and optimized system performance	2,3,4,5,10	1
CO5	Debug and analyze ARM programs using integrated development environments (IDE)	4,5,11	1

LIST OF EXPERIMENTS:

[30]

1. Study and Configuration of ARM Cortex-M4 Development Environment using Keil μ Vision
2. GPIO Programming using Cortex-M4 – LED Blinking and Switch Interface.
3. Delay Generation and Event Timing using On-chip Timers
4. Interrupt Handling and NVIC Configuration in ARM Cortex-M4
5. Analog Sensor Interfacing using On-chip ADC Module
6. External DAC Interfacing using SPI Communication Protocol
7. External RTC Interfacing using I2C Communication Protocol
8. Mini Project – Design of an ARM-based Embedded Application (e.g., Temperature-Controlled Fan or Smart Lighting System)

Total Notional Hours:30

25ME201	ENGINEERING MECHANICS	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Understand and apply the fundamental concepts of force systems, free body diagrams, and moments.	1,2	1
CO2	Analyze and determine the conditions of equilibrium for coplanar force systems using appropriate theorems and methods	1,2	1
CO3	Explain the laws of dry friction and solve problems involving friction in wedges, belts, screws, and rolling resistance.	1,2	1
CO4	Describe and analyze the kinematics and kinetics of particles, including the use of Newton's second law, work-energy, and impulse-momentum principles.	1,2	1
CO5	Compute centroids and moments of inertia for simple and composite sections and understand their significance in engineering applications.	1,2	1

BASICS AND STATICS OF PARTICLES

[9]

Basic dimensions and units, Classification of force system, principle of transmissibility of a force, composition of forces, Free body diagrams, moment, Principle of moments, couple.

EQUILIBRIUM OF COPLANAR FORCE SYSTEM

[9]

Equilibrium of coplanar concurrent force system, Lami's theorem, Equilibrium of coplanar parallel force system, types of loadings, types of supports, Varignon's theorem, Equilibrium of Rigid bodies in two and three dimensions.

FRICTION

[9]

The Laws of Dry Friction, Coefficients of Friction, Description and applications of friction in wedges, thrust bearing (disk friction), belt, screw, Rolling resistance.

DYNAMICS OF PARTICLES

[9]

Displacement, velocity and acceleration their relationship – Rectilinear motion and Curvilinear motion – Newton's second law of motion – Work Energy Equation – Impulse and Potential Energy.

PROPERTIES OF SURFACES AND SOLIDS

[9]

Centroids – simple figures - composite sections - moment of inertia – moment of inertia of composite sections (T, L and I Section) – principal moment of inertia of plane areas - radius of gyration.

Total Notional Hours: 120

L	T	P	TW+SL	C
45	15	0	60	4

TEXT BOOKS:

[1] Beer F. P., and Johnson Jr. E. R., "Vector Mechanics for Engineers", McGraw Hill, 12 th Edition
Year of publication: 2024.

[2] Hibbeler, R.C and Ashok Gupta, “Engineering Mechanics: Statics and Dynamics”, Pearson Education , 15th Edition , 2022.

REFERENCE BOOKS:

- [1] Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, Vikas Publishing House Pvt. Ltd., 2011.
- [2] Kumar, K.L., “Engineering Mechanics”, Tata McGraw–Hill Publishing Company, New Delhi 2011.
- [3] Antony M. Bedford and Wallace Flower, “Engineering Mechanics: Statics and Dynamics”, Pearson, 5th Edition, 2007.

WEB REFERENCES

- [1] https://onlinecourses.nptel.ac.in/noc25_me108/preview
- [2] https://onlinecourses.swayam2.ac.in/aic22_ts73/preview

25ME203	THERMODYNAMICS AND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Analyze thermodynamic systems using fundamental concepts and apply the first law of thermodynamics to solve energy balance problems in closed and open systems including various engineering devices.	1,2,3	1
CO2	Evaluate the performance of heat engines, refrigerators, and heat pumps using second law principles, and calculate entropy changes to assess the feasibility and irreversibility of thermodynamic processes.	1,2,3	1
CO3	Apply property relations and thermodynamic tables to determine the state and properties of pure substances in different phases, and utilize Thermodynamic relations for complex property evaluations.	1,2,3	1
CO4	Analyze vapor power cycles and refrigeration systems to determine thermal efficiency and coefficient of performance, and evaluate the effect of operating parameters on system performance.	1,2,3	1
CO5	Apply psychrometric principles and gas mixture concepts to design and analyze air conditioning processes for various industrial and comfort applications.	1,2,3	1

FUNDAMENTAL CONCEPTS AND FIRST LAW

[9]

Basic concepts: System, control volume, boundaries, property, state, process, cycle. Intensive and extensive properties. Zeroth law and temperature. Work and heat transfer - Sign conventions. First Law for closed systems - Energy balance, internal energy. SFEE for open systems - Applications to turbines, compressors, nozzles, heat exchangers.

SECOND LAW AND ENTROPY

[9]

Second Law: Kelvin-Planck and Clausius statements, reversibility, Carnot cycle and theorem. Heat engines, refrigerators, heat pumps - COP and efficiency. Entropy: Clausius inequality, principle of increase of entropy, T-s diagrams. Entropy changes for ideal gases.

PROPERTIES OF PURE SUBSTANCES

[9]

Phase diagrams: P-v, T-v, P-T diagrams. Triple point, critical point. Steam tables and Mollier chart - Usage and property calculations. Quality determination. Basic Maxwell relations, Tds equations. Ideal gas equation, compressibility factor.

POWER AND REFRIGERATION CYCLES

[9]

Vapor Power Cycles: Rankine cycle - Simple and reheat cycles. Effect of operating parameters on efficiency. Refrigeration: Vapor compression refrigeration cycle, COP calculations. Refrigerants and properties.

PSYCHROMETRY AND GAS MIXTURES

[9]

Gas Mixtures: Dalton's law, partial pressure, properties of ideal gas mixtures. Psychrometry: Humidity ratio, relative humidity, dew point, wet-bulb temperature. Psychrometric chart usage. Processes: Sensible heating/cooling, humidification/dehumidification. Basic air conditioning systems.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Yunus A. Cengel and Michael A. Boles, *Thermodynamics: An Engineering Approach*, 9th ed., McGraw-Hill Education, 2019.
- [2] Nag P.K., *Engineering Thermodynamics*, 6th ed., Tata McGraw Hill, 2017.

REFERENCE BOOKS:

- [1] R.K. Rajput, *Engineering Thermodynamics*, 4th ed., Laxmi Publications, 2018.
- [2] Arora C.P., *Thermodynamics*, Tata McGraw-Hill, 2003.
- [3] Rathakrishnan E., *Fundamentals of Engineering Thermodynamics*, 2nd ed., PHI Learning, 2016.
- [4] Moran M.J., Shapiro H.N., Boettner D.D., and Bailey M.B., *Fundamentals of Engineering Thermodynamics*, 9th ed., John Wiley & Sons, 2018.
- [5] Ballaney P.L., *Thermal Engineering*, 24th ed., Khanna Publishers, 2016.

WEB REFERENCES

- [1] "Basic thermodynamics: Classical and Statistical Approaches,"
<https://nptel.ac.in/courses/104106107>
- [2] "Basic Thermodynamics," <https://nptel.ac.in/courses/112105123>

25ME251	STRUCTURAL BEHAVIOR AND DEFORMATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Apply the concepts of stress, strain, elastic constants, deformation, and thermal stresses.	1,2,3	1
CO2	Apply shear force, bending moment, and bending theory to analyze beams under different loads.	1,2,3,4	1
CO3	Analyze torsion in solid and hollow shafts to determine stress, twist, and power transmission.	1,2,3	1
CO4	Solve problems related to thin and thick cylinders under internal and external pressure.	1,2,3,4	1
CO5	Apply strength of materials concepts to solve engineering and structural problems.	1,2,3	1

STRESS, STRAIN AND DEFORMATION OF SOLIDS

[8]

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stress – Elastic constants – Volumetric strains - Mohr's Circle.

BENDING MOMENT, SHEAR FORCE, STRESS AND DEFLECTION OF BEAMS

[8]

Beams – Types of loading (Point load and Uniformly Distributed Load) – Shear force and bending moment in beams – Cantilevers – Simply supported beams. Theory of simple bending – Bending stress distribution – Euler's Theory – Deflection of Beams – Double Integration Method.

TORSION OF CIRCULAR SHAFTS

[7]

Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts.

THICK AND THIN CYLINDERS

[7]

Stresses in thin cylinders, Lamé's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length, and volume), Simple problems.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

LIST OF EXPERIMENTS:

1. Tension test on a mild steel rod.
2. Torsion test on mild steel rod.
3. Impact test on metal specimen.
4. Deflection test on simply supported beam.
5. Hardness test on metals - Brinell and Rockwell Hardness Number

TEXT BOOKS:

- [1] R. K. Rajput, Strength of Materials (Mechanics of Solids), 8th ed. New Delhi, India: S. Chand Publishing, 2025.
- [2] R. K. Bansal, A Textbook of Strength of Materials, 16th ed. New Delhi, India: Laxmi Publications, 2024.

REFERENCE BOOKS:

- [1] S. S. Rattan, Strength of Materials, 3rd ed. New Delhi, India: McGraw Hill Education, 2023.
- [2] D. K. Singh, Strength of Materials, New Delhi, India: PHI Learning, Latest ed., 2024.
- [3] B. S. Basavarajaiah and P. Mahadevappa, Strength of Materials (SI Units), Bangalore, India: Universities Press, Latest ed., 2023.

WEB REFERENCES

- [1] "Strength Of Materials," <https://nptel.ac.in/courses/112106319>

25ME252	PRODUCTION PROCESSES AND FABRICATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the principles of metal casting processes to produce cast components and analyze the influence of molds, cores, gating and riser systems on casting quality.	1,2,3	1
CO2	Apply appropriate joining processes including welding, brazing, soldering and adhesive bonding techniques for manufacturing and fabrication requirements.	1,2,3	1
CO3	Analyze sheet metal forming operations, die configurations and press mechanisms to determine process parameters and manufacturing feasibility for sheet metal products.	1,2,3	1
CO4	Analyze bulk deformation processes such as rolling, drawing, forging and extrusion to evaluate material flow, defects and product characteristics.	1,2,3	1
CO5	Evaluate powder metallurgy and plastic processing techniques and select suitable manufacturing processes for producing engineering components based on material, quality and application requirements.	1,2,3	1
CO6	Evaluate metal removal processes and select appropriate machining operations, cutting parameters, and machine tools such as lathe, milling, shaping, and grinding machines for the production of components with specified dimensional accuracy and surface finish.	1,2,3	1

METAL CASTING

[6]

Casting process: Terminology, green sand molding, investment casting, die casting, patterns, molds, and cores; solidification and cooling; riser and gating systems; casting defects.

JOINING PROCESSES

[6]

Gas welding: flame types, equipment; Electric Arc Welding (EAW), Gas Metal Arc Welding (GMAW), Gas Tungsten Arc Welding (GTAW); Resistance welding - Spot, seam, projection and flash; Welding defects; Laser beam and friction-stir welding; Principles of brazing, soldering and adhesive bonding.

SHEET METAL PROCESSES

[6]

Principle of shearing, punch-die clearance; Sheet metal operations: blanking, punching, bending, drawing, spinning; Blanking force calculation; Die-set: simple, progressive, compound; Press: open back inclinable press, hydraulic press; Deep drawing and bending processes.

BULK DEFORMATION PROCESSES

[6]

Plastic deformation, hot and cold working; Rolling - Rolling mills, defects in rolled parts; Drawing - Wire and rod drawing; Forging - Open and closed die forging, forging hammers, rotary swaging; Extrusion - direct and indirect extrusion.

POWDER METALLURGY AND PLASTIC PROCESSING

[6]

Production of metal powder: Atomization, crushing; Blending; Compacting; Die pressing, isostatic pressing; Sintering; Types and characteristics of plastics – Molding of thermoplastics – working principles and typical applications – injection molding – Plunger and screw machines – Compression molding transfer molding – Typical industrial applications – introduction to blow-molding Rotational-molding – Film-blowing – Extrusion

LIST OF EXPERIMENTS

1. Preparation of Mould and Casting of a Component using Solid Pattern
2. Machining of spur gear on Cast Iron Workpiece using Milling Machine
3. Gear Shaping using Gear Shaper Machine
4. Step Turning on Workpiece using Lathe Machine
5. Surface Finishing of Workpiece using Grinding Machine

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXTBOOKS:

- [1] Rao P N *Manufacturing Technology*, Tata McGraw Hill Education Private Limited., New Delhi, 2013.
- [2] Serope Kalpakjian and Stephen Schmid *Manufacturing, Engineering and Technology*, Pearson Education., 2018.

REFERENCES:

- [1] Mikell P Groover *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, Wiley., 2015,
- [2] Arora R P *Manufacturing Technology*, Macmillan India Limited., New Delhi, 2011
- [3] Ian Gibson, David Rosen Brent Stucker, *Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing* Springer 2nd ed., 2015
- [4] Amitabhaghosh and Ashok Kumar Mallik, *Manufacturing Science*, East-west press pvt ltd, 2010

WEB REFERENCES

- [1] "Manufacturing Processes I," <https://nptel.ac.in/courses/112107145>

25ME204	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the constitution of alloys, solid solutions, and phase diagrams to understand solidification mechanisms and interpret Fe-Fe ₃ C equilibrium diagram for material selection.	1,2	1
CO2	Apply heat treatment processes including annealing, normalizing, hardening, and tempering to control microstructure and properties of steels using TTT and CCT diagrams.	1,2,3	1
CO3	Select appropriate ferrous and non-ferrous metals including cast irons, steels, copper, aluminum, titanium, and nickel-based alloys based on their microstructure, properties, and engineering applications.	1,2,3	1
CO4	Evaluate the properties and applications of non-metallic materials including polymers, engineering ceramics, composites, and nano-composites for specific engineering requirements.	1,2,4	1
CO5	Analyze mechanisms of plastic deformation, fracture, and failure modes, and perform mechanical testing including tensile, hardness, impact, fatigue, and creep tests to characterize material behavior.	1,2,4	1

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS

[9]

Constitution of alloys - Solid solutions: substitutional and interstitial - Phases - Mechanism of solidification. Phase diagrams - Eutectic, peritectic, eutectoid, peritectoid reactions - Iron-Iron carbide equilibrium diagram.

HEAT TREATMENT

[9]

Full annealing, stress relief, recrystallisation and spheroidising - Normalizing, hardening and tempering of steel. Isothermal transformation diagrams - TTT diagram - Continuous cooling transformation diagram - Austempering, Martempering - Hardenability, Jominy end quench test - Case hardening: carburizing, nitriding, cyaniding, carbonitriding - Flame and induction hardening.

FERROUS AND NON-FERROUS METALS

[9]

Classification of cast iron: compositions, microstructure, properties and applications - Grey, white, malleable, spheroidal - Alloy cast irons. Classification of steels: microstructure, properties and application - Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - Stainless and tool steels - HSLA, Maraging steels. Copper and its alloys: Brass, Bronze and Cupronickel - Aluminium and its alloys: Al-Cu - Precipitation strengthening treatment - Titanium alloys, Mg-alloys, Ni-based super alloys - Shape memory alloys - Properties and applications.

NON-METALLIC MATERIALS

[9]

Polymers: Types of polymer - Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE. Thermoset polymers: Urea and Phenol formaldehydes. Engineering ceramics: Properties and applications of Al₂O₃, SiC, Si₃N₄, PSZ and SIALON -

Intermetallic - Introduction to Composites – Reinforcements- Matrix Materials- Manufacturing Methods-Classification Properties of Composites - Applications- Nano composites - Applications.

MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS [9]

Mechanisms of plastic deformation: slip and twinning - Types of fracture - Fracture mechanics: Griffith's theory. Testing of materials under tension, compression and shear loads - Hardness tests: Micro and nano-hardness tests - Impact test: Izod and Charpy - Fatigue and creep failure mechanisms.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Williams D. Callister, *Material Science and Engineering*, Wiley India Pvt. Ltd., Revised Indian Edition, 2007.

[2] A. Alavudeen, N. Venkateshwaran, and J. T. Winowlin Jappes, *A Textbook of Engineering Materials and Metallurgy*, Laxmi Publications, 2006.

REFERENCE BOOKS:

[1] Kenneth G. Budinski and Michael K. Budinski, *Engineering Materials*, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

[2] Sydney H. Avner, *Introduction to Physical Metallurgy*, McGraw Hill Book Company, 1994.

[3] Amandeep Singh Wadhwa and Harvinder Singh Dhaliwal, *A Textbook of Engineering Material and Metallurgy*, University Sciences Press, 2008.

[4] G. S. Upadhyay and Anish Upadhyay, *Materials Science and Engineering*, Viva Books Pvt. Ltd, New Delhi, 2006.

[5] Raghavan V., *Materials Science and Engineering*, Prentice Hall of India Pvt. Ltd., 1999.

WEB REFERENCES

[1] "Non-ferrous Extractive Metallurgy," <https://nptel.ac.in/courses/113105021>

[2] "Principles of Physical Metallurgy," <https://nptel.ac.in/courses/113105023>

25ME205	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts, terminology and governing laws of mechanisms, cams, gears and friction elements as applied in mechanical systems.	1,2	1
CO2	Explain the working principles and motion characteristics of mechanisms, cams, gear systems and friction drives as used in the design of machines.	1,2,3	1
CO3	Solve kinematic and friction-related problems in mechanisms, cams and gear trains using standard methods as applied to the analysis of machine components.	1,2,3,4,5	1
CO4	Analyse the motion, force transmission and frictional behaviour of machine elements as applied to evaluating the performance of mechanical systems.	1,2,3,4,5,6	1
CO5	Design mechanisms, cam profiles, gear trains and friction drives to meet specified motion and performance requirements as applied in the development of mechanical machines.	1,2,3,4,5,6,9,10	1

BASICS OF MECHANISMS

[9]

Classification of mechanisms - Basic kinematic concepts and definitions - Degree of freedom, - Kutzbach criterion, Gruebler's criterion - Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains - Universal Joint - rocker mechanisms - Introduction to software tools (MATLAB, ADAMS, GeoGebra) for mechanism simulation.

KINEMATICS OF LINKAGE MECHANISMS

[9]

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method Velocity and acceleration polygons - Velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms - Coriolis component of Acceleration - Coincident points- Introduction to linkage synthesis problem.

KINEMATICS OF CAM MECHANISMS

[9]

Classification of cams and followers - Terminology and definitions - Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions - Layout of plate cam profiles - Circular arc and tangent cams.

GEARS AND GEAR TRAINS

[9]

Law of toothed gearing - Involute tooth profiles –Spur Gear terminology and definitions - Gear tooth action - contact ratio - Interference and undercutting- Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value - Parallel axis gear trains -Epicyclic Gear Trains.

FRICTION IN MACHINE ELEMENTS

[9]

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives - Friction in brakes

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] F.B. Sayyad, *Kinematics of Machinery*, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
- [2] Rattan, S.S, *Theory of Machines*, 4th ed., Tata McGraw-Hill, 2014.
- [3] Uicker, J.J., Pennock G.R and Shigley, J.E., *Theory of Machines and Mechanisms*, 4th ed., Oxford University Press, 2014

REFERENCES:

- [1] Allen S. Hall Jr., *Kinematics and Linkage Design*, Prentice Hall, 1961
- [2] Cleghorn.W. L, *Mechanisms of Machines*, Oxford University Press, 2014
- [3] Ghosh. A and Mallick, A.K., *Theory of Mechanisms and Machines*, 3rd ed. Affiliated East-West Pvt. Ltd., New Delhi, 2006.
- [4] John Hannah and Stephens R.C., *Mechanics of Machines*, Viva Low-Prices Student Edition, 1999.
- [5] Thomas Bevan, *Theory of Machines*, 3rd ed., CBS Publishers and Distributors, 2005.

WEB REFERENCES

- [1] "Kinematics of Machines," <https://nptel.ac.in/courses/112104121>
- [2] "Kinematics of Mechanisms and Machines," <https://nptel.ac.in/courses/112105268>

25ME206	MANUFACTURING AND SUSTAINABILITY INTEGRATION	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Explain conventional manufacturing processes and machining operations.	1	1
CO2	Illustrate advanced manufacturing technologies and automation systems.	2	2
CO3	Apply sustainable manufacturing concepts for resource and energy efficiency.	2,3	2,3
CO4	Analyze sustainability integration techniques in manufacturing industries.	3,4	2
CO5	Demonstrate awareness of sustainable industrial practices and modern production systems.	6	2,3

CONVENTIONAL MANUFACTURING TECHNOLOGIES

[8] Introduction to manufacturing systems – Types of Cutting tools-tool geometry-tool life- Centre Lathe Machining processes – Material selection in manufacturing – Economics of Machining.

ADVANCED MANUFACTURING TECHNOLOGIES

[8]

NC - CNC machining — Flexible manufacturing systems (FMS) components and its types– Elements of Computer Integrated Manufacturing (CIM).

SUSTAINABILITY IN MANUFACTURING SYSTEMS

[7]

Principles of Non Traditional Machining Process- Abrasive Machining Process— Sustainable manufacturing concepts – Energy-efficient manufacturing – Resource conservation techniques – Waste minimization and cleaner production.

SUSTAINABILITY INTEGRATION AND INDUSTRIAL APPLICATIONS

[7]

Life Cycle Assessment (LCA) – Sustainable supply chain management – Carbon footprint and environmental impact assessment – Industrial case studies on sustainability integration – Future trends in sustainable manufacturing.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Manufacturing Engineering and Technology, Serope Kalpakjian & Steven R. Schmid, Pearson Education, 8th ed., 2021.
- [2] Additive Manufacturing Technologies, Springer, 3rd ed., 2021.
- [3] Sustainable Manufacturing, Springer, Latest ed., 2021.

REFERENCE BOOKS:

- [1] Smart Manufacturing Technologies for Industry 4.0, CRC Press, 1st ed., 2022.
- [2] Sustainable Manufacturing Processes, Wiley, 1st ed., 2021.
- [3] Green Manufacturing, Springer, Latest ed., 2021.
- [4] Industry 4.0 and Advanced Manufacturing, Elsevier, 1st ed., 2023.

WEB REFERENCES

- [1] "Sustainability through Green Manufacturing Systems: An Applied Approach,"
<https://nptel.ac.in/courses/112104225>
- [2] "Manufacturing Processes II," <http://nptel.ac.in/courses/112105126>
- [3] "Digital Manufacturing & Design Technology Specialization,"
<http://www.coursera.org/specializations/digital-manufacturing-design-technology>

25ME253	THERMAL ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Analyze air-standard power cycles and evaluate the performance parameters of Otto, Diesel, Dual, and Brayton cycles to determine thermal efficiency and mean effective pressure.	1,2	1
CO2	Apply the working principles of internal combustion engines to analyze combustion processes, fuel and ignition systems, and evaluate engine performance parameters through experimental testing.	1,2	1
CO3	Analyze steam generation systems and steam turbines to evaluate boiler performance, nozzle flow characteristics, and turbine efficiencies for power generation applications.	1,2	1
CO4	Evaluate the performance of air compressors and gas turbine power plants, and apply methods to improve cycle efficiency through intercooling, reheating, and regeneration.	1,2	1
CO5	Analyze refrigeration and air conditioning systems to determine coefficient of performance, design suitable refrigeration cycles, and select appropriate components for comfort and industrial applications.	1,2	1

GAS POWER CYCLES

[6]

Air Standard Cycles: Otto cycle, Diesel cycle, Dual cycle and Brayton cycle.

INTERNAL COMBUSTION ENGINES

[6]

Classification & components, working principles, Combustion & knock, Fuel & ignition systems, Engine performance.

STEAM BOILERS AND TURBINES

[6]

Boiler types, Mountings, accessories & performance, Steam nozzles, Impulse turbine, Reaction turbine.

AIR COMPRESSORS AND GAS TURBINES

[6]

Single-stage reciprocating compressor, Multi-stage compression, Rotary & centrifugal compressors, Gas turbine power plant.

REFRIGERATION AND AIR CONDITIONING

[6]

Vapor Compression Refrigeration system, Refrigerants, Vapor absorption system, Air Conditioning systems, Applications.

LIST OF EXPERIMENTS

1. Determination of valve and port timing diagram
2. Determination of Flash & Fire Point and viscosity of various fuels / lubricants
3. Performance Test on Single Cylinder Four-Stroke Diesel Engine
4. Determination of Heat Balance Test on four – stroke Diesel Engine
5. Performance on Retardation Test in four stroke Diesel Engine
6. Morse Test on four stroke petrol Engine
7. Performance Test on Reciprocating Air Compressor
8. Study of Steam Generators and turbines

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] R.K. Rajput, *Thermal Engineering*, 10th ed., Laxmi Publications Pvt. Ltd., 2018.
[2] Mahesh M. Rathore, *Thermal Engineering*, 1st ed., Tata McGraw Hill, 2010.

REFERENCE BOOKS:

- [1] V. Ganesan, *Internal Combustion Engines*, 4th ed., McGraw Hill Publishers, India, 2012.
[2] Domkundwar A.V., Domkundwar V.M., and Kothandaraman C.P., *A Course in Thermal Engineering*, Dhanpat Rai & Co., 2016.
[3] C.P. Arora, *Refrigeration and Air Conditioning*, 3rd ed., McGraw-Hill Education, 2017.
[4] P.K. Nag, *Power Plant Engineering*, 3rd ed., Tata McGraw Hill Publishing Company Ltd., 2008.
[5] S.M. Yahya, *Turbines, Compressors and Fans*, 4th ed., Tata McGraw-Hill Education, 2017.

WEB REFERENCES

- [1] "Thermal Engineering: Basic and Applied," <https://nptel.ac.in/courses/112103316/>
[2] "Thermal Energy," <https://ocw.mit.edu/courses/16-050-thermal-energy-fall-2002/>

25ME254	ENGINEERING METROLOGY AND GEOMETRIC DIMENSIONING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the principles, purpose, parameters, and error sources involved in engineering measurements and metrology systems.	1,2	1
CO2	Apply linear, angular, and form measurement techniques for evaluating dimensional and geometric characteristics of engineering components.	1,2,5	1
CO3	Analyze the working principles and applications of comparators and interferometric instruments used in precision measurement.	1,3,5	1
CO4	Interpret limits, fits, tolerances, and GD&T specifications for manufacturing and assembly applications.	2,4,5	1
CO5	Examine computer aided metrology systems such as Coordinate Measuring Machines (CMM) and Machine Vision Systems for industrial inspection and quality control.	4,5	2

MEASUREMENT PURPOSE AND PARAMETERS

[6]

Measurement – important, Process, Role in quality control; Factors affecting measurement; Errors in Measurements; Measurement of Linear and Angular measuring Instruments; Accuracy, precision, range, resolution, uncertainty and error sources.

COMPARATORS AND INTERFEROMETRY

[6]

Mechanical comparators – Electrical and electronic comparators – Optical comparators – Pneumatic comparators – Advantages and applications of comparators – Principles of interferometry – Optical flats – Interferometers and their applications in precision measurement and quality inspection.

FORM MEASUREMENT

[6]

Principles and methods of straightness and flatness measurement – Thread and gear measurement techniques – Form and surface finish measurement – Roundness measurement. Alignment and testing methods for machine elements and assemblies.

GEOMETRIC TOLERANCING

[6]

Principles of limits, fits, and tolerances – Tolerance zones and grades – Hole basis and shaft basis systems – Taylor's principle of gauging – Fundamentals of Geometric Dimensioning and Tolerancing (GD&T) – Datum systems, geometric tolerances, and inspection methods – Introduction to tolerance analysis in manufacturing and assembly.

COMPUTER AIDED METROLOGY

[6]

Basic concept of Coordinate Measuring Machine (CMM) – Types of CMM – Constructional features – Probes – Accessories – Software – Applications. Basic concepts of Machine Vision System – Elements – Applications.

LIST OF EXPERIMENTS

[30]

1. Measurement of Linear Measuring Instruments
2. Measurement of Angular Measuring Instruments
3. Measurement of Assembly and Transmission Elements
4. Measurement of Screw Thread Parameters Using Optical Profile Projector

5. Measurement of Single Point Cutting Tool Parameters Using Tool Maker's Microscope
6. Measurement of Surface Roughness Using Surface Finish Tester
7. Dimensional Measurement Using Coordinate Measuring Machine (CMM)

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Raghavendra N V, Krishnamurthy L, *Engineering metrology and measurements*, Oxford university press, New Delhi, 2021
- [2] I.C. Gupta *A Textbook of Engineering Metrology*, Dhanpat Rai Publications, New Delhi, 2021

REFERENCE BOOKS:

- [1] Mark Curtis, Francis T. Farago, *Handbook of Dimensional Measurement*, Industrial Press, 5th ed., 2013.
- [2] Beckwith T G, Roy D, Marangoni, John H Lienhard V, *Mechanical Measurements*, Pearson, India, 2019.
- [3] E.O Doebelin and Dhanesh Manik, *Measurement Systems*, McGraw Hill, 2017
- [4] Bewoor & Kulkarni, *Metrology & Measurement* Tata McGraw Hill, 2009.
- [5] 3D. James, and S, Meadow, *Geometric Dimensioning and Tolerancing*, Marcel Dekker, 1995

WEB REFERENCES

- [1] "Mechanical Measurements and Metrology," <https://nptel.ac.in/courses/112106138>
- [2] "Principles Of Mechanical Measurement," <https://nptel.ac.in/courses/112103261>

25ME255	FLOW DYNAMICS AND HYDRAULIC SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental behavior and characteristics of fluids and interpret their role in engineering applications.	1	1
CO2	Apply governing principles to analyze fluid motion and quantify flow behavior in practical engineering systems.	1,2	1
CO3	Analyze fluid transport systems and evaluate performance considering energy interactions and system constraints.	1,2	1
CO4	Apply similarity principles to develop models and evaluate system behavior under varying operating conditions.	1,2,4	1
CO5	Evaluate the performance of fluid-based energy systems and interpret their operational characteristics for engineering applications.	1,2	1

FLUID PROPERTIES - STATICS & DYNAMICS

[8]

Properties of fluids - Classification of fluids - Types of fluid flow, Forces on submerged bodies, Stability of floating bodies, Continuity equation, Bernoulli's equation and its applications, Momentum equation.

FLOW THROUGH PIPES

[7]

Basics of compressible fluid flow, Viscous flow of incompressible fluids, Boundary layer concepts, Losses in pipes - Major losses - Darcy - Weisbach equation and Chezy's equation - Minor losses - pipes in series and parallel - Equivalent length.

DIMENSIONAL ANALYSIS AND MODELLING

[8]

Dimensional Analysis - Basic and derived quantities, Buckingham π - theorem, Reynolds, Froude and Mach numbers and their applications in model testing.

HYDRAULIC MACHINERY

[7]

Turbines - Classification & Performance, Specific speed and their significance, Pumps - Classification & working principles, Indicator diagram.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

LIST OF EXPERIMENTS

1. Determination of Major and Minor Losses in Pipe Flow
2. Experimental determination of Coefficient of Discharge [C_d] of Venturimeter and Orificemeter.
3. Experimental Analysis of a Centrifugal Pump / Reciprocating Pump
4. Determination of Coefficient of Discharge [C_d] using Rotameter
5. Performance Test on a Pelton Wheel Turbine / Francis Turbine

TEXT BOOKS:

- [1] Bansal, R.K., Fluid Mechanics and Hydraulics Machines, 11th ed., Laxmi Publications Pvt. Ltd, New Delhi, 2023.
- [2] Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd ed. 2019.

REFERENCE BOOKS:

- [1] Shiv Kumar, Fluid Mechanics, Vol. 1: Basic Concepts and Principles, Springer, Cham, 4th ed., 2023.
- [2] Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
- [3] Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House (p) Ltd. New Delhi, 2016.

WEB REFERENCES

- [1] "Fluid dynamics and turbomachines," <https://nptel.ac.in/courses/112106200>
- [2] "Ideal fluid flows using complex analysis," <https://nptel.ac.in/courses/112102316>

25ME207	SENSORS AND ACTUATORS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals and characteristics of sensors.	1,2	2
CO2	Illustrate the working of smart sensors used in automation systems.	2,5	2
CO3	Apply the principles of actuators in engineering applications.	1,3	1
CO4	Analyze actuator systems and their integration in industrial automation and robotics	1,2,3,4	1,2
CO5	Demonstrate awareness of modern sensor and actuator applications in smart manufacturing systems.	3,5	2

FUNDAMENTALS OF SENSORS

[7]

Introduction to sensors – Classification of sensors – Static and dynamic characteristics – Measurement principles – Displacement, temperature, pressure, and flow sensors – Signal conditioning basics.

INDUSTRIAL AND SMART SENSORS

[8]

Proximity sensors – Optical sensors – Ultrasonic sensors – MEMS sensors – Smart sensors and IoT-based sensing systems – Sensor calibration and interfacing techniques.

FUNDAMENTALS OF ACTUATORS

[7]

Introduction to actuators – Classification of actuators – Electrical actuators – Pneumatic actuators – Hydraulic actuators – Solenoids and relay systems – Actuator characteristics and selection criteria.

INDUSTRIAL ACTUATORS AND APPLICATIONS

[8]

Types of Servo motors – Linear actuators – Sensor-actuator interfacing – Actuators in industrial automation – Robotics and mechatronics applications – Smart manufacturing and Industry 4.0 applications.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Sensors and Transducers, PHI Learning, 3rd ed., 2021.
- [2] Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education, 7th ed., 2021.
- [3] Industrial Automation and Robotics, Mercury Learning and Information, 2nd ed., 2022.

REFERENCE BOOKS:

- [1] Instrumentation, Measurement and Analysis, McGraw Hill, 5th ed., 2021.
- [2] Principles of Industrial Instrumentation, McGraw Hill, Latest ed., 2021.
- [3] Modern Industrial Automation, New Age International, 1st ed., 2022.
- [4] Robotics and Industrial Automation, Wiley India, Latest ed., 2023.

WEB REFERENCES

- [1] "Industrial Instrumentation," <http://nptel.ac.in/courses/108105064>
- [2] "Sensors and Sensor Circuit Design," <https://www.coursera.org/learn/sensors-circuit-interface>
- [3] "Mechatronics," <http://nptel.ac.in/courses/112107298>

25ME208	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of stress, failure theories, material behaviour and design parameters as applied in machine member design.	1,2	1
CO2	Explain the principles of static and variable loading, fatigue behaviour, design philosophies and the working of machine joints and energy storing elements as used in mechanical design.	1,2,3	1
CO3	Solve problems on shaft design, fastener selection, spring and flywheel sizing, and bearing selection using standard design equations as applied to machine components.	1,2,3,4	1
CO4	Analyse the stress states, failure modes and loading conditions of machine elements to assess their suitability in mechanical systems.	1,2,3,4	1
CO5	Design shafts, welded and bolted joints, springs, flywheels and bearings to satisfy specified load, life and performance requirements as applied in the development of mechanical machines.	1,2,3,4	1

INTRODUCTION, STEADY AND VARIABLE STRESSES IN MACHINE MEMBER [10]

Machine design: Definition, design process, machine element design, review of types of stress including buckling stress, contact stress and impact stress; Introduction to design standards - IS, ASME, ISO codes - Design for static loading: Modes of failure, factor of safety, eccentric loading, theories of failure, problems; Design for variable loading: Stress concentration factor design equations - Soderberg, Goodman and Gerber equations, combined stresses.

DESIGN OF SHAFTS AND COUPLINGS

[9]

Design of shafts: Forces on shafts due to gears, belts and chains, design for strength and rigidity – lateral stiffness, torsional rigidity, critical speed; Design of keys; Overview of couplings and coupling design.

DESIGN OF WELDED JOINTS AND SCREWED FASTENERS

[9]

Welded joints: Types - strength of a welded joint - Design of parallel and transverse fillet Welded Joints - Eccentric loading; Screwed Fasteners: Nomenclature, Forms of screw threads, Types, bolts of uniform strength - Design of bolted joints under tension - Eccentric loading.

DESIGN OF ENERGY STORING ELEMENTS

[8]

Springs: Introduction, Types - Design of Helical and Leaf springs subject to constant loads and varying loads - Design of Concentric helical springs. Flywheel: Introduction, Fluctuation of Speed and Energy.

DESIGN OF BEARINGS AND CONNECTING ROD

[9]

Bearings: Introduction, Nomenclature, Types - Design of Sliding contact bearings - Selection of Rolling contact bearings; Design of Connecting rod.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

NOTE:

1. Use of P.S.G. Design data Book is permitted in the Semester Examination.

TEXTBOOKS

- [1] Bhandari V, *Design of Machine Elements*, 5th ed., Tata McGraw-Hill Book Co, 2020. ISBN-10 : 9390177472, ISBN-13 : 978-9390177479
- [2] Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett *Mechanical Engineering Design*, 10th ed., Tata McGraw-Hill, 2017. ISBN-10 : 933922163X ISBN-13 : 978- 8184956207.

REFERENCES

- [1] Robert L. Norton, *Machine Design - An Integrated Approach*, Pearson, 6th ed. 2019.
- [2] Spotts M.F., Shoup T.E. and L. E. Hornberge, *Design of Machine Elements*, Pearson Education, 8th ed., 2019.
- [3] Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, *Design of Machine Elements* 8th ed., Prentice Hall, 2003. ISBN-13: 9780130489890
- [4] Prabhu. T.J., *Design of Transmission Elements*, Mani Offset, Chennai, 2015.
- [5] Sundararajamoorthy T. V. Shanmugam N., *Machine Design*, Anuradha Publications, Chennai, 2015. ISBN-13 : 9788187721208.

WEB REFERENCES

- [1] "Design of Machine Elements I," <http://nptel.ac.in/courses/112105124/>

25ME256	DYNAMICS OF MACHINERY	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the principles of dynamic forces, balancing, vibrations, governors, and gyroscopic effects used in automotive and industrial systems.	1,2,5	1
CO2	Explain the behavior of vibrating systems, balancing methods, speed regulation, and gyroscopic stabilization in modern mechanical applications.	1,2,3,4,5	1
CO3	Apply force analysis, balancing, and vibration concepts to reciprocating engines, rotating machines, and EV drivetrain systems.	1,2,3,4,5	1
CO4	Analyze machine performance using vibration signatures, stability characteristics, and intelligent control techniques for fault diagnosis and condition monitoring.	1,2,3,4,5,6	1,2
CO5	Design and evaluate advanced speed control and autonomous stability systems using AI, PID controllers, and MEMS gyroscopes for smart mobility applications.	1,2,3,4,5,6,9,10,11	1,2

KINEMATICS & DYNAMIC FORCE ANALYSIS

[6]

Dynamic force analysis – Inertia force and Inertia torque– D Alembert’s principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses.

BALANCING

[6]

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines.

VIBRATION

[6]

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration – Two rotor torsional systems. Harmonic disturbances –transmissibility – Vibration isolation.

INTELLIGENT SPEED REGULATION & CONTROL

[6]

Governors – Types of governors – Centrifugal governors – Gravity-controlled and spring-controlled governors – Controlling force diagrams – Characteristics of governors – Sensitiveness.

AUTONOMOUS STABILITY

[6]

Gyroscopes – Gyroscopic principles – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in automobiles – Gyroscopic effects in ships – Gyroscopic effects in airplanes – MEMS gyroscopes, IMUs in autonomous vehicles,

LIST OF EXPERIMENTS:

[30]

1. Determination of moment of inertia of flywheel and axle system.
2. Undamped free vibrations of a single degree freedom spring-mass system.
3. Torsional Vibration (Undamped) of single rotor shaft system.
4. Dynamic analysis of cam mechanism.
5. Experiment on Watt Governor.
6. Experiment on Porter Governor.
7. Experiment on Proell Governor.
8. Experiment on motorized gyroscope.
9. Determination of critical speed of shafts.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] F.B. Sayyad, *Kinematics of Machinery*, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
- [2] Rattan, S.S, *Theory of Machines*, 4th ed., Tata McGraw-Hill, 2014. 3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th ed., Oxford University Press, 2014.

REFERENCES:

- [1] Allen S. Hall Jr., *Kinematics and Linkage Design*, Prentice Hall, 1961
- [2] Cleghorn.W. L, *Mechanisms of Machines*, Oxford University Press, 2014
- [3] Ghosh. A and Mallick, A.K., *Theory of Mechanisms and Machines*, 3rd Edit ion Affiliated East-West Pvt. Ltd., New Delhi, 2006.
- [4] John Hannah and Stephens R.C., *Mechanics of Machines*, Viva Low-Prices Student Edition, 1999.
- [5] Thomas Bevan, *Theory of Machines*, 3rd ed., CBS Publishers and Distributors, 2005.

WEB REFERENCES

- [1] "Dynamics of Machines," <https://nptel.ac.in/courses/112101096>
- [2] "Dynamics of Machines," <https://nptel.ac.in/courses/112104114>

25ME257	DIGITAL DESIGN AND AUTOMATED PRODUCTION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply appropriate CAD tools to create 2D layouts, sectional views, and parametric solid models using operations such as extrude, revolve, sweep, and loft.	1,2,4,5	2
CO2	Analyze geometric modeling techniques by comparing curve, surface, and solid representations (Bezier, B-spline, CSG, B-Rep) for suitability in engineering product design.	1,2,3,4,5	2
CO3	Analyze CNC machine structures, axis systems, drives, and controllers to determine their influence on machining accuracy, productivity, and process performance.	1,2,4,5	1,2
CO4	Evaluate smart manufacturing strategies, including CAPP, feature recognition, and machinability data systems, to optimize process planning and manufacturing decisions.	1,2,3,4,5	2
CO5	Evaluate component assemblies using CAD by performing constraint-based assembly, exploded views, and interference analysis to validate design functionality.	1,2,3,4,5	2

FUNDAMENTALS OF COMPUTER-AIDED DESIGN

[8]

Product cycle- Design process- sequential and concurrent engineering– CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation. CAD data exchange standards (STEP, IGES, and STL)

GEOMETRIC MODELING

[7]

Representation of curves- Hermite cubic spline curve - Bezier curve- B-spline curves-Techniques for surface modeling - Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep, Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.

FUNDAMENTALS OF CNC

[8]

Introduction of CAM package, Introduction to NC systems and CNC - Machine axis and Co- ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers.

MANUFACTURING IN INDUSTRY

[7]

Process Planning function, Retrieval & Generative process planning systems, Feature Recognition in CAPP, Benefits of CAPP, Machine-ability Data systems, Computer generated time standards.

LIST OF EXPERIMENTS:

[30]

1. Part Modelling and Assembly of a Flange Coupling
2. Part Modelling and Assembly of a Knuckle Joint

3. Part Modelling and Assembly of a Screw Jack
4. Part Modelling and Assembly of a Plummer Block
5. Part Modelling and Assembly of a Universal Coupling

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Ibrahim Zeid *Mastering CAD CAM* Tata McGraw-Hill Publishing Co.2008
- [2] P. Radhakrishnan, S. Subramanyan and V. Raju, *CAD/CAM/CIM*, 5th ed.. New Delhi, India: New Age International, 2024.

REFERENCE BOOKS:

- [1] Rogers, D.E and Adams, J.A., *Mathematical Elements for Computer Graphics*, 2nd ed. McGraw-Hill, 2002.
- [2] Peter scalon, *Process planning, Design/Manufacture Interface*, Elsevier science technology Books, Dec 2003.
- [3] Sinha B.P, *Mechanical estimating and Costing*, Tata-McGraw Hill publishing co, 2004.

WEB REFERENCES

- [1] "Computer Aided Design and Manufacturing I," <https://nptel.ac.in/courses/112102102>
- [2] "Computer Aided Engineering Design," <https://nptel.ac.in/courses/112104031>

25ME258	HEAT TRANSFER	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply Fourier's law and thermal resistance concepts to analyze steady-state heat conduction through composite walls and cylindrical systems with internal heat generation.	1,2,4	1
CO2	Analyze transient heat conduction using lumped capacitance method and Heisler charts, and evaluate fin performance for heat transfer enhancement.	1,2,4	1
CO3	Apply empirical correlations to determine convection heat transfer coefficients for forced and natural convection, boiling and condensation.	1,2,4	1
CO4	Analyze and design heat exchangers using LMTD and Effectiveness-NTU methods to evaluate thermal performance.	1,2,4	1
CO5	Apply radiation heat transfer principles concepts for industrial thermal applications.	1,2,4	1

STEADY STATE HEAT CONDUCTION

[6]

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation.

TRANSIENT CONDUCTION AND FINS

[6]

Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts – Methods of enhanced thermal conduction.

CONVECTIVE HEAT TRANSFER

[6]

Differential analysis of hydrodynamic and thermal boundary layers; Forced and free convection, external and internal flow, laminar and turbulent flow.

HEAT EXCHANGERS

[6]

Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications. Case study.

RADIATION

[6]

Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

LIST OF EXPERIMENTS

1. Determination of Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.

2. Determination of heat transfer coefficient convection heat transfer.
3. Determination of Thermal conductivity of insulating powder.
4. Determination of Heat transfer from pin-fin apparatus.
5. Determination of Stefan – Boltzmann constant.
6. Determination of emissivity of a grey surface.
7. Determination of Effectiveness of Parallel / counter flow heat exchanger
8. Determination of COP of a refrigeration system and air conditioning system.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Yunus A. Cengel and Afshin J. Ghajar, *Heat and Mass Transfer: Fundamentals and Applications*, 5th ed., McGraw Hill Education, 2020.
- [2] P.K. Nag, *Heat and Mass Transfer*, 3rd ed., Tata McGraw Hill, 2017.

REFERENCE BOOKS:

- [1] Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, and Adrienne S. Lavine, *Fundamentals of Heat and Mass Transfer*, 8th ed., John Wiley & Sons, 2017.
- [2] R.C. Sachdeva, *Fundamentals of Engineering Heat and Mass Transfer*, 2nd ed., New Age International Publishers, 2017.

WEB REFERENCES

- [1] "Heat Transfer," <https://nptel.ac.in/courses/103105140>
- [2] "Heat Transfer," <https://nptel.ac.in/courses/112101003>

25ME209	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand and summarize the basics of finite element formulation, Weighted residual methods and Ritz technique.	1,2	1,2
CO2	Apply the stiffness matrices and force vector equations in one-dimensional problems of bar, solid mechanics and springs.	1,2	1,2
CO3	Analyze the two dimensional scalar and vector variable problems of triangular and axisymmetric elements.	1,2	1,2
CO4	Apply the Jacobian matrix solution techniques in the isoparametric Formulation.	1,2	1,2
CO5	Analyze the heat transfer in finite element formulation various modes	1,2	1,2

INTRODUCTION TO FEA

[9]

Historical Background – Basic concepts of FEA, General procedure of FEA, Mathematical Modeling of field problems in Engineering –Governing Equations –Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique.

ONE-DIMENSIONAL PROBLEMS

[9]

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Natural coordinates- Solution of problems from solid mechanics, bar, springs, Temperature effects, plane stresses and strains.

TWO DIMENSIONAL SCALAR AND VECTOR VARIABLE PROBLEMS

[9]

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations.

ISOPARAMETRIC FORMULATION

[9]

Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions, Jacobian matrix – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems.

HEAT TRANSFER ANALYSIS

[9]

Basic equations of heat transfer and fluid flow, finite element formulation and solution of one-dimensional heat transfer problems involving steady state heat conduction and convection.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] David Hutton, *Fundamentals of Finite Element Analysis*, Tata McGrawHill, 2017
- [2] Dhanaraj. R and Prabhakaran Nair. K, *Finite Element Analysis*, Oxford Publications, 2015.
- [3] Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, 4th ed., Wiley Student Edition, 2017.

REFERENCE BOOKS:

- [1] Seshu.P, *Text Book of Finite Element Analysis*, PHI Learning Pvt. Ltd., New Delhi, 2017.
- [2] Rao, S.S., *The Finite Element Method in Engineering*, 6th ed., Butterworth-Heinemann, 2015.
- [3] Reddy,J.N. *Introduction to the Finite Element Method*, 4th ed., Tata McGrawHill,2018.

WEB REFERENCES

- [1] “Basics of Finite Element Analysis - I” <https://nptel.ac.in/courses/112104193>
- [2] “Basics of Finite Element Analysis - II” <https://nptel.ac.in/courses/112104205>

25ME209	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand and summarize the basics of finite element formulation, Weighted residual methods and Ritz technique.	1,2	1,2
CO2	Apply the stiffness matrices and force vector equations in one-dimensional problems of bar, solid mechanics and springs.	1,2	1,2
CO3	Analyze the two dimensional scalar and vector variable problems of triangular and axisymmetric elements.	1,2	1,2
CO4	Apply the Jacobian matrix solution techniques in the isoparametric Formulation.	1,2	1,2
CO5	Analyze the heat transfer in finite element formulation various modes	1,2	1,2

INTRODUCTION TO FEA

[9]

Historical Background – Basic concepts of FEA, General procedure of FEA, Mathematical Modeling of field problems in Engineering –Governing Equations –Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique.

ONE-DIMENSIONAL PROBLEMS

[9]

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Natural coordinates- Solution of problems from solid mechanics, bar, springs, Temperature effects, plane stresses and strains.

TWO DIMENSIONAL SCALAR AND VECTOR VARIABLE PROBLEMS

[9]

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Constitutive matrices and Strain displacement matrices – Stiffness matrix – Stress calculations.

ISOPARAMETRIC FORMULATION

[9]

Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions, Jacobian matrix – Numerical integration - Matrix solution techniques – Solutions Techniques to Dynamic problems.

HEAT TRANSFER ANALYSIS

[9]

Basic equations of heat transfer and fluid flow, finite element formulation and solution of one-dimensional heat transfer problems involving steady state heat conduction and convection.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] David Hutton, *Fundamentals of Finite Element Analysis*, Tata McGrawHill, 2017
- [2] Dhanaraj. R and Prabhakaran Nair. K, *Finite Element Analysis*, Oxford Publications, 2015.
- [3] Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, 4th ed., Wiley Student Edition, 2017.

REFERENCE BOOKS:

- [1] Seshu.P, *Text Book of Finite Element Analysis*, PHI Learning Pvt. Ltd., New Delhi, 2017.
- [2] Rao, S.S., *The Finite Element Method in Engineering*, 6th ed., Butterworth-Heinemann, 2015.
- [3] Reddy,J.N. *Introduction to the Finite Element Method*, 4th ed., Tata McGrawHill,2018.

WEB REFERENCES

- [1] "Basics of Finite Element Analysis - I," <https://nptel.ac.in/courses/112104193>
- [2] "Basics of Finite Element Analysis - II," <https://nptel.ac.in/courses/112104205>

25ME210	ADDITIVE MANUFACTURING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles of additive manufacturing and compare various AM processes including extrusion, jetting, sintering, and photopolymerization.	1, 2	1
CO2	Analyze file formats, software tools, and data processing workflows used in the AM design and fabrication pipeline.	1, 3	2
CO3	Select appropriate AM process parameters, materials, and equipment to meet specific engineering design requirements.	2, 4	1
CO4	Apply design for additive manufacturing (DfAM) principles including support strategies, hybrid, and composite material considerations.	3, 5	1
CO5	Evaluate real-world AM applications in aerospace, automotive, and biomedical sectors, and assess rapid tooling and distributed manufacturing approaches.	6, 11	1,2
CO6	Discuss commercialization pathways, current trends, and future directions in additive manufacturing including mass customization and direct digital manufacturing.	7, 11	2,3

INTRODUCTION TO ADDITIVE MANUFACTURING

[6]

Basic principles of additive manufacturing; historical development and evolution of AM technologies; comparison with subtractive and formative manufacturing; AM process chain overview; classification of AM processes; advantages, limitations, and application domains of AM.

AM PROCESSES

[8]

Extrusion-based processes (FDM/FFF); jetting processes (material jetting, binder jetting); sheet lamination (LOM); photo polymerization (SLA, DLP); powder bed fusion (SLS, DMLS, EBM); directed energy deposition (LENS, EBAM); process principles, materials, and capabilities for each.

DESIGN AND DATA PROCESSING FOR AM

[6]

Data sources and 3D scanning; STL, AMF, and 3MF file formats; model repair and validation; slicing software and toolpath generation; design for additive manufacturing (DfAM) principles; support structure strategies; topology optimization; design with multiple materials, hybrids, and composites; pre- and post-processing operations.

PROCESS SELECTION, MATERIALS AND APPLICATIONS

[6]

Process and material selection criteria; direct digital manufacturing (DDM); distributed manufacturing concepts; related technologies: rapid tooling, mold making, and 3D scanning; applications in aerospace, automotive, and biomedical sectors; case studies in industrial AM adoption.

COMMERCIALIZATION AND FUTURE DIRECTIONS

[4]

Product development using AM; mass customization and on-demand manufacturing; business models for AM commercialization; current trends in metal AM, bioprinting, and 4D printing. Future directions: AI-assisted AM, multi-material systems, sustainability considerations, and emerging AM technologies.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Gibson, I., Rosen, D., Stucker, B., and Khorasani, M., Additive Manufacturing Technologies, 3th ed., Springer, 2021.
- [2] Chua, C.K., Leong, K.F., 3D Printing and Additive Manufacturing: Principles and Applications, 5th ed., World Scientific, 2017.

REFERENCE BOOKS:

- [1] Hopkinson, N., Hague, R., and Dickens, P., Rapid Manufacturing: An Industrial Revolution for the Digital Age, 1th ed., Wiley, 2006.
- [2] Gibson, I., Advanced Manufacturing Technology for Medical Applications, 1th ed., Wiley, 2005.
- [3] Gebhardt, A., Understanding Additive Manufacturing, 1th ed., Hanser, 2011.
- [4] Redwood, B., Schaffer, F., and Garret, B., The 3D Printing Handbook, 1th ed., 3D Hubs, 2017.

WEB REFERENCES

- [1] "Fundamentals of Additive Manufacturing Technologies," <https://nptel.ac.in/courses/112103306>
- [2] "Metal Additive Manufacturing," <https://nptel.ac.in/courses/112104312>

25ME211	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the terminology, classifications, materials, and standard design procedures involved in flexible elements, gears, gearboxes, clutches, and brakes.	1,2	1
CO2	Explain the working principles, power transmission mechanisms, stress distribution, and operational characteristics of belts, chains, gears, clutches, and braking systems.	1,2,3	1
CO3	Apply standard design equations, AGMA standards, and design methodologies to design flat belts, V-belts, chain drives, spur gears, helical gears, bevel gears, and worm gears for specified applications.	1,2,3,4	1
CO4	Analyze the performance, load carrying capacity, thermal behavior, efficiency, and failure modes of transmission elements and gearbox systems under varying operating conditions.	1,2,3,4	1
CO5	Evaluate suitable materials, design standards, lubrication methods, and manufacturing considerations for mechanical power transmission systems based on industrial requirements.	1,2,3,4,6	1,2
CO6	Design and develop complete mechanical transmission systems including gearboxes, clutches, brakes, and gear drives for machine tool and industrial applications considering safety, reliability, and performance criteria.	1,2,3,4,6	1

DESIGN OF FLEXIBLE ELEMENTS

[9]

Belt-types, materials, belt joint, Design of Flat belts - Design of V belts – Design of hoisting wire ropes – Design of Transmission chain drives.

DESIGN OF SPUR GEARS AND HELICAL GEARS

[9]

Gear introduction- Types, Terminology, materials – Design of spur gear based on Hertz and Belayav method, AGMA method – Design of helical gear based on Hertz and Belayav method, AGMA method.

DESIGN OF BEVEL AND WORM GEARS

[9]

Straight bevel gear: Tooth terminology, Design of straight bevel gears. Worm Gear: tooth terminology. Design of worm gear pair, thermal capacity, materials.

DESIGN OF GEAR BOXES

[9]

Fundamentals - step ratio- ray diagram - kinematics layout -Design of multi-speed gearbox for machine tools.

DESIGN OF CLUTCHES AND BRAKES

[9]

Internal - Expanding Rim clutches - contracting rim clutches and Band type clutches - Friction materials - Design of single and multiple plate and cone clutches - Types of brakes - Internal and External shoe brakes.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

NOTE:

1. Use of P.S.G. Design data Book is permitted in the Semester Examination.

TEXTBOOKS:

- [1] Bhandari V, *Design of Machine Elements*, 5th ed., Tata McGraw-Hill Book Co, 2020. ISBN-10 : 9390177472, ISBN-13 : 978-9390177479
- [2] Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett *Mechanical Engineering Design*, 10th ed., Tata McGraw-Hill, 2017. ISBN-10 : 933922163X ISBN-13 : 978- 8184956207.

REFERENCES BOOKS:

- [1] Robert L. Norton, *Machine Design - An Integrated Approach*, Pearson, 6th ed. 2019.
- [2] Spotts M.F., Shoup T.E. and L. E. Hornberge, *Design of Machine Elements*, Pearson Education, 8th ed., 2019.
- [3] Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, *Design of Machine Elements* 8th ed., Printice Hall, 2003. ISBN-13: 9780130489890
- [4] Prabhu. T.J., *Design of Transmission Elements*, Mani Offset, Chennai, 2015.
- [5] Sundararajamoorthy T. V. Shanmugam .N, *Machine Design*, Anuradha Publications, Chennai, 2015. ISBN-13 : 9788187721208.

WEB REFERENCES

- [1] "Design of Machine Elements I," <http://nptel.ac.in/courses/112105124/>

25ME259	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of CFD, governing equations, boundary conditions, and classification of partial differential equations used in fluid flow analysis.	1,2	2
CO2	Apply finite difference and finite volume methods for discretization of fluid flow and heat transfer governing equations.	1,2,3,4	2
CO3	Analyze convection–diffusion problems using various numerical schemes and evaluate their accuracy and stability.	1,2,3,4	2
CO4	Evaluate pressure–velocity coupling methods, mesh generation techniques, and flow field solution procedures for CFD analysis	1,2,3,4	2
CO5	Develop CFD models using modern computational tools and interpret simulation results for engineering applications.	1,2,3,4,5	2

CFD FUNDAMENTALS AND GOVERNING EQUATIONS

[8]

Introduction to CFD – Applications in Mechanical Engineering – Conservation of Mass, Momentum and Energy – General Transport Equation – Boundary Conditions – Classification of PDEs: Elliptic, Parabolic and Hyperbolic Equations.

DISCRETIZATION METHODS

[7]

Finite Difference Method – Taylor Series Expansion – Forward, Backward and Central Difference Schemes – Explicit and Implicit Methods – Stability, Consistency and Convergence – Finite Volume Method – Control Volume Formulation.

CONVECTION–DIFFUSION ANALYSIS

[8]

Convection–Diffusion Problems – Central and Upwind Differencing Schemes – Hybrid and Power Law Schemes – QUICK Scheme – Properties of Numerical Schemes – Applications in Heat Transfer and Fluid Flow.

PRESSURE–VELOCITY COUPLING AND FLOW FIELD ANALYSIS

[7]

Mesh Generation: Structured and Unstructured Grids – Grid Quality and Grid Independence – Staggered Grid – Pressure Correction Equation – SIMPLE and PISO Algorithms – Internal and External Flow Analysis.

LABORATORY EXPERIMENTS

1. Design a 3D CAD Model
2. Geometric Modeling and Mesh Generation of 2D rectangle geometry
3. Study of Laminar flow inside the circular pipe
4. Geometric Modeling and Mesh Generation of A 2-D Convergent-Divergent Nozzle and Analysis of Flow for Adiabatic Conditions /
5. Geometric Modelling and Mesh Generation of A 2-D Pipe and Modeling Steady/ Unsteady Heat Convection and Conduction

6. Numerical simulation of Flow over an airfoil /
7. Numerical simulation of Flat plate boundary layer

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] P.S. Ghosdastidar, Computer Simulation of Flow and Heat Transfer, Tata McGraw-Hill (2015).
- [2] Muralidhar, K., and Sundararajan, T. Computational Fluid Flow and Heat Transfer, Narosa Publishing. House (2017).

REFERENCE BOOKS:

- [1] Niyogi, P. Chakrabarty, S.K. and Laha, M.K., Introduction to computational fluid dynamics, Pearson education (2006).
- [2] LI J., G. H. Yeoh, C Liu. A Computational Fluid Dynamics, ELSEVER (2008)
- [3] S K Gupta. Numerical Methods for Engineers, New Age Publishers, 2nd ed. (2005).
- [4] Anderson J.D. Computational Fluid Dynamics, Mc-Graw Hills (2005).
- [5] Ranade, V.V., Computational flow modeling for chemical reactor engineering, Academic Press (2002).
- [6] J H Ferziger and M Peric, Computational Methods for Fluid Dynamics, Springer (2012)

WEB REFERENCES

- [1] "Computational Fluid Dynamics," <https://nptel.ac.in/courses/112105045>
- [2] "Applied Computational Fluid Dynamics," <https://nptel.ac.in/courses/101104450>

25ME260	INDUSTRIAL AUTOMATION AND MECHATRONICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify the basic elements of Mechatronics system and choose suitable sensors and actuators for appropriate applications.	1,2	1,2
CO2	Apply mechatronic design concepts for engineering applications and case studies.	1,2,3	1,2
CO3	Explain industrial automation principles, control systems, and PLC architectures.	1,2,5	2
CO4	Analyze SCADA, DCS, robotics, and Industry 4.0 applications in industrial automation.	1,2,3	1,2
CO5	Demonstrate awareness of modern mechatronics and automation technologies in industrial applications.	1,2,5	2,3

INTRODUCTION TO MECHATRONICS

[8]

Introduction to Mechatronics – Need for Mechatronics – Types of Control system – Elements of Mechatronics System. Sensors and Transducers: Static and Dynamic Characteristics, Sensors: LVDT – Capacitance sensors – Eddy current sensor – Hall effect sensor. Actuators: Stepper Motor and Servo Motor.

MECHATRONIC SYSTEM DESIGN

[7]

Design process - Stages of Design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems: Drone actuation and Control – Engine Management system – Interactive IoT Sensors for Agriculture

FUNDAMENTALS OF INDUSTRIAL AUTOMATION

[8]

Introduction to industrial automation – Automation principles and strategies – Types of automation – Industrial control systems – Sensors and actuators in automation – Architecture of Programmable Logic Controllers (PLC) – Selection of PLC.

AUTOMATION SYSTEMS AND INDUSTRIAL APPLICATIONS

[7]

Architecture of SCADA and Distributed Control Systems (DCS) – Robotics in industrial automation – Automated material handling systems – Industry 4.0 and smart factory concepts.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

LIST OF EXPERIMENTS:

1. Study of Hydraulic, Pneumatic and Electro-pneumatic circuits
2. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software
3. Design and implement a PLC ladder logic program to actuate a single acting cylinder using AND & OR gate
4. Design and implement a PLC ladder logic program to actuate a single acting cylinder using a two way pressure valve and 3/2 single solenoid valve
5. Design and implement a PLC ladder logic program to actuate a double acting cylinder using electrical push button switch in meter-in and meter- out circuit
6. Design and implement an interface circuit to control a stepper motor using an 8051 microcontroller
7. Study of SCADA and DCS

TEXT BOOKS:

- [1] Bradley D.A., Burd N.C., Dawson D., Loader A.J., *Mechatronics: Electronics in Products and Processes*, Routledge, 2017.
- [2] Groover, M.P., *Industrial Robotics, Technology, Programming and Applications*, 2nd ed., Tata McGraw-Hill, 2012.

REFERENCE BOOKS:

- [1] J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 4th ed., Upper Saddle River, NJ, USA: Pearson, 2018
- [2] De Silva, *Mechatronics: A Foundation Course*, Taylor & Francis, Indian Reprint, 2013
- [3] Deb, Sathya Ranjan, *Robotics Technology and Flexible Automation*, 2nd ed., Tata McGraw-Hill Publication, New Delhi, 2010.
- [4] Saeed B. Niku, *Introduction to Robotics: Analysis, Control, Applications*, 2nd ed., John Wiley & Sons, Inc., 2011.

WEB REFERENCES

- [1] "Mechatronics," <https://nptel.ac.in/courses/112107298>
- [2] "Industrial Automation and Control," <https://nptel.ac.in/courses/108105062>

25ME212	VEHICLE SYSTEMS AND MOBILITY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the classification, architecture, and layout of conventional and modern automobiles including IC engine, hybrid, electric, and fuel-cell vehicles.	1,2	1
CO2	Illustrate the working principles and performance characteristics of automotive propulsion and transmission systems.	1,2,5	1
CO3	Analyze steering, suspension, and braking systems with respect to vehicle stability, ride comfort, and safety.	2,3,5	1
CO4	Examine energy storage systems, EV charging technologies, and electric vehicle design packages for sustainable mobility applications.	1,4,5,1 1	1,2,3
CO5	Analyze advanced automotive safety systems and emission control techniques used in modern vehicles.	2,5,6,1 1	1,3

AUTOMOBILE ARCHITECTURE AND VEHICLE CLASSIFICATION

[9]

Introduction to automobiles - Classification of vehicles: IC engine vehicles, hybrid vehicles, electric vehicles, fuel-cell vehicles - Chassis layout -Types of frames - Basic vehicle dimensions and terminology - Liquid and gaseous alternate fuels for automobiles – Alcohol fuels, LPG, CNG, and Hydrogen.

PROPULSION SYSTEMS

[9]

IC Engines: Types, Fuel injection systems: MPFI and CRDI, superchargers and turbochargers, digital engine control - Transmission systems: Manual, AMT, CVT, DCT, automatic transmissions - Drivetrain layouts and power flow.

STEERING, SUSPENSION AND BRAKING SYSTEMS

[9]

Steering systems: manual, power steering, rack-and-pinion, electronic steering - Suspension systems: types, geometry, ride comfort, anti-dive/squat - Braking systems: drum, disc, ABS, EBD, regenerative braking.

ENERGY STORAGE SYSTEM AND EV DESIGN PACKAGES

[9]

Batteries – types, range, life and recycling; super-capacitors; Charging – standards, infrastructure, methods, modes, wireless power transfer, solar charging; EV design packages – Battery car conversion technology, electric van and truck design.

SAFETY SYSTEMS AND EMISSION CONTROL

[9]

Electronic transmission control. Traction control system – Adaptive cruise control – Antilock braking system - Electronic suspension system – ADAS - Airbag system and role of MEMS in airbag systems. Automotive air pollution and engine emissions – Emission control techniques – Three-way catalytic converter system – Introduction to Motor Vehicle Act (MV Act) – Emission norms: Euro and Bharat Stage (BS) standards.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Tom Denton, *Automobile Electrical and Electronics Systems*, 5th ed., Routledge Taylor and Francis Publishers, London, 2018.
- [2] Ribbens William B, *Understanding Automotive Electronics*, 8th ed., Butterworth- Heinemann, Burlington, 2017.

REFERENCE BOOKS:

- [1] James D Halderman, *Automotive Electricity and Electronics*, 6th ed., Pearson Education, New York, 2020.
- [2] Najamuz Zaman, *Automotive Electronics Design Fundamentals*, 1st ed., Springer International Publishing, Switzerland, 2015.
- [3] Denton Tom, *Automobile Electrical and Electronics Systems*, 3rd ed., Edward Arnold Publishers, 2012.
- [4] Dhameja, S. (2018). *Electric Vehicle Engineering* (1st ed.). Khanna Publishing House.

WEB REFERENCES

- [1] "Fundamentals of Automotive Systems," <https://nptel.ac.in/courses/107106088>
- [2] "EV - Vehicle Dynamics and Electric Motor Drives," <https://nptel.ac.in/courses/108102121>

25CS203	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles of algorithm analysis.	1, 2	1
CO2	Apply divide-and-conquer, greedy, and dynamic programming techniques to solve classical computational problems.	1, 2	1
CO3	Derive the time and space complexity of algorithmic strategies.	2, 4	1
CO4	Design algorithmic solutions for real-world problems using appropriate paradigms such as greedy methods, dynamic programming, and heuristic-based approaches.	3	1
CO5	Evaluate the suitability and efficiency of different algorithmic approaches for solving NP-hard problems and justify the use of approximation algorithms where exact solutions are intractable.	2, 4	1

Introduction to Algorithm Analysis

[9]

Algorithm analysis: Fundamentals of Algorithmic Problem Solving, the Analysis Framework, Asymptotic Notations and its properties, Recurrence relation: substitution method and Master's method.

Divide-and-conquer

[9]

Divide and Conquer: Finding Maximum and Minimum, Quick Sort, Merge Sort, Strassen's Matrix Multiplication, Closest pair and convex hull.

Greedy method and Dynamic Programming

[9]

Knapsack problem, Dijkstra's Algorithm. Dynamic Programming techniques: Principle of Optimality, Floyd's algorithm, longest common subsequence, Optimal binary search trees.

Backtracking and Branch-and-bound

[9]

N-Queens's problem, Sum of subsets, Hamiltonian Cycle, Branch and Bound: Knapsack problem – Traveling salesman problem.

NP-Problems and Approximation Algorithms

[9]

P and NP problems, NP-Complete problems, Cook's theorem, Theory of reducibility, Approximation Algorithms: Knapsack problem, Traveling salesman problem.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Anany Levitin. Introduction to the Design and Analysis of Algorithms, 3/E. Pearson, 2021.

REFERENCE BOOKS:

[1] Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. Fundamentals of Computer Algorithms, 2/E. University Press, 2024.

- [2] Sridhar S. Design and Analysis of Algorithms, 2/E. Oxford University Press, 2014.
- [3] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein. Introduction to Algorithms, 4/E, PHI Learning, 2018.
- [4] Jon Kleinberg, Eva Tardos. Algorithm Design, Pearson, 2013.

WEB REFERENCES:

- [1] "Design and analysis of algorithms, 2025," <https://nptel.ac.in/courses/106106131>
- [2] "Design and Analysis of Algorithms, 2023," <https://nptel.ac.in/courses/106101060>
- [3] "Design and Analysis of Algorithms," <https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2012/>

25CS204	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of computer organization.	1, 2	1
CO2	Apply computer arithmetic principles to design and evaluate hardware algorithms for signed and unsigned integer operations, floating-point arithmetic, and their implementation in ARM architecture.	1, 2	1
CO3	Distinguish between processor design techniques.	2, 4	1
CO4	Design memory and I/O interfacing systems.	3	1
CO5	Evaluate parallel processing architectures and their performance implications.	2, 4	1

Basic Structure of Computers

[9]

Functional units – basic operational concepts – Bus Structures - Technology – Performance – Power wall – Uniprocessor to multiprocessor – Instructions: Operations and Operands – Instruction Set: RISC and CISC - Representing Instructions — ARM Addressing for 32-bit Immediate and more complex addressing modes.

Computer Arithmetic

[9]

Addition and Subtraction – Multiplication – Multiplication Algorithm and Hardware – Signed Multiplication - Faster Multiplication in ARM - Division – Division Algorithm and Hardware - Signed Division – Faster Division in ARM - Floating Point Representation – Floating Point Operations: Addition - Multiplication – Floating point instructions in ARM.

Processor Design

[9]

An abstract view of implementation - Logic design Conventions - Building a datapath – Simple implementation scheme – Pipelining – Pipelined Datapath and Control - Hazards – Data Hazards – Control Hazards – Exceptions.

Memory and I/O Interfacing

[9]

Memory Technologies – Basics of Caches – Measuring and Improving Cache Performance – Virtual Memory – Transaction- Look aside Buffer (TLB) - Memory Hierarchy - Input/output system, programmed I/O, DMA and interrupts, I/O processors.

Parallel Processing

[9]

Parallelism - Instruction-level-parallelism – Parallel processing challenges - Hardware multithreading – SISD, MIMD, SIMD, SPMD and Vector - Multicore processors – Shared memory Multiprocessors – Graphical Processing Units – Multiprocessor Network Topologies.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] David A. Patterson and John L. Hennessey. Computer Organization and Design: The Hardware / Software Interface. Morgan Kaufman / Elsevier, ARM Edition, 2021.

REFERENCE BOOKS:

- [1] V. Carl Hamacher, Zvonko G Vranesic, and Safwat G Zaky. Computer Organization, 6/E. McGraw-Hill Inc, 2021.
- [2] William Stallings. Computer Organization and Architecture – Designing for Performance, 11/E, PHI Learning, 2022.
- [3] Morris Mano M, Rajib Mall. Computer System Architecture, 3/E, Pearson, 2023.
- [4] Andrew S. Tanenbaum. Structured Computer Organization, 6/E, Pearson, 2024.

WEB REFERENCES:

- [1] "Computer Architecture, 2025," <https://nptel.ac.in/courses/106102157>
- [2] "Computer Architecture and Organization, 2023," <https://nptel.ac.in/courses/106105163>
- [3] "Computer System Architecture," <https://ocw.mit.edu/courses/6-823-computer-system-architecture-fall-2005/>

25CS254	OPERATING SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental organization and architecture of computer systems, the evolution of operating systems, OS structure, and the process of building and booting an OS.	1, 2	1
CO2	Implement process management techniques to solve scheduling problems.	1, 2	1
CO3	Apply synchronization mechanisms to coordinate concurrent processes and resolve resource conflicts.	1,2, 3, 5	1
CO4	Recommend memory management strategies to improve system performance.	1, 2, 3, 4, 5	1
CO5	Compare their trade-offs across different operating systems in terms of system structure.	1,2,4	1

Introduction to Operating Systems

[4]

Computer System Organization – Computer System Architecture- Evolution of Operating System- OS Structures: OS Services - System Calls –OS Structures- Building and Booting an OS.

Process Management

[8]

Processes: Process Concept- Process Scheduling-Operations on Process- Inter-process Communication – Threads - Multithread Models. CPU Scheduling: Basic Concept-Scheduling Criteria-Scheduling Algorithms- Multi-Processor Scheduling. Process Synchronization: Critical Section Problem – Peterson’s Solution-Semaphores - Monitors – Hardware Synchronization: Deadlocks: System Model-Characterization-Methods-Prevention -Avoidance and Detection-Recovery from Deadlocks.

Memory Management

[6]

Memory Management Strategies: Swapping – Contiguous Memory Allocation -Segmentation - Paging. Virtual Memory Management: Demand Paging - Page Replacement Algorithms- Thrashing.

File Management and Disk Management

[8]

File System: File concepts – Access Methods -Directory and Disk Structure-File System Mounting- File System Structure-Implementation-Directory Implementation-Allocation Methods-Free Space Management. Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management -Swap Space Management- I/O Systems - System Protection and Security.

Advancements in Operating Systems

[4]

Virtual Machines- Network and Distributed Systems – Case Studies: Linux-Windows 11.

LIST OF EXPERIMENTS

[30]

1. Linux Commands
2. System Calls
3. CPU Scheduling
4. Semaphore
5. Deadlock Avoidance

6. Paging
7. Page Replacement Algorithms
8. File Allocation Methods
9. Directory Implementation
10. Disk Scheduling

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. Operating System Concepts, 10/E. John Wiley and Sons, 2021.

REFERENCE BOOKS:

- [1] William Stallings. Operating Systems - Internals and Design Principles, 9/E. Pearson, 2018.
 [2] Andrew S. Tanenbaum. Modern Operating Systems, Pearson, 2024.

WEB REFERENCES:

- [1] "Introduction to Operating Systems, 2021," https://onlinecourses.nptel.ac.in/noc21_cs72
 [2] "Operating System Fundamentals, 2021," https://onlinecourses.nptel.ac.in/noc21_cs88/

25CS255	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe fundamental DBMS concepts, data models, database architecture, and schema design principles.	1, 2	1
CO2	Apply relational algebra and SQL queries to create, manipulate, and retrieve database data.	1, 2	1
CO3	Recommend normalization techniques and ER modeling to eliminate redundancy and improve database integrity.	1,2,5	1
CO4	Evaluate query execution and optimization strategies for improving database performance.	1,2,3,5	1
CO5	Design ETL pipelines, data warehousing solutions, and data engineering workflows for scalable data processing.	1,2,3,5	1

DATABASE CONCEPTS AND ARCHITECTURE

[6]

Database system overview, DBMS architecture, data models (hierarchical, network, relational), schema vs instance, data independence, ER modeling, enhanced ER concepts (specialization, generalization, aggregation), relational schema mapping.

RELATIONAL MODEL AND QUERY LANGUAGES

[6]

Relational algebra (operators and expressions), relational calculus (tuple and domain), SQL: DDL, DML, DQL, constraints, joins, nested/correlated subqueries, views, triggers, assertions, transactions, concurrency basics.

NORMALIZATION AND INTEGRITY

[6]

Functional, multivalued, and join dependencies, attribute closure, keys and candidate keys, normal forms (1NF, 2NF, 3NF, BCNF), lossless decomposition, dependency preservation, indexing concepts (B-tree, B+-tree).

QUERY PROCESSING, STORAGE & OPTIMIZATION

[6]

Query execution stages, cost estimation, sorting, hashing, join techniques, query rewrite rules, plan selection, buffer management, caching, RAID storage, file organizations (heap, sorted, hashed, clustered).

DATA ENGINEERING AND WAREHOUSING

[6]

Introduction to data engineering, ETL lifecycle, data integration techniques, data warehousing architecture, OLTP vs OLAP, star/snowflake schema, dimensional modeling, ETL/ELT tools, Big Data platforms and distributed processing.

LIST OF EXPERIMENTS

[30]

1. Create and query relational databases using SQL DDL/DML/DQL.
2. Implement joins, nested and correlated queries.
3. Apply constraints, triggers, and views in database design.
4. Perform ER modeling and map to relational schemas.

5. Normalize database tables to 3NF/BCNF and test for integrity.
6. Develop a mini ETL pipeline or data warehousing workflow using a sample dataset.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Abraham Silberschatz, Henry F. Korth, S. Sudharshan. Database System Concepts, 7/E. McGraw-Hill, 2021.

REFERENCE BOOKS:

- [1] Ramez Elmasri and Shamkant B. Navathe. Fundamentals of Database Systems, 7/E. Pearson, 2017.
- [2] Garcia-Molina H., Ullman J.D., Widom J. Database Systems: The Complete Book, 3/E, Pearson, 2020.
- [3] Mark L. Gillenson, Pradeep Singh. Fundamentals of Database Management Systems, 3/E, Wiley, 2025.

WEB REFERENCES:

- [1] "Database Systems, 2025," https://onlinecourses.nptel.ac.in/noc24_cs55
- [2] "Data Engineering Foundations, 2025," <https://www.coursera.org/specializations/data-engineering-foundations>

25IT253	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of AI and the ethical implications of modern AI systems.	1, 2	1
CO2	Apply supervised learning algorithms to build predictive models using appropriate performance metrics and optimization techniques.	1,2,3,5	1
CO3	Deploy unsupervised learning techniques to discover hidden patterns in unlabeled data.	1,2,3,5	1
CO4	Use reinforcement learning algorithms to develop agents that learn optimal behaviors through interaction with environments.	1,2,3,5	1
CO5	Select appropriate machine learning models considering the limitations, bias, fairness, and data privacy concerns.	1,2,3,4,5	1

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

[6]

History and evolution of AI - Turing Test - intelligent agents - agent environments - State space representation - uninformed search (BFS, DFS, UCS) - informed search (Greedy BFS, A* algorithm) - heuristic functions, adversarial search (Minimax, Alpha-Beta pruning) - Propositional logic - first-order logic - knowledge graphs - inference rules – resolution - expert systems.

MODERN AI CONCEPTS

[6]

Bayesian networks - probabilistic inference - Markov chains - Monte Carlo methods - Dempster-Shafer theory for uncertainty handling - LLM architectures (transformers, attention mechanisms) - prompt engineering - fine-tuning - Retrieval-Augmented Generation (RAG) - ethical considerations - Fuzzy set theory - fuzzy inference systems - genetic algorithms (selection, crossover, mutation) - swarm intelligence - applications in optimization and control.

SUPERVISED LEARNING

[6]

Linear regression - polynomial regression - logistic regression - performance metrics (MSE, MAE, R^2 , accuracy, precision, recall, F1-score, ROC-AUC) - bias-variance tradeoff - cross-validation techniques - K-Nearest Neighbors (KNN) - Decision Trees (ID3, C4.5, CART) - Random Forest, Support Vector Machines (SVM) - Naïve Bayes classifier - ensemble methods (bagging, boosting, AdaBoost) – Perceptron - multi-layer perceptrons (MLP) - activation functions (sigmoid, ReLU, tanh) – backpropagation - gradient descent optimization (SGD, Adam) - introduction to CNNs and RNNs.

UNSUPERVISED LEARNING

[6]

Curse of dimensionality - Principal Component Analysis (PCA) - t-SNE - Linear Discriminant Analysis (LDA) - feature selection methods - K-Means clustering, hierarchical clustering – DBSCAN - Gaussian Mixture Models - cluster evaluation metrics (silhouette score, Davies-Bouldin index) - Apriori algorithm - FP-Growth - market basket analysis - support-confidence-lift framework - rule generation and pruning.

REINFORCED LEARNING

[6]

Markov Decision Processes (MDPs) - rewards and returns - policy and value functions - exploration vs. exploitation - Q-learning - SARSA - Deep Q-Networks (DQN) - policy gradient methods (REINFORCE,

PPO) - Actor-Critic architectures - applications in robotics and autonomous systems - AI ethics (bias, fairness, transparency, accountability) - explainable AI (XAI) - data privacy (GDPR, anonymization) - real-world case studies in healthcare, finance, autonomous vehicles and NLP.

LAB EXPERIMENTS

1. Introduction to Python for AI/ML
2. Search Algorithm Implementation
3. Knowledge Graph Construction
4. Bayesian Network Inference
5. Regression and Classification
6. Neural Network Implementation.
7. Dimensionality Reduction and Visualization
8. Clustering for Customer Segmentation
9. Q-Learning
10. Generative AI Application

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Pradeep Singh, Tapan K. Gandhi, & Balasubramanian Raman. Artificial Intelligence and Machine Learning, 1/E. McGraw-Hill, 2025.

REFERENCE BOOKS:

- [1] Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 4/E. Pearson, 2022.
[2] Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das. Machine Learning, Pearson, 2024.
[3] Reema Thareja. Artificial Intelligence: Beyond Classical AI. Pearson, 2023.

WEB REFERENCES:

- [1] "Introduction to Machine Learning," <https://nptel.ac.in/courses/106106139>
[2] "Artificial Intelligence: Search Methods for Problem Solving," <https://nptel.ac.in/courses/106106226>

25CS205	COMPUTATIONAL THEORY AND AUTOMATA	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the fundamental concepts of finite automata.	1,2	1
CO2	Describe regular expressions and the limitations of finite automata.	1, 2	1
CO3	Construct a DFA/NFA/ ϵ -NFA for the given languages and apply the pumping lemma to prove that a language is not regular.	1,2,3,4	1
CO4	Design context-free grammar and construct push-down automata from CFGs for language acceptance by the final state or the empty stack.	1,2,3	1
CO5	Design Turing machines for language acceptance and integer functions to evaluate the halting problem and the Post correspondence problem (PCP).	1,2,3,4	1

Finite Automata

[9]

Alphabets - Strings and Languages - Automata and Grammars - Deterministic Finite Automata (DFA) - Formal Definition - Simplified notation: State transition graph - Transition table - Language of DFA - Nondeterministic Finite Automata (NFA) - NFA with epsilon transition - Language of NFA - Equivalence of NFA and DFA - Minimization of Finite Automata – Weighted Automata.

Regular Expression

[9]

Definition - Operators of regular expression and their precedence - Algebraic laws for Regular expressions - Kleene's Theorem - Regular expression to FA - DFA to Regular expression - Arden Theorem - Non Regular Languages - Pumping Lemma for Regular Languages. Application of Pumping Lemma - Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.

Grammars

[9]

Grammar Introduction– Types of Grammar - Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols - Unit productions - Null productions – Greibach Normal form – Chomsky Normal form – Problems related to CNF and GNF.

Pushdown Automata

[9]

Description and definition - Instantaneous Description - Language of PDA - Acceptance by Final state - Acceptance by empty stack - Deterministic PDA - Equivalence of acceptance by empty stack and final state - Conversion of CFG to PDA and PDA to CFG.

Turing Machines & Undecidability

[9]

Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions - Universal TM - Recursive and recursively enumerable languages - Halting problem - Introduction to undecidability - undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP and undecidable nature of Post correspondence problem.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Hopcroft J.E., Motwani R. and Ullman J.D. Introduction to Automata Theory, Languages and Computations, 2/E. Pearson Education, 2016.

REFERENCE BOOKS:

- [1] John C. Martin. Introduction to Languages and the Theory of Computation, 4/E. Tata McGraw-Hill, 2010.
- [2] Mishra K L P and Chandrasekaran N. Theory of Computer Science – Automata, Languages and Computation, 3/E, Prentice Hall of India, 2006.
- [3] K.R. Chowdhary. Theory of Computation: Automata, Formal Languages, Computation and Complexity, Springer, 2025.

WEB REFERENCES:

- [1] "Theory of Computation, 2025," <https://nptel.ac.in/courses/106104148>
- [2] "Theory of Computation, 2025," <https://nptel.ac.in/courses/106106242>
- [3] "Theory of Computation," <https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/>

25IT254	PROGRAMMING IN JAVA	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply fundamental Java programming concepts.	1,2	1
CO2	Apply inheritance, interfaces, packages, and exception handling to develop modular and robust programs.	1, 2, 4	1
CO3	Apply multithreading, concurrency, and Java I/O mechanisms to manage parallel execution and data streams.	1,2,3,5	1
CO4	Apply generics, collections, and functional programming (lambda expressions and the Stream API) to write efficient, reusable code.	1,2,3,5	1
CO5	Develop interactive Java applications using GUI components and JDBC for database connectivity.	1,2,3,5	1
CO6	Integrate modern Java features such as text blocks, records, switch expressions, and sealed classes into applications to enhance readability, scalability, and performance.	1,2,3,5	1

JAVA FUNDAMENTALS & OBJECT-ORIENTED CONCEPTS

[6]

Introduction to Java – JDK, JRE, JVM, platform independence – Data types, variables, operators, expressions – Control statements (if, switch, loops) – Arrays, Strings, StringBuilder – Classes, objects, constructors, methods, this, static, access modifiers – Encapsulation and packages.

INHERITANCE, INTERFACES & EXCEPTION HANDLING

[6]

Inheritance: super/subclasses, method overriding, dynamic dispatch, final classes/methods – Abstract classes and interfaces (default/private methods) – Nested and inner classes – Packages and access control – Exception handling: try/catch/finally, throw/throws, custom exceptions, assertions.

MULTITHREADING, CONCURRENCY & I/O

[6]

Threads: Thread vs Runnable, lifecycle, priorities, synchronization, inter-thread communication – Concurrency utilities: ExecutorService, Future, concurrent collections – Java I/O: byte/character streams, buffered streams, Files API, serialization/deserialization.

GENERIC, COLLECTIONS & FUNCTIONAL PROGRAMMING

[6]

Generics: parameterized types, wildcards, bounded types – Collections framework: List, Set, Map, Queue, iterators, comparators – Lambda expressions, method references, functional interfaces – Stream API: filtering, mapping, reducing, parallel streams.

GUI, JDBC & MODERN JAVA FEATURE

[6]

GUI development using Swing: frames, panels, layout managers, event handling – JDBC: architecture, CRUD operations, transactions – Modern Java features: text blocks, records, switch expressions, sealed classes.

LAB EXPERIMENTS

1. Java basics: data types, operators, control statements, arrays, and Strings.

2. Object-oriented programming: classes, objects, constructors, encapsulation, inheritance, and polymorphism.
3. Exception handling and interfaces/abstract classes.
4. Multithreading and file I/O operations.
5. Generics, collections, lambda expressions, and Stream API operations.
6. GUI development and JDBC CRUD application (e.g., Student Record Management).

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Herbert Schildt. Java: The Complete Reference, 12/E. McGraw-Hill, 2021.

REFERENCE BOOKS:

[1] Cay S. Horstmann. Core Java, Volume I: Fundamentals, 13/E. Pearson, 2024.

[2] P. Deitel and H. Deitel. Java: How to Program, 12/E, Pearson, 2025.

[3] Joshua Bloch. Effective Java, 3/E, Addison-Wesley, 2018.

WEB REFERENCES:

[1] "Programming in Java, 2025," https://onlinecourses.nptel.ac.in/noc21_cs04/

[2] "Learning Java Programming, 2025," <https://docs.oracle.com/javase/tutorial/>

25IT213	DISCRETE STRUCTURES	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply basic set theory, relations, and function operations, including composition and inverse	1,2,5	1
CO2	Analyze partial orders, construct lattices and Boolean algebras, and apply them to logical reasoning.	1,2,5	1
CO3	Apply propositional and predicate logic to construct valid proofs using different proof strategies.	1,2,5	1
CO4	Use concepts of groups, monoids, and codes to solve algebraic and coding problems.	1,2,5	1
CO5	Analyze finite state machines and classify formal languages using grammar rules.	1,2,5	1

Sets, Relations and Functions

[9]

Basic concepts- Algebra of sets - The power set - Ordered pairs and Cartesian product - Relations on sets -Types of relations and their properties - Relational matrix and the graph of a relation - Equivalence relations. Functions - Classification of functions-Types of functions- Composition of functions and inverse of a function.

Lattices and Boolean Algebra

[9]

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra.

Logic and Proofs

[9]

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

Algebraic Structures

[9]

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Rings and Fields (Definitions and examples).

Graph Theory

[9]

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

List of Experiments using MATLAB

1. Truth Table Generation for Propositional Logic
2. Implementation of Relations and Equivalence Classes
3. Hasse Diagram for Lattices
4. Boolean Algebra Expression Simplification
5. Predicate Logic Evaluation
6. Automated Proof Checker

7. Group Theory Operations
8. Coset Generation and Visualization
9. Graph Representation using Adjacency Matrix
10. Euler & Hamiltonian Graph Simulation

Total Notional Hours: 90

L	T	P	TW+SL	C
30	15	0	45	3

TEXT BOOK:

- [1] Kenneth H. Rosen, and Kamala Krithivasan. Discrete Mathematics and its Applications, 8/E. Tata McGraw-Hill, 2021.
- [2] Tremblay, J.P. and Manohar, R. Discrete Mathematical Structures with Applications to Computer Science, 1/E. Tata McGraw-Hill, 2017.

REFERENCE BOOKS:

- [1] Lipschutz, S. and Mark Lipson. Discrete Mathematics, 3/E, Tata McGraw-Hill, 2017.
- [2] Grimaldi, R.P. Discrete and Combinatorial Mathematics: An Applied Introduction, 4/E, Pearson Education Asia, Delhi, 2007.
- [3] Koshy, T. Discrete Mathematics with Applications, Elsevier Publications, 2006.

WEB REFERENCES:

- [1] "Discrete Mathematics," <https://nptel.ac.in/courses/106106094>
- [2] "Mathematical Foundations for Computer Science," <https://nptel.ac.in/courses/106102220>
- [3] "Mathematics for Computer Science," <https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2005/>
- [4] "Introduction to Discrete Mathematics for Computer Scientists," <https://www.coursera.org/learn/discrete-mathematics>
- [5] "Mathematical Thinking in Computer Science," <https://www.coursera.org/specializations/mathematics>
- [6] "Discrete Math – Set Theory and Logic," <https://www.khanacademy.org/math/statistics-probability/probability-library>,
<https://www.khanacademy.org/computing/computer-science/cryptography>

25IT255	COMPUTER NETWORKS AND COMMUNICATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts, layered architectures (OSI/TCP-IP), and core functionalities of data communication and computer networks, from physical transmission to application protocols.	1, 2	1
CO2	Analyze the operation of key data-link and network-layer protocols to evaluate their design choices, addressing schemes, and performance across different network scenarios.	1, 2, 3, 4	1
CO3	Apply principles of reliable data transfer, flow control, and congestion control to configure, troubleshoot, and optimize transport layer protocols (TCP/UDP) for efficient end-to-end communication.	1,2,3, 4,5	1
CO4	Analyze the role, interaction, and security implications of standard application layer protocols and network management frameworks in the context of modern networked systems.	1,2,3,4, 5	1
CO5	Utilize foundational concepts of network security and emerging paradigms (IoT, SDN, virtualization) to design basic secure network architectures and assess their vulnerabilities.	1,2,3,4, 5	1

FUNDAMENTALS

[6]

Introduction to data communications and networking – network types – OSI and TCP/IP models – signals – bandwidth – data rate limits – transmission media – line coding – modulation techniques – multiplexing – circuit and packet switching.

PHYSICAL AND DATA LINK LAYERS

[6]

Error detection and correction – framing – flow control – MAC sublayer – channel access methods – Ethernet IEEE 802.3 – wireless LAN IEEE 802.11 – LAN switching and VLAN concepts.

NETWORK LAYER & INTERNETWORKING

[6]

IPv4/IPv6 addressing – subnetting – CIDR – routing principles – distance vector and link state algorithms – router architecture – ARP, ICMP, NAT and forwarding.

TRANSPORT LAYER & CONGESTION CONTROL

[6]

Transport layer services – UDP and TCP – connection establishment and release – reliable data transfer – flow and congestion control – SCTP overview – QoS basics.

APPLICATION LAYER, NETWORK MANAGEMENT & SECURITY

[6]

Application protocols: HTTP, DNS, SMTP, FTP, DHCP – SNMP – network management – cryptography basics – TLS/SSL – firewalls – VPNs – introduction to IoT, SDN and network virtualization.

LIST OF EXPERIMENTS

1. Network Topology Design and Simulation using Cisco Packet Tracer
2. IP Addressing and Subnetting in Packet Tracer

3. Implementation of Error Detection Techniques
4. Simulation of Flow Control Protocols
5. Simulation of Error Control Protocols
6. Implementation of Distance Vector Routing Algorithm
7. Implementation of Link State Routing Algorithm
8. Configuration of VLANs and Inter-VLAN Routing in Cisco Packet Tracer
9. Socket Programming using TCP and UDP (Client–Server Communication)
10. Network Traffic Capture and Analysis using Wireshark.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Behrouz A. Forouzan. Data Communications and Networking, 6/E. McGraw-Hill, 2023.

REFERENCE BOOKS:

- [1] James F. Kurose and Keith W. Ross. Computer Networking: A Top-Down Approach, 8/E. Pearson, 2021.
- [2] Andrew S. Tanenbaum and David J. Wetherall. Computer Networks, 5/E, Pearson, 2017.
- [3] William Stallings. Data and Computer Communications, 10/E, Pearson, 2020.
- [4] Larry L. Peterson and Bruce S. Davie. Computer Networks: A Systems Approach, 6/E, Morgan Kaufmann, 2022

WEB REFERENCES:

- [1] "Cisco Networking Academy," <https://www.netacad.com/>
- [2] "Computer Networks," <https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/>
- [3] "Internet Engineering Task Force (IETF)," <https://www.ietf.org/standards/>

25IT206	CYBER GOVERNANCE, RISK, AND COMPLIANCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of governance, risk management, and compliance (GRC) and the role of GRC in strategic planning.	1,2	1
CO2	Interpret the cybersecurity maturity landscape across different sectors and the traits, ethical dimensions, and strategic responsibilities of cybersecurity leadership.	1,2	1
CO3	Define the risk management lifecycle, regulatory expectations, third-party risk management, compliance and legal risk, and the distinction between different risk types.	1,2	1
CO4	Apply cybersecurity metrics to support decision-making, resource allocation, compliance tracking, and the integration of the overall cybersecurity strategy.	1,2,5	1
CO5	Implement major cybersecurity frameworks (ISO/IEC 27001, COBIT, CMMC, CIS Controls, PCI DSS, ISO 27701, etc.) to design, assess, compare, and improve an organization's security posture.	1,3,5	1

INTRODUCTION

[6]

Understanding GRC – Business Case for GRC – Governance – Risk Management – Compliance – Intersection of Governance, Risk Management and Compliance – GRC Frameworks and Standards – GRC Tools and Technologies – Building GRC Culture – Role of GRC in Strategic Planning – Case Study: GRC Implementation at SpectraCorp.

CYBERSECURITY LANDSCAPE AND LEADERSHIP

[6]

Overview of Cybersecurity Maturity – Cybersecurity in Finance, Healthcare, Government, Small and Larger Enterprises – Traits of a Cybersecurity Leader – building and leading effective cybersecurity teams – adapting to emerging trends – strategic decision making – developing the next generation – incident management – ethical dimensions – Case Study: Cybersecurity Leadership at CyberFusion Inc.

RISK MANAGEMENT

[6]

Risk management in business – understanding the risk management life cycle – FFIEC Handbooks and Risk Management Guidance – Governance and Risk Management Framework – Risk approvals – Risk identification and Analysis – Third-party Risk Management – Regulatory Expectations – Compliance and Legal Risk Management – Monitoring and Reporting – Case Study: Navigating Risk Management at Phoenix Innovations.

CYBERSECURITY METRICS

[6]

Importance of metrics in cybersecurity – role of metrics in decision making and resource allocation – differentiating between KPIs and KRIs – Role of Metrics in Compliance – challenges and considerations – KPIs – KRIs – Integrating KPIs and KRIs into Cybersecurity Strategy - Case Study: Transforming TechNova's Defense Landscape.

CYBERSECURITY FRAMEWORKS

[6]

ISO/IEC 27001: Information Security Management - COBIT (Control Objectives for Information and Related Technologies) – CMMC (Cybersecurity Maturity Model Certification) - CIS (Center for Internet

Security) Controls - PCI DSS (Payment Card Industry Data Security Standard) - ICFR (Internal Control Over Financial Reporting) - Cloud Security Alliance Controls - ISO 27017: Code of Practice for Information Security Controls - ISO 27701: Privacy Information Management - Comparing and Integrating Different Cybersecurity Frameworks - Future Trends in Cybersecurity Frameworks - Case Study: Securing Globex Corporation - top strengths of each framework.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

- [1] Jason Edwards, & Griffin Weaver. The Cybersecurity Guide to Governance, Risk, and Compliance, 1/E. Wiley, 2024.

REFERENCE BOOKS:

- [1] Anne Kohnke, Dan Shoemaker, Ken E. Sigler. The Complete Guide to Cybersecurity Risks and Controls. CRC Press, 2022.
 [2] Akashdeep Bhardwaj. Mastering Cybersecurity: A Practical Guide to Cyber Tools and Techniques Vol. 2, CRC Press, 2025.
 [3] Akashdeep Bhardwaj. Mastering Cybersecurity: A Practical Guide for Professionals Vol. 1. CRC Press, 2025.

WEB REFERENCES:

- [1] "GRC Resources," <https://allaboutgrc.com/grc-resources/>

25CS257	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles, phases, and methodologies of the software development life cycle (SDLC).	1, 2	1
CO2	Extract software requirements using formal and agile techniques to develop, validate, and manage requirement specifications, ensuring traceability and alignment with stakeholder needs across the project lifecycle.	1, 2, 3, 4	1
CO3	Apply software modeling, architectural design principles, and standardized notations (such as UML) to translate requirements into structured design models that support maintainability, scalability, and DevOps integration.	1, 2, 3, 4, 5	1
CO4	Evaluate software project planning, estimation, scheduling, and risk management strategies using models such as COCOMO, CPM, and PERT, and assess their effectiveness in delivering projects within scope, time, and resource constraints.	1, 2, 3, 4	1
CO5	Utilize appropriate coding standards, testing techniques, and maintenance practices—supported by modern tools for development, testing, and CI/CD—to ensure software quality, reliability, and sustainable evolution.	1, 2, 3, 4, 5	1

SOFTWARE PROCESS MODELS

[9]

Introduction – Software Development Life Cycle (SDLC) – Traditional Models: Waterfall, V-Model, Spiral – Alternative Techniques: Rapid Application Development (RAD), Agile Development Models – Scrum Framework – Agile Tools: JIRA (backlog management, sprint planning), Product Discovery, Team Collaboration – Extreme Programming (XP) – Comparison and Suitability of Models.

SOFTWARE PROJECT MANAGEMENT

[9]

Role and responsibilities of a Software Project Manager – Project Planning – Metrics for Project Size Estimation – COCOMO (Basic, Intermediate & Detailed) – Scheduling Techniques: CPM & PERT – Risk Management: Identification, Assessment, Mitigation – Resource Allocation and Tracking – Modern Tools for Project Management (MS Project, Trello, Asana).

REQUIREMENTS ANALYSIS

[9]

Requirements Gathering Techniques – Functional and Non-functional Requirements – Software Requirements Specification (SRS) – Formal Specification – Executable Specifications – Validating Requirements – Achieving Requirements Traceability – Managing Changing Requirements – Reviews, Walkthroughs, Inspections – Tools: Jama Software, IBM Rational DOORS, JIRA.

SOFTWARE MODELLING AND DESIGN

[9]

Elements of Software Modeling and Design – Translating Requirement Models into Design Models – Design Notations: DFDs, Structured Flowcharts, Decision Tables – UML: Use Case, Class, Sequence, Activity Diagrams – Data Modeling – Design Concepts and Principles – Architectural Mapping using

Data Flow – Design Tools: Sparx Enterprise Architect – DevOps: Concepts, Lifecycle, Adoption, DevOps Tools.

CODING, TESTING, AND MAINTENANCE

[9]

Coding Standards and Guidelines – Code Reviews – IDEs: Eclipse, IntelliJ IDEA, XCode, Atom – Testing Techniques: Black-box, White-box, Unit, Integration, System Testing – Testing Tools: JUnit, Selenium – Software Maintenance: Characteristics, Process Models, Reverse Engineering – Estimation of Maintenance Cost – Modern Practices: Continuous Integration and Continuous Deployment (CI/CD).

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Roger S. Pressman & Bruce R. Maxim. Software Engineering: A Practitioner's Approach, 9/E. McGraw-Hill, 2020.

REFERENCE BOOKS:

- [1] Ian Sommerville. Software Engineering, 10/E. Pearson, 2019.
- [2] K. K. Aggarwal & Yogesh Singh. Software Engineering, 3/E, New Age International, 2019.
- [3] Pankaj Jalote. Software Project Management in Practice, 2/E, Pearson, 2017.
- [4] Bertrand Meyer. Software Engineering with Applications, 2/E, Prentice Hall, 2018

WEB REFERENCES:

- [1] "Software Engineering," https://onlinecourses.nptel.ac.in/noc21_cs13
- [2] "Software Engineering Concepts," <https://ocw.mit.edu/courses/16-355j-software-engineering-concepts-fall-2005/>

25IT256	WEB TECHNOLOGIES AND FULL STACK DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the structure and components of modern web applications.	1	1
CO2	Apply HTML5 semantic elements, forms, and multimedia, along with CSS3 styling, responsive layouts, and visual effects, to create accessible, SEO-friendly, and visually engaging web interfaces.	1, 2, 3,5	1
CO3	Implement client-side interactivity, form validation, and dynamic content updates using JavaScript, DOM manipulation, event handling, and asynchronous programming techniques (AJAX/fetch API).	1, 2, 3, 5	1
CO4	Develop server-side functionality using PHP to handle form data, manage sessions and cookies, perform CRUD operations with MySQL, and apply security best practices in web programming.	1, 2, 3, 4, 5	1
CO5	Integrate front-end and back-end technologies to design, build, test, and deploy a full-stack web application, incorporating version control (Git) and deployment on local or cloud platforms.	1, 2, 3, 4, 5	1

HTML5: WEB PAGE STRUCTURE AND ELEMENTS

[6]

Introduction to web technologies – client–server architecture – structure of HTML document – headings, paragraphs, lists, tables, and hyperlinks – forms and input types – semantic tags: header, nav, section, article, footer – multimedia elements (audio, video, canvas) – metadata and accessibility – SEO-friendly markup.

CSS3: STYLING AND RESPONSIVE DESIGN

[6]

Introduction to CSS3 – syntax and selectors – box model – borders, margins, padding, positioning – display properties – Flexbox and CSS Grid – typography and color schemes – gradients, shadows, transitions, animations – responsive design using media queries – mobile-first design principles.

JAVASCRIPT: CLIENT-SIDE PROGRAMMING

[6]

Introduction to JavaScript – variables, data types, operators – control structures – functions, arrays, and objects – DOM manipulation – event handling (click, mouse, form) – form validation – ES6 features (let, const, arrow functions, template literals) – asynchronous JavaScript (AJAX, fetch API) – debugging and developer tools.

PHP: SERVER-SIDE SCRIPTING AND DATABASE CONNECTIVITY

[6]

Introduction to PHP – syntax and variables – control structures and arrays – functions and file handling – form handling using GET and POST – session and cookie management – error handling and input validation – connecting PHP with MySQL using MySQLi/PDO – CRUD operations – security practices in web programming.

FULL STACK INTEGRATION AND DEPLOYMENT

[6]

Integration of front-end and back-end – combining HTML, CSS, JavaScript, PHP, and MySQL – designing a full stack architecture – client–server communication and data flow – user authentication

and session tracking – testing and debugging – version control using Git – deployment on XAMPP/WAMP or cloud platforms – documentation and maintenance.

LAB EXPERIMENTS

1. Design a personal portfolio webpage using HTML5 structure and semantic tags.
2. Create a responsive web layout using CSS3 Flexbox and Grid system.
3. Develop a form with various HTML5 input types and validate it using JavaScript.
4. Implement JavaScript DOM manipulation to dynamically change web page content.
5. Use JavaScript events to create an interactive image gallery or slideshow.
6. Write a PHP program to process a feedback form using POST method.
7. Develop a PHP script for performing CRUD operations in MySQL (student database).
8. Implement user login and session management using PHP and MySQL.
9. Build an integrated mini web application combining HTML, CSS, JS, PHP, and MySQL.
10. Deploy the mini full stack web application on a local or cloud-based web server (e.g., XAMPP/WAMP/000webhost).

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Philip Ackermann. Full Stack Web Development: The Comprehensive Guide. Wiley, 2022.

REFERENCE BOOKS:

- [1] Luke Welling & Laura Thomson. PHP and MySQL Web Development. Pearson, 2020.
- [2] Robin Nixon. Learning PHP, MySQL & JavaScript, 5/E, O'Reilly, 2022.
- [3] Jon Duckett. Web Design with HTML, CSS, JavaScript and jQuery. Wiley, 2021.

WEB REFERENCES:

- [1] "W3Schools Online Web Tutorials," <https://www.w3schools.com>
- [2] "Mozilla Developer Network," <https://developer.mozilla.org>

25CS258	COMPILER DESIGN AND PROGRAM TRANSLATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the phases of a compiler, the role of lexical and syntax analysis, and the translation process from source code to intermediate and target code.	1, 2	1
CO2	Apply formal language theory to design and implement lexical analyzers and parsers using tools such as LEX and YACC.	1, 2, 3, 4, 5	1
CO3	Distinguish between top-down (LL) and bottom-up (LR) parsing techniques, evaluate grammar for parsing suitability, and construct parsing tables (LL(1), SLR, CLR, LALR) to resolve syntactic structures.	1, 2, 3, 4	1
CO4	Utilize intermediate code representations and attribute grammar to translate programming language constructs and implement basic code generation for a target machine.	1, 2, 3, 4, 5	1
CO5	Evaluate code optimization techniques to improve the efficiency of generated code while preserving semantics.	1, 2, 3, 4, 5	1

INTRODUCTION & LEXICAL ANALYSIS

[6]

Compilers- Phases of Compiler- Cousins of the Compiler - Grouping of Phases - Compiler construction tools- Need and Role of Lexical Analyzer - Input Buffering - Specification of Tokens - Lexical Errors - Expressing Tokens by Regular Expression - Finite Automata: NFA- DFA - Converting NFA to DFA - Minimization of DFA- Converting Regular Expression to DFA. LEX Tool: Structure of LEX Program – Predefined Variables – Library routines – Design of Lexical Analyzer for a Sample Language.

TOP DOWN PARSING

[6]

Role of Parser-Grammars-Error Handling-Context-Free Grammars-Writing a grammar- Elimination of Ambiguity-Left Recursion- Left Factoring-Top Down Parsing — Recursive Descent Parser- Predictive Parser- LL(1) Parser- Computation of FIRST-Computation of FOLLOW-Construction of a predictive parsing table-Predictive Parsers LL(1) Grammars- Predictive Parsing Algorithm- Problems related to Predictive Parser - Error Recovery in Predictive Parsing.

BOTTOM UP PARSING

[7]

Bottom Up Parsing-Reductions-Handle Pruning-Shift Reduce Parser-Problems related to Shift Reduce Parsing-Operator Precedence Parser, LEADING, TRAILING -LR Parser- LR Parsers- Need of LR Parsers-LR (0) Item-Closure of Item Sets- Construction of SLR Parsing Table -Problems related to SLR- Construction of Canonical LR(1)- Problems related to CLR - LALR Parser—Problems related to LALR- Error Handling and Recovery in Syntax Analyzer – YACC Tool: Structure of YACC Program – Design of a Syntax Analyzer for a Sample Language.

CODE GENERATION

[6]

Intermediate Code Generation- prefix – postfix notation - Quadruple - triple - indirect triples Representation- Syntax tree- Evaluation of expression - Three-address code- Synthesized attributes – Inherited attributes - Intermediate languages – Declarations- Assignment Statements- Boolean Expressions- Case Statements- Type Checking- Back patching – Procedure calls- Code Generation-

Issues in the design of code generator- The target machine – Runtime Storage management- A simple Code generator- Code Generation Algorithm- Register and Address Descriptors.

CODE OPTIMIZATION

[5]

Code optimization -Principal Sources of Optimization- Function Preserving Transformation- Loop Optimization- Peephole optimization — DAG- Basic Blocks- Flow Graphs- Global Data Flow Analysis — Efficient Data Flow Algorithm- Runtime Environments- Source Language issues- Storage Organization- Activation Records- Storage Allocation strategies.

LAB EXPERIMENTS

[30]

1. Using the LEX tool, Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
2. Implement a Lexical Analyzer using LEX Tool
3. Generate YACC specification for a few syntactic categories.
 - a. Program to recognize a valid arithmetic expression that uses operator +, -, * and /.
 - b. Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.
 - c. Program to recognize a valid control structures syntax of C language (For loop, while loop, if-else, if-else-if, switch-case, etc.).
 - d. Implementation of calculator using LEX and YACC
4. Generate three address code for a simple program using LEX and YACC.
5. Implement type checking using Lex and Yacc.
6. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
7. Implement back-end of the compiler for which the three address code is given as input and the 8086 assembly language code is produced as output.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman and Sorav Bansal. Compilers: Principles, Techniques, and Tools, 2/E. Pearson, 2024.

REFERENCE BOOKS:

- [1] S. Godfrey Winster, S. Aruna Devi, R.Sujatha. Compiler Design, 2/E. Yesdee Publishing Ltd., 2019.
[2] V. Raghavan. Principles Of Compiler Design, Tata McGraw-Hill, 2016.
[3] K. Muneeswaran. Compiler Design, 4/E, Oxford Higher Education, 2014.
[4] Bertrand Meyer. Software Engineering with Applications, 2/E, Prentice Hall, 2018

WEB REFERENCES:

- [1] "Compiler Design," https://onlinecourses.nptel.ac.in/noc21_cs07
[2] "Compiler Design," <https://nptel.ac.in/courses/106104123>
[3] "Principles of Compiler Design," <https://nptel.ac.in/courses/106108113>

25IT257	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational concepts, architecture models (NIST), service and deployment models of cloud computing, along with its key characteristics, benefits, and challenges in modern IT infrastructure.	1	1
CO2	Apply principles of virtualization, containerization, and web service architectures to design, configure, and manage virtualized cloud environments using appropriate platforms and tools.	1, 2, 3,5	1
CO3	Recommend cloud storage solutions, interoperability standards, and deployment strategies to evaluate performance, cost, and suitability for different application scenarios across major cloud platforms.	1, 2, 3, 4, 5	1
CO4	Utilize cloud security frameworks, identity and access management (IAM) policies, and governance models to implement secure, compliant, and resilient cloud-based systems.	1, 2, 3, 4, 5	1
CO5	Evaluate the architectural trade-offs, security threats, and operational governance of virtualized and containerized cloud environments to recommend solutions that balance performance, cost, and risk.	1, 2, 3, 4, 5	1

CLOUD ARCHITECTURE & INFRASTRUCTURE

[6]

Introduction to Cloud Computing – Need and Evolution of Cloud – Cloud Architecture – NIST Reference Model – Service Models (IaaS, PaaS, SaaS) – Deployment Models (Public, Private, Hybrid, Community Cloud) – Characteristics and Benefits of Cloud – Cloud Infrastructure Components – Cloud Challenges and Applications.

WEB SERVICES & VIRTUALIZATION BASICS

[6]

Service-Oriented Architecture – SOAP & REST – Basics of Virtualization – Virtual Machine Concepts – Hypervisors (Type 1 & Type 2) – Virtualization Techniques: Full, Para and Hardware Virtualization – CPU, Memory and I/O Virtualization – Resource Allocation and Performance Considerations.

CLOUD STORAGE & CONTAINERIZATION

[6]

Cloud Storage Fundamentals – Storage Provisioning – Managed vs Unmanaged Storage – Cloud Backup Strategies – Cloud Storage Interoperability (CDMI, OCCI) – Introduction to Containers – Docker Architecture – Docker Images, Containers and Repositories – Basics of Kubernetes.

CLOUD PLATFORMS & DEPLOYMENT

[6]

Google App Engine – Amazon AWS – Microsoft Azure – OpenStack Overview and Architecture – Eucalyptus and OpenNebula – Programming on EC2 and S3 – Application Deployment Models – Performance Evaluation Parameters – Cost Optimization Concepts.

CLOUD SECURITY & GOVERNANCE

[6]

Security Challenges in Virtualized Environments – VM Attacks: VM Escape, Guest Hopping, VM Migration Attacks – Hypervisor Threats – Data Security and Storage Security – Identity and Access

Management (IAM) – IAM Architecture, Policies and Best Practices – Cloud Compliance and Governance.

LAB EXPERIMENTS

1. Study of Cloud Models – Demonstration of IaaS / PaaS / SaaS and Deployment Models
2. Creation and Management of Virtual Machines using VMware / VirtualBox
3. Study and Comparison of Hypervisors and Virtualization Types
4. Docker Installation and Basic Container Operations
5. Docker Image Building and Application Deployment
6. Implementation of Cloud Storage & Basic IAM Configuration on AWS / Azure

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Application Programming. Elsevier, 2021.

REFERENCE BOOKS:

- [1] Kai Hwang, Jack Dongarra, Geoffrey Fox. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things. Morgan Kaufmann, 2022.
- [2] Thomas Erl, Ricardo Puttini, Zaigham Mahmood. Cloud Computing: Concepts, Technology & Architecture. Pearson, 2020.
- [3] Chris Dotson. Practical Cloud Security, O'Reilly, 2019.

WEB REFERENCES:

- [1] "Cloud Computing," <https://nptel.ac.in/courses/106105167>
- [2] "Cloud Computing and Distributed Systems," <https://nptel.ac.in/courses/106104182>

25IT258	PENETRATION TESTING AND VULNERABILITY ASSESSMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of VAPT.	1,2	1
CO2	Perform infrastructure vulnerability assessment techniques using automated tools, static application security testing (SAST) tools and develop remediation methodologies for identified vulnerabilities.	1,2,3, 5	1
CO3	Apply dynamic application security testing (DAST) and penetration testing using industry tools to exploit vulnerabilities and work with payloads.	1,2,3, 5	1
CO4	Deploy web application penetration testing methodologies to identify and exploit OWASP Top 10 vulnerabilities.	1,2,3,5	1
CO5	Write comprehensive professional penetration testing reports using CVSS 4.0 for risk scoring and remediation recommendations.	1,2, 3, 4, 5	1

VAPT AND INFRASTRUCTURE SECURITY TOOLS

[6]

Vulnerability, penetration testing, threats and risk exposure terminologies – Vulnerability Assessment Management Lifecycle – Cyber Kill Chain – MITRE Attack framework – STRIDE Model – OWASP Top 10 – Practical risk exposure approach – Setting up tools for VAPT – OWASP ZAP attack Proxy.

INFRASTRUCTURE VULNERABILITY ASSESSMENT & STATIC CODE ANALYSIS

[6]

Vulnerability assessment using tools – Infrastructure Security Testing Methodology – Security Testing – Vulnerabilities identification using tools – Threats and risk exposure – Remediation methodology – Static application security testing – Vulnerabilities detected by SAST tools – Pros and cons of SAST – SAST testing tools - SonarQube.

DYNAMIC APPLICATION SECURITY TESTING ANALYSIS & PEN TESTING

[6]

Pros and Cons of DAST – Requirements of DAST – Working of DAST – DAST testing alignment – Port Swigger – Burp Suite – ZAP Proxy tools – Metasploit Framework– Components – Basic Commands – Exploiting vulnerabilities –Working with payloads – Pot Exploitations.

WEB APPLICATION TESTING

[6]

HTTP – HTTP Methods – Sessions – Cookies – HTML data in HTTP response – Secure Software Development Lifecycle – vulnerability assessment – Vulnerability scan – Nikto – Arachni – Web pen testing approach – Broken access control – cryptographic failures – injections – insecure design – security misconfiguration – vulnerable and outdated components – identification and authentication failures – software and data integrity failures – server-side request forgery – post-exploitation.

API PEN TESTING AND REPORT WRITING

[6]

API Penetration test – Burp Suite settings – Passive reconnaissance – active reconnaissance – reverse engineering – vulnerabilities – report writing stages – content of vulnerability testing report – penetration testing report – vulnerability assessment using new CVSS 4.0 – Conclusion of the report.

LAB EXPERIMENTS

1. Introduction to VAPT & Legal Frameworks
2. VAPT Methodologies
3. Building the Laboratory
4. Information Gathering & OSINT
5. Vulnerability Assessment
6. Analyzing Scanning Results.
7. Network Exploitation.
8. Web Application Testing
9. Specialized System Attacks
10. Post-Exploitation Fundamentals
11. Lateral Movement & Persistence
12. Evasion & Anti-Forensics
13. Professional Report Writing
14. Remediation & Retesting

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Rishabh Bhardwaj. Vulnerability Assessment and Penetration Testing (VAPT): Detailed Guide with Highlighted Threats, Risk Exposure, and Remediations. BPB Publications, 2025.

REFERENCE BOOKS:

- [1] David Maynor. Metasploit Toolkit for Penetration Testing, Exploit Development, and Vulnerability Research. Syngress, 2021.
- [2] Ummed Meel. Advanced Penetration Testing with Kali Linux: Unlocking Industry-Oriented VAPT Tactics. Bpb Publications, 2023.
- [3] Saral Jeeva Jothy, Anne Michel. Penetration Testing, Khanna Publishing House, 2025.

WEB REFERENCES:

- [1] "OWASP Top Ten Web Application Security Risks," <https://owasp.org/www-project-top-ten/>
- [2] "Metasploit," <https://www.metasploit.com/>

25IT259	CRYPTOGRAPHY AND CYBERSECURITY	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of cryptography.	1	1
CO2	Recall the principles of data integrity mechanisms.	1	1
CO3	Apply symmetric and asymmetric cipher techniques for secure data transmission.	1, 2, 3, 5	1
CO4	Deploy cryptographic key management and distribution methods to establish mutual trust in networked environments.	1, 2, 3, 4, 5	1
CO5	Implement network and internet security protocols to protect data in transit across various network layers.	1, 2, 3, 4, 5	1
CO6	Apply appropriate security measures for diverse technological contexts based on specific security requirements and constraints	1, 2, 3, 4, 5	1

Cryptography Fundamentals

[5]

Cybersecurity, Information Security and Network Security - OSI Security Architecture – Cryptography – Network Security – Trust and Trustworthiness – Standards – Number Theory – Divisibility and Division Algorithm – Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermat’s and Euler’s Theorem – Testing for primality – Chinese Remainder Theorem – Discrete Logarithms.

Symmetric and Asymmetric Ciphers

[7]

Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Data Encryption Standard – Block Cipher Design Principles – Finite Fields: Groups – Rings – Fields – Finite Fields of the Form $GF(p)$ – Polynomial Arithmetic – Finite Fields of the Form $GF(2^n)$ – Advanced Encryption Standard – Block Cipher Operation – Random Bit Generation and Stream Ciphers – Public Key Cryptography – RSA Algorithm – Diffie-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography.

Data Integrity

[5]

Applications of Cryptographic Hash Functions – Requirements and Security – Secure Hash Algorithm – SHA-3 – Message Authentication Codes – Digital Signatures – Lightweight Cryptography – Post-Quantum Cryptography.

Mutual Trust

[6]

Cryptographic Key Management and Distribution: Key distribution using symmetric and asymmetric encryption – Distribution of Public Keys – X.509 Certificates – Public Key infrastructure – Remote User-Authentication Principles – Remote User authentication using Symmetric and Asymmetric Encryption – Kerberos – Federated Identity Management.

Network and Internet Security

[7]

Transport-level Security: Web Security Considerations – Transport Layer Security – HTTPS – SSH – Wireless Security – Mobile Device Security – IEEE 802.11i Wireless LAN Security – Electronic Mail Security – IP Security – Network Endpoint Security – Cloud Security – Internet of Things (IoT) Security.

LAB EXPERIMENTS

1. Classical and Modern Symmetric Ciphers.
2. Number Theory and Public-Key Cryptography.
3. Hash Functions and Digital Signatures.
4. PKI and Secure Communication.
5. Network Security Protocols and Attacks.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Stallings, William. Cryptography and Network security, 8/E. Pearson Education India, 2023.

REFERENCE BOOKS:

- [1] Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (SIE), 3/E. McGraw-Hill Education, 2023.
- [2] Kahate, Atul. Cryptography and network security, 4/E. McGraw-Hill Education, 2024.
- [3] Katz, Jonathan, and Yehuda Lindell. Introduction to Modern Cryptography, 4/E. Chapman and Hall/CRC, 2025.
- [4] Dholakia, Sandip. Modern Cryptography: The Practical Guide. Rheinwerk Publishing, 2024.

WEB REFERENCES:

- [1] "Cryptography and Network Security," <https://nptel.ac.in/courses/106105162>
- [2] "Computational Number Theory & Cryptography," <https://nptel.ac.in/courses/106103015>
- [3] "Cryptography and Network Security," <https://nptel.ac.in/courses/106105031>

25IT207	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Distinguish between the human cognitive and physical characteristics and computer capabilities that influence the design of interactive systems.	1	1
CO2	Describe the fundamental models of interaction and their role in capturing requirements and designing user interfaces.	1	1
CO3	Deploy the principles of the user-centered design process to create effective interactive systems.	1, 2, 3	1
CO4	Apply task analysis techniques to gather user requirements and inform interface design decisions.	1, 2, 3	1
CO5	Use dialog design notations to specify, analyze, and design user-computer dialogues for interactive applications.	1, 2, 3	1
CO6	Choose appropriate evaluation methods to assess and improve the usability of interactive systems for diverse user populations.	1, 2, 3	1

Foundations of Human Computer Interaction

[9]

The Human: Input-output channel – Human Memory – Thinking: reasoning and problem solving – emotion – individual differences – Psychology and the design of interactive systems – The computer: Text entry devices – Positioning, pointing and drawing – Display devices – Devices for virtual reality and 3D interaction – physical controls, sensors and special devices – Paper: Printing and scanning – Memory – Processing and Networks – Interaction: Models of Interaction – Frameworks and HCI – Ergonomics – Interaction styles – Elements of the WIMP interface – Interactivity – Paradigms for interaction.

Design Process

[9]

Process of design – User focus – Scenarios – navigation design – Screen design and layout – iteration and prototyping – usability engineering – iterative design and prototyping – design rationale – principles to support usability – standards – guidelines – Golden rules and heuristics – HCI patterns – Elements of windowing system – user interface management systems- evaluation: expert analysis – user participation – Universal design principles – Multi-modal interaction – Designing for diversity – user support.

Models

[9]

Cognitive Models: Goals and task hierarchies – Linguistic Models – Physical and device models – cognitive architectures – organisational issues – capturing requirements – Communication and collaboration models – face-to-face communication – conversation – text-based communication – group working – standard formalisms – interaction models – continuous behavior.

Task Analysis and Dialog notations

[9]

Task analysis – differences – task decomposition – knowledge-based analysis – Entity-relationship-based techniques – sources of information and data collection – uses – dialog – dialog design notations – diagrammatic notations – textual dialog notations – dialog semantics – dialog analysis and design – status-event analysis – rich contexts- low intention and sensor-based interaction.

Advanced interaction systems**[9]**

Groupware systems - computer-mediated communication – meeting and decision support systems – shared applications and artifacts – Frameworks for groupware – synchronous groupware – ubiquitous computing applications research – Virtual and augmented reality – information and data visualization – Hypertext – web technology and issues – static web content – dynamic web content.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Dix, Alan, Finlay, Janet, Gregort D. Abowd, Russell Beale. Human-computer Interaction, 3/E. Pearson Education India, 2024.

REFERENCE BOOKS:

- [1] Samit Bhattacharya. Human-computer Interaction. McGraw-Hill, 2019.
[2] Scott MacKenzie. Human-Computer Interaction: An Empirical Research Perspective. Morgan Kaufmann, 2013.

WEB REFERENCES:

- [1] "Human-Computer Interaction: The Foundations of UX Design," <https://www.interaction-design.org/courses/hci-foundations-of-ux-design>
[2] "Human Computer Interaction," <https://www.coursera.org/learn/human-computer-interactions-odc>

25IT260	REALTIME AND EMBEDDED SYSTEMS DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Interpret the fundamental concepts of real-time systems, RTOS, development boards (STM32), hardware/software roles, super-loop architectures, interrupts, timers, and the STM32Cube IDE toolchain.	1,2	1
CO2	Implement FreeRTOS scheduler mechanisms to develop multi-tasking embedded applications.	1, 2, 3, 5	1
CO3	Use synchronization and inter-task communication primitives to protect shared data and coordinate tasks.	1, 2, 3, 5	1
CO4	Apply driver development models for peripherals for hardware sharing among tasks.	1, 2, 3, 5	1
CO5	Troubleshoot real-time embedded system issues and optimize system performance.	1, 2, 3, 4, 5	1

RTOSes, the Dev-Board and Tools

[6]

Real-time Systems – Hardware and Software roles in real-time systems – Defining RTOSes – Practical Real-time Systems – Development Boards – Dev-board components – hardware documentation – Development Tools – STM32Cube IDE – Debugging tools: J-link, Ozone and SystemView – Super-Loops – improving super-loops with interrupts – adding timer to super-loop – implanting super-loop – Design and testing considerations – developing super-loop program.

FreeRTOS Scheduler, Tasks and Primary APIs

[6]

RTOS tasks – FreeRTOS – scheduler and tasks – creating tasks and starting the scheduler – deleting tasks – coding – task states – idle task – scheduler architecture –

Tasks and Primary APIs

[6]

Task implementation and troubleshooting - task memory allocation – optimizing task states – troubleshooting task startup problems – protecting data and synchronizing tasks – semaphores – priority inversion – mutexes – race conditions – software timers – intertask communication – task notifications.

Building Systems

[6]

Drivers and ISRs – UART – polled UART driver – tasks vs ISRs – creating ISR-based drivers – buffer-based driver – DMA-based drivers – double-buffered DMA – implementing driver – choosing driver model – third-party libraries and drivers – sharing hardware peripherals among tasks – using simple USB API – creating VCP driver – enhancing VCP driver – loose coupling with queues – reusing queue definition – queues as interfaces.

System Design and Troubleshooting

[6]

Memory Management – Static and dynamic allocation – multi-processor and multi-core systems - troubleshooting.

LAB EXPERIMENTS

1. Toolchains & Debugging

2. RTOS Architecture & Tasks
3. Scheduling Algorithms
4. Queues & Message Passing
5. Event Management
6. Memory Management
7. Interrupt Management
8. Peripheral Drivers
9. Advanced RTOS/SMP
10. Low-Power Design

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

[1] Jim Yuill, Penn Linder. Hands-On RTOS with Microcontrollers. Packt Publishing, 2025.

REFERENCE BOOKS:

- [1] Ivan Cibrario Bertolotti, Gabriele Manduchi. Real-time Embedded Systems With Open-source Operating Systems. CRC Press, 2025.
- [2] Gedare Bloom, Joel Sherrill, Tingting Hu, Ivan Cibrario Bertolotti. Real-time Systems Development with RTEMS and Multicore Processors. CRC Press, 2022.

WEB REFERENCES:

- [1] "Introduction to Embedded System Design," <https://nptel.ac.in/courses/108102169/>
- [2] "Real Time Systems," <https://nptel.ac.in/courses/106105086>

25IT208	INFORMATION SECURITY	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the importance of information security.	1, 2	1
CO2	Deploy risk identification, risk assessment, and risk control practices to organizational security planning.	2	1
CO3	Apply appropriate security technologies to protect information assets.	3	1
CO4	Implement physical security measures and strategies to protect facilities and systems.	3	1
CO5	Recommend suitable security personnel, employment policies, maintenance approaches, and digital forensics mechanisms for continuous security management.	2	1

Information Security: Need and Issues

[6]

History – CNSS Security Model – Components – Approaches – Security in Systems Development Life Cycle – Security Professionals and the organization – Threats and Attacks – Compromises to Intellectual Property – Deviations in QoS – Espionage – Forces of Nature – Human Error – Information Extortion – Sabotage – Software Attacks – Failures and Errors – Technological Obsolescence – Theft – Law and Ethics in Information Security – International Laws and Legal Bodies – Ethics and Information Security – Codes of Ethics of Professional Organization.

Planning and Risk Management

[6]

Information Security Planning and Governance – Information Security Policy, Standards and Practices – The information security blueprint – Security Education, Training, and Awareness program – Continuity strategies – overview of risk management – risk identification – assessment – control – Quantitative vs Qualitative Risk Management Practices – Recommended Risk Control Practices.

Security Technologies

[6]

Access Control – Firewalls – Protecting Remote Connections – Intrusion Detection and Prevention Systems – Honeypots, Honeynets, and Padded Cell Systems – Scanning and Analysis tools.

Physical Security and Information Security Implementation

[6]

Physical Access Controls – Fire Security and Safety – Failure of Supporting Utilities and Structural Collapse – Interception of Data – Securing Mobile and Portable Systems – Special Considerations – Information Security Project Management – Technical and nontechnical aspects of implementation – Information System Security Certification and Accreditation.

Personnel and Maintenance

[6]

Positioning and Staffing the security function – credentials for information security professionals – employment policies and practices – security considerations for temporary employees, consultants, and other workers – Security Management Maintenance Models – Digital Forensics.

Total Notional Hours: 60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] Whitman, M. E., & Mattord. Principles of Information Security. 7/E. Cengage, 2022.

REFERENCE BOOKS:

[1] Stallings, W., & Brown, L. Computer Security: Principles and Practice, 5/E. Pearson, 2024.

WEB REFERENCES:

[1] "NIST Special Publications (SP 800 series)," <https://csrc.nist.gov/publications/sp800>

25IT209	AI SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the major categories of catastrophic AI risks.	1, 6, 8	1
CO2	Apply monitoring and robustness techniques to detect emergent goal-directed behavior, proxy gaming, and adversarial attacks in AI systems.	2, 3	1
CO3	Implement safety engineering principles to design safer AI systems.	3, 8	1
CO4	Use game-theoretic and governance concepts to analyze collective action problems, commitment problems, and compute governance in AI safety.	2, 4, 6	1
CO5	Evaluate failure modes in AI deployment based on complex systems paradigms, systemic accident models, and tail events.	1, 2, 6, 8	1

Catastrophic AI Risks

[9]

Introduction to Catastrophic Risks – Malicious Use: Bioterrorism – Unleashing AI Agents, Persuasive AIs – Concentration of Power – AI Race: Military AI Arms Race – Corporate AI Race – Evolutionary Pressures – Organizational Risks – Rogue AIs: Proxy Gaming – Goal drift – Power seeking – Deception – Connections between risks – Scaling Laws – Speed of AI Development.

Single-Agent Safety

[9]

Monitoring: Opacity of ML Systems – Transparency Research – Approaches to Transparency – Emergent Capabilities – Emergent Goal-directed behavior – Tail Risk of Emergent Goals – Evaluations and Anomaly Detection – Robustness: Proxies – Proxy Gaming – Adversarial attacks – Trojan Attacks and other security threats – Tail Risk of AI Evaluator Gaming – Alignment: Deception – Deceptive Evaluation Gaming – Tail Risk of Deceptive Alignment and Treacherous Turns – Power – Using AI for power seeking – instrumental rationality of power seeking – Structural pressures – Tail risk of power seeking behavior – Techniques to control AI systems – Systemic Safety – Safety and General Capabilities.

Safety Engineering

[12]

Risk Decomposition: Failure Modes, Hazards and Threats – Classic Risk Equation – Risk reduction as a goal – Disaster Risk Equation – Applying the disaster risk equation – Nines of reliability – Safe Design Principles: Redundancy – Separation of Duties – Principle of Least Privilege – Fail Safes – Antifragility – Negative Feedback Mechanisms – Transparency – Defense in Depth – Review of Safe Design Principles – Component Failure Accident Models and Methods: Swiss Cheese Model – Bow Tie Model – Fault Tree Analysis Method – Limitations – Systemic Accident Models – Drift into Failure and Existential risks – Tail events and black swans: Identification of Tail events – caricature of tail events – black swans: known unknown and unknown unknown - implications.

Complex Systems

[6]

The reductionist paradigm – complex systems paradigm – DL systems as complex systems – hallmarks of complex systems – social systems as complex systems – complex systems for AI safety: general lessons – puzzles, problems, and wicked problems – challenges with interventionism – systemic issues.

Ethics and Society

[9]

Collective action problems: motivation – game theory: fundamentals – Prisoner’s Dilemma – The iterated Prisoner’s Dilemma – Collective action problems – cooperation – conflict: bargaining theory – commitment problems – Information Problems – Factors outside bargaining theory – Evolutionary Pressures: Generalized Darwinism – Levels of selection and selfish – Governance – Economic Growth – Distribution of AI – Corporate Governance – National Governance – International Governance – Compute Governance.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Dan Hendrycks. Introduction to AI Safety, Ethics and Society. CRC Press, 2025.

REFERENCE BOOKS:

- [1] Ambuj Agrawal. LLM Development and AI Ethics: A guide to AI safety, governance, generative AI, LLM, prompt engineering, and AGI. BPB Publishers, 2025.
- [2] Zacharias Voulgaris, Arnoud Engelfriet. AI Safety: Strategies for Ensuring Responsible, Ethical, and Reliable AI Systems. Technics Publications, 2025.

WEB REFERENCES:

- [1] "AI Safety, Ethics and Society," <https://www.aisafetybook.com/>
- [2] "Ethics and Safety in Open AI," <https://www.coursera.org/learn/ethics-and-safety-in-open-ai>

25AI252	NEURAL NETWORKS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	To understand the fundamentals of artificial neural networks	1,2	1
CO2	To analyse learning mechanisms and optimization techniques	1,2,4	1,2
CO3	To study different neural network architectures	1,2,3	1,2
CO4	To apply neural networks to real-world problems	2,3,5	1,2,3
CO5	To explore recent trends in deep learning	5,11	1,2,3

COURSE CONTENT:

INTRODUCTION TO NEURAL NETWORKS

[6]

Introduction to Artificial Intelligence and Neural Networks, Biological neuron vs Artificial neuron, McCulloch-Pitts neuron model, Perceptron model and learning rule, Linear separability, Limitations of perceptron.

MULTI-LAYER NEURAL NETWORKS

[6]

Multi-Layer Perceptron (MLP), Activation functions: Sigmoid, Tanh, ReLU, Softmax, Forward propagation, Loss functions: Mean Squared Error, Cross-Entropy, Backpropagation algorithm.

OPTIMIZATION AND REGULARIZATION

[6]

Gradient Descent (Batch, Stochastic, Mini-batch), Optimization techniques: Momentum, RMSProp, Adam optimizer, Overfitting and underfitting, Regularization techniques: L1, L2, Dropout, Hyperparameter tuning.

ADVANCED NEURAL NETWORK ARCHITECTURES

[6]

Convolutional Neural Networks (CNN) basics, Recurrent Neural Networks (RNN) basics, Introduction to LSTM and GRU, Feedforward vs recurrent networks, Applications of CNN and RNN.

APPLICATIONS AND EMERGING TRENDS

[6]

Neural networks in: Computer Vision, Natural Language Processing, Speech Processing, Introduction to Deep Learning frameworks (TensorFlow, PyTorch), Basics of Transfer Learning, Overview of Transformers and Generative AI.

EXPERIMENTS:

[30]

1. Implementation of AND Gate using McCulloch–Pitts Neuron
2. Implementation of OR Gate using Perceptron
3. Demonstration of XOR Problem in Perceptron
4. Implementation of Sigmoid Activation Function
5. Implementation of ReLU Activation Function
6. Simple Forward Propagation in Neural Network

7. Simple Backpropagation Algorithm
8. Gradient Descent for Weight Update
9. Simple Image Classification using CNN
10. Simple Sequence Prediction using RNN

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXTBOOKS

- [1] Ian Goodfellow, Yoshua Bengio & Aaron Courville, *Deep Learning*, MIT Press, 2016.
 [2] Simon Haykin, *Neural Networks and Learning Machines (3rd Edition)*, Pearson, 2009.

REFERENCE BOOKS

- [1] S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, PHI Learning, 2003.
 [2] Satish Kumar, *Neural Networks: A Classroom Approach*, Tata McGraw-Hill, 2004.
 [3] Charu C. Aggarwal, *Neural Networks and Deep Learning*, Springer, 2018.

WEB REFERENCES:

- [1] "Neural Networks and Applications," <https://nptel.ac.in/courses/117105084>
 [2] "Fuzzy Logic and Neural Networks," <https://nptel.ac.in/courses/127105006>

25CS254	OPERATING SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental organization and architecture of computer systems, the evolution of operating systems, OS structure, and the process of building and booting an OS.	1,2	1
CO2	Implement process management techniques to solve scheduling problems.	1,2	1
CO3	Apply synchronization mechanisms to coordinate concurrent processes and resolve resource conflicts.	1,2,3,5	1
CO4	Recommend memory management strategies to improve system performance.	1,2,3,4,5	1
CO5	Compare their trade-offs across different operating systems in terms of system structure.	1,2,4	1

INTRODUCTION TO OPERATING SYSTEMS

[4]

Computer System Organization – Computer System Architecture- Evolution of Operating System- OS Structure Services - System Calls –OS Structures- Building and Booting an OS.

PROCESS MANAGEMENT

[8]

Processes: Process Concept-Process Scheduling-Operations on Process-Interprocesses Communication – Threads-Multithreads Models. CPU Scheduling: Basic Concept-Scheduling Criteria-Scheduling Algorithms- Multi Processor Scheduling. Process Synchronization: Critical Section Problem – Peterson’s Solution-Semaphores - Monitors – Hardware Synchronization: Deadlocks: System Model-Characterization-Methods-Prevention -Avoidance and Detection-Recovery from Deadlocks.

MEMORY MANAGEMENT

[6]

Memory Management Strategies: Swapping – Contiguous Memory Allocation-Segmentation -Paging. Virtual memory Management: Demand Paging - Page Replacement Algorithms- Thrashing

FILE MANAGEMENT AND DISK MANAGEMENT

[8]

File System: File concepts – Access Methods -Directory and Disk Structure-File System Mounting - File System Structure-Implementation-Directory Implementation-Allocation Methods-Free Space Management. Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management -Swap Space Management- I/O Systems - System Protection and Security.

ADVANCED TOPICS

[4]

Virtual Machines- Network and Distributed Systems – Case Studies: Linux-Windows 11

LABORATORY EXPERIMENTS

1. Linux Commands
2. System Calls

3. CPU Scheduling
4. Semaphore
5. Deadlock Avoidance
6. Paging
7. Page Replacement Algorithms
8. File Allocation Methods
9. Directory Implementation
10. Disk Scheduling

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK

- [1] Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, *Operating System Concepts*, John Wiley and Sons Inc., 10th ed., ISBN: 978-1-119-45408-3, 2021.

REFERENCE BOOK:

- [1] William Stallings, *Operating Systems - Internals and Design Principles*, Pearson Education India 9th ed., 2018.
- [2] Andrew S Tanenbaum, *Modern Operating Systems*, Pearson Education, 5th ed., 2024.

WEB RESOURCE:

- [1] "Operating System," https://onlinecourses.nptel.ac.in/noc21_cs72/preview
- [2] "Operating System Fundamentals," https://onlinecourses.nptel.ac.in/noc21_cs88/preview

25AI202	DATA SCIENCE AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain Python environment setup and Excel data handling using pandas.	1,5	1
CO2	Apply data cleaning and pre-processing techniques using Excel and pandas.	1,2,5	1.2
CO3	Perform exploratory data analysis and visualization using pandas and Excel tools.	2,4,5	1,2
CO4	Implement basic machine learning models using datasets prepared in Excel and pandas.	2,3,5	1,2,3
CO5	Develop automated data analysis and reporting pipelines using pandas and Excel integration.	3,5,11	1,2,3

COURSE CONTENT:

INTRODUCTION AND DATA HANDLING

[9]

Python environment setup (Jupyter/VS Code), introduction to pandas, reading and writing Excel files, working with multiple sheets, data inspection (head, info, describe), comparison of Excel functions and pandas operations.

DATA CLEANING AND EXCEL–PANDAS INTEGRATION

[9]

Handling missing values, duplicates, and inconsistent formats, data type conversions (dates, categorical, numeric), working with date/time data, merging and concatenating datasets, automation of repetitive Excel tasks using pandas.

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

[9]

Descriptive statistics, value counts, groupby operations, pivot tables, basic Excel charts and pivot charts, visualization using pandas/matplotlib, exporting visualizations and results to Excel, basic feature engineering.

MACHINE LEARNING WITH EXCEL DATA

[9]

Using pandas Data Frames for ML workflows, integrating Excel datasets with ML pipelines, simple regression and classification models, training–testing split, evaluation metrics (MAE, MSE, accuracy), exporting results to Excel.

AUTOMATION, DEPLOYMENT AND REPORTING

[9]

Automating Excel reports using pandas scripts, exporting outputs to multiple Excel sheets and charts, maintaining reproducible data pipelines, versioning workflows, capstone mini-project integrating Excel data, pandas analysis, ML model, and report generation.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Wes McKinney, *Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter*, 3rd ed., O'Reilly Media, 2022.
- [2] Eric Mithcell and Clive Pearson, *Excel Data Analysis: Your visual blueprint for analysing data, charts & PivotTables*, 3rd ed., Wiley, 2022.

REFERENCE BOOKS:

- [1] Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, 2nd ed., O'Reilly, 2022.

WEB REFERENCES:

- [1] "Data Analytics with Python," <https://nptel.ac.in/courses/106107220>
- [2] "Data Science with Python Tutorial," <https://www.geeksforgeeks.org/data-science/data-science-with-python-tutorial/>

25CS255	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Ability to Describe fundamental DBMS concepts, data models, database architecture, and schema design principles.	1,2	1,2
CO2	Ability to Apply relational algebra and SQL queries to create, manipulate, and retrieve database data.	1,2	1,2
CO3	Ability to Recommend normalization techniques and ER modeling to eliminate redundancy and improve database integrity.	1,2,5	1,2
CO4	Ability to Evaluate query execution and optimization strategies for improving database performance.	1,2,3,5	2
CO5	Ability to Design ETL pipelines, data warehousing solutions, and data engineering workflows for scalable data processing.	1,2,3,5	2

DATABASE CONCEPTS AND ARCHITECTURE

[6]

Database system overview, DBMS architecture, data models (hierarchical, network, relational), schema vs instance, data independence, ER modeling, enhanced ER concepts (specialization, generalization, aggregation), relational schema mapping.

RELATIONAL MODEL AND QUERY LANGUAGES

[6]

Relational algebra (operators and expressions), relational calculus (tuple and domain), SQL: DDL, DML, DQL, constraints, joins, nested/correlated subqueries, views, triggers, assertions, transactions, concurrency basics.

NORMALIZATION AND INTEGRITY

[6]

Functional, multivalued, and join dependencies, attribute closure, keys and candidate keys, normal forms (1NF, 2NF, 3NF, BCNF), lossless decomposition, dependency preservation, indexing concepts (B-tree, B+-tree).

QUERY PROCESSING, STORAGE AND OPTIMIZATION

[6]

Query execution stages, cost estimation, sorting, hashing, join techniques, query rewrite rules, plan selection, buffer management, caching, RAID storage, file organizations (heap, sorted, hashed, clustered).

DATA ENGINEERING AND WAREHOUSING

[6]

Introduction to data engineering, ETL lifecycle, data integration techniques, data warehousing architecture, OLTP vs OLAP, star/snowflake schema, dimensional modeling, ETL/ELT tools, Big Data platforms and distributed processing.

LIST OF EXPERIMENTS

1. Create and query relational databases using SQL DDL/DML/DQL.
2. Implement joins, nested and correlated queries.
3. Apply constraints, triggers, and views in database design.
4. Perform ER modeling and map to relational schemas.

5. Normalize database tables to 3NF/BCNF and test for integrity.
6. Develop a mini ETL pipeline or data warehousing workflow using a sample dataset.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Abraham Silberschatz, Henry F. Korth, S. Sudharshan. Database System Concepts, 7/E. McGraw-Hill, 2021.

REFERENCE BOOKS:

- [1] Ramez Elmasri and Shamkant B. Navathe. Fundamentals of Database Systems, 7/E. Pearson, 2017.
- [2] Garcia-Molina H., Ullman J.D., Widom J. Database Systems: The Complete Book, 3/E, Pearson, 2020.
- [3] Mark L. Gillenson, Pradeep Singh. Fundamentals of Database Management Systems, 3/E, Wiley, 2025.

WEB REFERENCES:

- [1] "Database Systems, 2025," https://onlinecourses.nptel.ac.in/noc24_cs55
- [2] Data Engineering Foundations, 2025.
- [3] "Data Engineering Foundations," <https://www.coursera.org/specializations/data-engineering-foundations>

25AI253	COMPUTER VISION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of computer vision, image formation, and camera models.	1,2,11	1
CO2	Apply image processing and filtering techniques for enhancement and edge detection.	1,2,3,5	1
CO3	Analyse feature detection, descriptors, and feature matching methods.	1, 2, 4, 5	1,2
CO4	Examine geometric vision concepts including transformations, stereo vision, and 3D understanding	1, 2, 3, 4	2
CO5	Implement motion analysis and image segmentation techniques for object detection and tracking.	1,2,3,4,5	1,2,3

COURSE CONTENT:

INTRODUCTION AND IMAGE FORMATION

[6]

Introduction and scope of computer vision, human vs machine vision, image formation using the pinhole camera model, camera geometry (intrinsic and extrinsic parameters), image sampling and quantization, color models (RGB, grayscale, HSV).

IMAGE PROCESSING AND FILTERING

[6]

Pixel intensity transformations, histogram processing, image smoothing (averaging, Gaussian), image sharpening, convolution and correlation, edge detection (Sobel, Prewitt, Canny), thresholding techniques, morphological operations (erosion and dilation), basic noise removal methods.

FEATURES, DESCRIPTORS AND MATCHING

[6]

Interest point detection (Harris, Shi–Tomasi), scale-space concept, blob detection (LoG, DoG), local feature descriptors (SIFT, SURF, ORB – overview), feature matching techniques (SSD, NCC), Hough transform for line and circle detection.

GEOMETRIC VISION AND 3D UNDERSTANDING

[6]

2D geometric transformations (translation, rotation, scaling, affine), camera projection model, fundamentals of epipolar geometry, stereo vision basics and depth estimation, homography and planar scene understanding, introduction to structure from motion.

MOTION ANALYSIS AND SEGMENTATION

[6]

Motion detection concepts and brightness constancy, optical flow (Lucas–Kanade – overview), basic tracking methods, background subtraction, image segmentation techniques (thresholding, region-based methods, clustering), watershed algorithm concept, connected component labeling.

LAB EXPERIMENTS:**[30]**

1. Basic Image I/O and Color Conversions
2. Image Resizing, Cropping & Rotation
3. Pixel Intensity Transformations
4. Histogram Generation & Equalization
5. Image Smoothing using basic filters
6. Edge Detection Basics
7. Thresholding Techniques
8. Morphological Operations
9. Contour Detection
10. Basic Feature Detection

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Szeliski, R. (2022). Computer Vision: Algorithms and Applications (2nd ed.). Springer.
- [2] Hartley, R., & Zisserman, A. (2003). Multiple View Geometry in Computer Vision (2nd ed.). Cambridge University Press.

REFERENCE BOOKS:

- [1] Forsyth, D. A., & Ponce, J. (2011). Computer Vision: A Modern Approach (2nd ed.). Pearson.

WEB REFERENCES:

- [1] "Modern Computer Vision," <https://nptel.ac.in/courses/108106189>
- [2] "Computer Vision," <https://nptel.ac.in/courses/106105216>
- [3] "Feature Extraction in Image Processing: Techniques and Applications," <https://www.geeksforgeeks.org/computer-vision/feature-extraction-in-image-processing-techniques-and-applications/>

25CS211	DISCRETE MATHEMATICS	L	T	P	C
		2	1	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	Course Outcomes	POs	PSO
CO1	Understand propositional logic, predicates, quantifiers, inference rules, and proof strategies to evaluate logical statements and construct formal proofs.	1,2,5	1
CO2	Apply combinatoric methods to count, organize, and solve problems involving permutations, combinations, recurrence relations, and the pigeonhole principle.	1,2,5	1
CO3	Solve problems involving graphs and their properties, including graph representation, connectivity, and special types like Eulerian and Hamiltonian paths.	1,2,5	1
CO4	Analyze the concepts of algebraic systems such as groups, rings, and fields, including their properties and operations, and apply them to solve algebraic problems.	1,2,5	1
CO5	Analyze the properties and applications of lattices and Boolean algebra, including minimization of Boolean expressions and their role in digital logic design.	1,2,5	1

MATHEMATICAL LOGIC

[9]

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs.

COMBINATORICS

[9]

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions.

GRAPH THEORY

[9]

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

ALGEBRAIC STRUCTURES

[9]

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Rings and Fields (Definitions and examples).

LATTICES AND BOOLEAN ALGEBRA

[9]

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Minimization of Boolean Expression.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	15	0	45	3

LIST OF EXPERIMENTS USING MATLAB

1. Truth Table Generator for Propositional Logic
2. Predicate Logic Evaluator

3. Permutations and Combinations Calculator
4. Recurrence Relation Solver
5. Graph Representation using Adjacency Matrix
6. Euler & Hamiltonian Graph Simulation
7. Group Operation Table Generator
8. Cosets and Subgroups Visualizer
9. Hasse Diagram Generator for Lattices
10. Boolean Expression Minimization and Logic Gate Simulation

TEXT BOOKS:

- [1] Rosen, K.H., *Discrete Mathematics and its Applications*, 7th ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
- [2] 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.

REFERENCE BOOKS:

- [1] Grimaldi, R.P. *Discrete and Combinatorial Mathematics: An Applied Introduction*, 4th ed., Pearson Education Asia, Delhi, 2007.
- [2] Lipschutz, S. and Mark Lipson., *Discrete Mathematics*, Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd ed., 2010.
- [3] Koshy, T. *Discrete Mathematics with Applications*, Elsevier Publications, 2006.

WEB REFERENCES:

- [1] "Discrete Mathematics – IIT Ropar," <https://nptel.ac.in/courses/111/106/111106086>
- [2] "Discrete Mathematics – IIT Madras," <https://nptel.ac.in/courses/111/106/111106130>
- [3] "Graph Theory – IIT Kharagpur," <https://nptel.ac.in/courses/111/105/111105035>
- [4] "Group Theory – IIT Madras," <https://nptel.ac.in/courses/111/106/111106112>
- [5] "Mathematics for Computer Science (6.042J)," <https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-spring-2015/>
- [6] "Introduction to Logic – Stanford University," <https://www.coursera.org/learn/logic-introduction>
- [7] "Algorithms on Graphs – UC San Diego," <https://www.coursera.org/learn/algorithms-on-graphs>
- [8] "Introduction to Group Theory – University of Sydney," <https://www.coursera.org/learn/introduction-to-group-theory>
- [9] "Discrete Math and Logic Concepts," <https://www.khanacademy.org/computing/computers-and-internet/xcae6f4a7ff015e7d:computers/xcae6f4a7ff015e7d:logic-gates-and-circuits/a/logic-gates>
- [10] "Permutations, Combinations & Counting," <https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations>
- [11] "Intro to Graph Theory," <https://www.khanacademy.org/computing/computer-science/algorithms/graph-representation>

25AI254	DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals, characteristics, and architecture of Big Data systems	1,2,11	1,2
CO2	Describe the Hadoop ecosystem and HDFS for distributed data storage	1,2,5	2
CO3	Apply the MapReduce programming model for processing large datasets.	1,2,3,5	1
CO4	Analyze big data processing using Apache Spark and its core components.	1,2,3,5	1,2
CO5	Evaluate Big Data analytics techniques and applications with security considerations.	1,2,6,8,11	2,3

COURSE CONTENT:

INTRODUCTION TO BIG DATA

[6]

Introduction to Big Data, characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), traditional data processing vs Big Data processing, Big Data use cases, challenges in Big Data, overview of Big Data architecture.

HADOOP ECOSYSTEM AND HDFS

[6]

Introduction to Hadoop, Hadoop architecture, Hadoop Distributed File System (HDFS), HDFS components, data storage in HDFS, HDFS read and write operations, fault tolerance and replication, overview of Hadoop ecosystem tools.

MAPREDUCE PROGRAMMING

[6]

Introduction to MapReduce programming model, Map and Reduce functions, data flow in MapReduce, word count example, combiners and partitioners, limitations of MapReduce, introduction to YARN.

APACHE SPARK AND BIG DATA PROCESSING

[6]

Introduction to Apache Spark, Spark architecture, Resilient Distributed Datasets (RDDs), Spark transformations and actions, Spark SQL and DataFrames, Spark vs MapReduce, basic Spark applications.

BIG DATA ANALYTICS AND APPLICATIONS

[6]

Introduction to Big Data analytics, data ingestion tools (Flume, Sqoop – overview), basic data analysis using Spark, visualization of Big Data results, real-world Big Data applications, security and privacy issues in Big Data.

LAB EXPERIMENTS:

[30]

1. Installation and configuration of Hadoop/Spark environment, understanding Hadoop file system commands.
2. Uploading, downloading, deleting files in HDFS, directory management and permissions.

3. Implementation of word count program using MapReduce.
4. Finding maximum, minimum, or average values from a large dataset using MapReduce.
5. Processing log files to count events or analyze access patterns.
6. Running basic Spark programs, understanding RDD operations.
7. Implementing map, filter, reduce, and collect operations.
8. Creating DataFrames, running SQL queries on structured data.
9. Importing data from relational databases into HDFS (conceptual or demo).
10. End-to-end analysis of a dataset using Hadoop or Spark and interpretation of results.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXTBOOKS

- [1] Tom White, Hadoop: The Definitive Guide, 4th ed., O'Reilly, 2015.
- [2] Viktor Mayer-Schönberger and Kenneth Cukier, Big Data: A Revolution That Will Transform How We Live, Work, and Think, Houghton Mifflin, 2013.

REFERENCE BOOKS

- [1] Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets, Cambridge University Press, 2010.
- [2] Bill Chambers and Matei Zaharia, Spark: The Definitive Guide, O'Reilly, 2018.

WEB REFERENCES:

- [1] "Big Data Analytics," <https://nptel.ac.in/courses/106104189>
- [2] "Introduction to Data Analytics," <https://nptel.ac.in/courses/110106072>

25IT256	WEB TECHNOLOGIES AND FULL STACK DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the structure and components of modern web applications.	1	1
CO2	Apply HTML5 semantic elements, forms, and multimedia, along with CSS3 styling, responsive layouts, and visual effects, to create accessible, SEO-friendly, and visually engaging web interfaces.	1,2,3,5	1
CO3	Implement client-side interactivity, form validation, and dynamic content updates using JavaScript, DOM manipulation, event handling, and asynchronous programming techniques (AJAX/fetch API).	1,2,3,5	1
CO4	Develop server-side functionality using PHP to handle form data, manage sessions and cookies, perform CRUD operations with MySQL, and apply security best practices in web programming.	1,2,3,4,5	1
CO5	Integrate front-end and back-end technologies to design, build, test, and deploy a full-stack web application, incorporating version control (Git) and deployment on local or cloud platforms.	1,2,3,4,5	1

COURSE CONTENT:

HTML5: WEB PAGE STRUCTURE AND ELEMENTS

[6]

Introduction to web technologies – client-server architecture – structure of HTML document – headings, paragraphs, lists, tables, and hyperlinks – forms and input types – semantic tags: header, nav, section, article, footer – multimedia elements (audio, video, canvas) – metadata and accessibility – SEO-friendly markup.

CSS3: STYLING AND RESPONSIVE DESIGN

[6]

Introduction to CSS3 – syntax and selectors – box model – borders, margins, padding, positioning – display properties – Flexbox and CSS Grid – typography and color schemes – gradients, shadows, transitions, animations – responsive design using media queries – mobile-first design principles.

JAVASCRIPT: CLIENT-SIDE PROGRAMMING

[6]

Introduction to JavaScript – variables, data types, operators – control structures – functions, arrays, and objects – DOM manipulation – event handling (click, mouse, form) – form validation – ES6 features (let, const, arrow functions, template literals) – asynchronous JavaScript (AJAX, fetch API) – debugging and developer tools.

PHP: SERVER-SIDE SCRIPTING AND DATABASE CONNECTIVITY

[6]

Introduction to PHP – syntax and variables – control structures and arrays – functions and file handling – form handling using GET and POST – session and cookie management – error handling and input validation – connecting PHP with MySQL using MySQLi/PDO – CRUD operations – security practices in web programming.

FULL STACK INTEGRATION AND DEPLOYMENT

[6]

Integration of front-end and back-end – combining HTML, CSS, JavaScript, PHP, and MySQL – designing a full stack architecture – client–server communication and data flow – user authentication and session tracking – testing and debugging – version control using Git – deployment on XAMPP/WAMP or cloud platforms – documentation and maintenance.

LAB MODULES:

[30]

1. Design a personal portfolio webpage using HTML5 structure and semantic tags.
2. Create a responsive web layout using CSS3 Flexbox and Grid system.
3. Develop a form with various HTML5 input types and validate it using JavaScript.
4. Implement JavaScript DOM manipulation to dynamically change web page content.
5. Use JavaScript events to create an interactive image gallery or slideshow.
6. Write a PHP program to process a feedback form using POST method.
7. Develop a PHP script for performing CRUD operations in MySQL (student database).
8. Implement user login and session management using PHP and MySQL.
9. Build an integrated mini web application combining HTML, CSS, JS, PHP, and MySQL.
10. Deploy the mini full stack web application on a local or cloud-based web server (e.g., XAMPP/WAMP/000webhost).

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Philip Ackermann (2022), *Full Stack Web Development: The Comprehensive Guide*, Wiley Publications. (Covers all five modules: HTML5, CSS3, JavaScript, PHP, and MySQL)
- [2] Luke Welling & Laura Thomson, *PHP and MySQL Web Development*, 5th ed., Pearson, 2020.
- [3] Robin Nixon, *Learning PHP, MySQL & JavaScript*, 5th ed., O'Reilly, 2022.
- [4] Jon Duckett, *Web Design with HTML, CSS, JavaScript and jQuery*, Wiley, 2021.

REFERENCE BOOKS:

- [1] Marijn Haverbeke, *Eloquent JavaScript*, 4th ed., No Starch Press, 2023.
- [2] Ben Frain, *Responsive Web Design with HTML5 and CSS*, 4th ed., Packt Publishing, 2022.
- [3] David Sawyer McFarland, *CSS: The Missing Manual*, 5th ed., O'Reilly, 2020.
- [4] W3C Consortium, *Web Standards and HTML5 Specifications*, Latest Online Version, W3C, 2024.

WEB REFERENCES:

- [1] "W3Schools Online Web Tutorials," <https://www.w3schools.com>
- [2] "Mozilla Developer Network (MDN Web Docs)," <https://developer.mozilla.org>
- [3] "PHP Manual and MySQL Developer Guide – and," <https://www.php.net/manual/en/>
<https://dev.mysql.com/doc/>

25AI255	MACHINE LEARNING TECHNIQUES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain basic concepts, types, and applications of Machine Learning	1,2,11	1
CO2	Apply regression techniques for predictive modeling.	1,2,3,5	1,2
CO3	Implement classification algorithms and evaluate their performance.	1,2,3,4,5	1,2
CO4	Analyse clustering and dimensionality reduction techniques.	1,2,4,5	1,2
CO5	Evaluate ML models using validation methods and simple applications.	1,2,4,5,11	1,3

COURSE CONTENT:

INTRODUCTION TO MACHINE LEARNING

[6]

Introduction to Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Reinforcement, Applications of Machine Learning, Machine Learning workflow, Challenges in Machine Learning.

SUPERVISED LEARNING – REGRESSION

[6]

Linear Regression, Multiple Linear Regression, Polynomial Regression, Cost functions and gradient descent, Model evaluation for regression

SUPERVISED LEARNING – CLASSIFICATION

[6]

Logistic Regression-Nearest Neighbors (k-NN), Naïve Bayes Classifier, Decision Trees, Performance measures: Accuracy, Precision, Recall, F1-score

UNSUPERVISED LEARNING

[6]

Introduction to clustering-Means Clustering, Hierarchical Clustering, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA)

MODEL EVALUATION AND APPLICATIONS

[6]

Training, validation, and test sets, Overfitting and underfitting, Cross-validation, Introduction to ensemble learning, Case studies and simple applications

LAB EXPERIMENTS:

[30]

1. Perform data cleaning and preprocessing.
2. Implement simple linear regression for prediction
3. Implement multiple linear regression.
4. Classify data using logistic regression.
5. Implement k-NN classification.
6. Implement Naïve Bayes classification.
7. Build a decision tree classifier

8. Perform clustering using k-means.
9. Evaluate and compare machine learning models using cross-validation techniques.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Mehryar Mohri, Afshin Rostamizadeh & Ameet Talwalkar — Foundations of Machine Learning (2nd ed.), MIT Press, 2018.

REFERENCE BOOKS:

- [1] Kevin P. Murphy — Probabilistic Machine Learning (volumes; MIT Press / recent editions, 2022 onward).
- [2] Christopher M. Bishop — Pattern Recognition and Machine Learning, Springer, 2006.
- [3] Trevor Hastie, Robert Tibshirani & Jerome Friedman — The Elements of Statistical Learning, 2nd ed., Springer, 2009.
- [4] Shai Shalev-Shwartz & Shai Ben-David — Understanding Machine Learning: From Theory to Algorithms, Cambridge Univ. Press, 2014

WEB REFERENCES:

- [1] "Introduction to Machine Learning," <https://nptel.ac.in/courses/106105152>
- [2] "Machine Learning and Deep Learning - Fundamentals and Applications," <https://nptel.ac.in/courses/108103192>
- [3] "Machine Learning Tutorial," <https://www.geeksforgeeks.org/machine-learning/machine-learning/>

25AI256	DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of deep learning, neural networks, activation functions, and optimization concepts.	1,2,11	1
CO2	Apply training techniques for deep neural networks including backpropagation, gradient descent, and regularization methods.	1,2,3,5	1,2
CO3	Analyse convolutional neural networks (CNNs) for image processing and classification tasks.	1,2,3,4,5	1,2
CO4	Examine recurrent neural networks (RNNs) and their variants for sequence and time-series data analysis	1,2,3,4,5	1,2
CO5	Evaluate modern deep learning models and applications such as autoencoders, transformers, and real-world case studies.	1,2,4,5,11	1,2,3

COURSE CONTENT:

INTRODUCTION TO DEEP LEARNING

[6]

Motivation for Deep Learning, Shallow vs Deep Networks, Biological neuron vs artificial neuron, Architecture of Artificial Neural Networks (ANN), Activation functions (Sigmoid, Tanh, ReLU, SoftMax), Loss functions and optimization overview

TRAINING DEEP NEURAL NETWORKS

[6]

Forward and backward propagation, Gradient descent and variants (SGD, Momentum, Adam), Weight initialization techniques, Overfitting and underfitting, Regularization methods (L1, L2, Dropout), Batch normalization

CONVOLUTIONAL NEURAL NETWORKS (CNNs)

[6]

Motivation for CNNs, Convolution, padding, stride, Pooling layers, CNN architectures (LeNet, AlexNet – overview), Image classification using CNNs, Transfer learning concept

RECURRENT NEURAL NETWORKS (RNNs)

[6]

Sequence modeling concepts, Recurrent Neural Networks, Backpropagation through Time (BPTT), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Applications: text and time-series data

MODERN DEEP LEARNING & APPLICATIONS

[6]

Autoencoders, Introduction to Transformers, Model evaluation and tuning, Ethics and limitations of Deep Learning, Case studies: vision, NLP, speech, End-to-end deep learning workflow

LAB EXPERIMENTS:

[30]

1. Installation and usage of Python, NumPy, TensorFlow/Keras or PyTorch, loading datasets, basic tensor operations.
2. Design a simple ANN with input, hidden and output layers, choose activation functions, train the model on a small dataset.

3. Manual or programmatic implementation of forward propagation and backpropagation for a simple neural network.
4. Train the same neural network using sigmoid, tanh and ReLU activation functions and compare performance.
5. Train a deep neural network with and without regularization techniques such as dropout or L2 regularization
6. Design a CNN for image classification using a standard dataset (e.g., MNIST or CIFAR-10)
7. Use a pre-trained CNN model (VGG, ResNet or MobileNet) and fine-tune it for a new dataset.
8. Implement a basic RNN for sequence prediction or text classification.
9. Build an LSTM-based model for sentiment analysis or time-series forecasting.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Ian Goodfellow, Yoshua Bengio & Aaron Courville,” Deep Learning (Adaptive Computation and Machine Learning)”, MIT Press, 2016.
- [2] Sudharsan Ravichandiran,”Hands-On Deep Learning Algorithms with Python”, Packt Publishing, 2020.

REFERENCE BOOKS:

- [1] François Chollet,” Deep Learning with Python”, 2nd ed., Manning Publications, 2021.
- [2] Denis Rothman,” Transformers for Natural Language Processing: Build BERT, GPT”, 2nd ed., Packt Publishing, 2022.
- [3] William L. Hamilton,Morgan & Claypool.,”Graph Representation Learning”, 2020(graph neural networks)

WEB REFERENCES:

- [1] "Deep Learning," <https://nptel.ac.in/courses/106105215>
- [2] "Machine Learning and Deep Learning - Fundamentals and Applications," <https://nptel.ac.in/courses/108103192>
- [3] "What Is Deep Learning? A Tutorial for Beginners," <https://www.datacamp.com/tutorial/tutorial-deep-learning-tutorial>

25IT257	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundational concepts, architecture models (NIST), service and deployment models of cloud computing, along with its key characteristics, benefits, and challenges in modern IT infrastructure.	1	*
CO2	Apply principles of virtualization, containerization, and web service architectures to design, configure, and manage virtualized cloud environments using appropriate platforms and tools.	1, 2, 3,5	*
CO3	Recommend cloud storage solutions, interoperability standards, and deployment strategies to evaluate performance, cost, and suitability for different application scenarios across major cloud platforms.	1, 2, 3, 4, 5	*
CO4	Utilize cloud security frameworks, identity and access management (IAM) policies, and governance models to implement secure, compliant, and resilient cloud-based systems.	1, 2, 3, 4, 5	*
CO5	Evaluate the architectural trade-offs, security threats, and operational governance of virtualized and containerized cloud environments to recommend solutions that balance performance, cost, and risk.	1, 2, 3, 4, 5	*

CLOUD ARCHITECTURE & INFRASTRUCTURE

[6]

Introduction to Cloud Computing – Need and Evolution of Cloud – Cloud Architecture – NIST Reference Model – Service Models (IaaS, PaaS, SaaS) – Deployment Models (Public, Private, Hybrid, Community Cloud) – Characteristics and Benefits of Cloud – Cloud Infrastructure Components – Cloud Challenges and Applications.

WEB SERVICES & VIRTUALIZATION BASICS

[6]

Service-Oriented Architecture – SOAP & REST – Basics of Virtualization – Virtual Machine Concepts – Hypervisors (Type 1 & Type 2) – Virtualization Techniques: Full, Para and Hardware Virtualization – CPU, Memory and I/O Virtualization – Resource Allocation and Performance Considerations.

CLOUD STORAGE & CONTAINERIZATION

[6]

Cloud Storage Fundamentals – Storage Provisioning – Managed vs Unmanaged Storage – Cloud Backup Strategies – Cloud Storage Interoperability (CDMI, OCCI) – Introduction to Containers – Docker Architecture – Docker Images, Containers and Repositories – Basics of Kubernetes.

CLOUD PLATFORMS & DEPLOYMENT

[6]

Google App Engine – Amazon AWS – Microsoft Azure – OpenStack Overview and Architecture – Eucalyptus and OpenNebula – Programming on EC2 and S3 – Application Deployment Models – Performance Evaluation Parameters – Cost Optimization Concepts.

CLOUD SECURITY & GOVERNANCE

[6]

Security Challenges in Virtualized Environments – VM Attacks: VM Escape, Guest Hopping, VM Migration Attacks – Hypervisor Threats – Data Security and Storage Security – Identity and Access

Management (IAM) – IAM Architecture, Policies and Best Practices – Cloud Compliance and Governance.

LAB EXPERIMENTS

1. Study of Cloud Models – Demonstration of IaaS / PaaS / SaaS and Deployment Models
2. Creation and Management of Virtual Machines using VMware / VirtualBox
3. Study and Comparison of Hypervisors and Virtualization Types
4. Docker Installation and Basic Container Operations
5. Docker Image Building and Application Deployment
6. Implementation of Cloud Storage & Basic IAM Configuration on AWS / Azure

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Application Programming. Elsevier, 2021.

REFERENCE BOOKS:

- [1] Kai Hwang, Jack Dongarra, Geoffrey Fox. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things. Morgan Kaufmann, 2022.
- [2] Thomas Erl, Ricardo Puttini, Zaigham Mahmood. Cloud Computing: Concepts, Technology & Architecture. Pearson, 2020.
- [3] Chris Dotson. Practical Cloud Security, O'Reilly, 2019.

WEB REFERENCES:

- [1] "Cloud Computing," <https://nptel.ac.in/courses/106105167>
- [2] "Cloud Computing and Distributed Systems," <https://nptel.ac.in/courses/106104182>

25CS265	DEVOPS SKILLS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the fundamental concepts, evolution, and principles of DevOps and modern software delivery models.	1,2,5	1
CO2	Explain version control mechanisms and collaborative workflows using Git, GitHub, and GitLab.	1,3,4	1,3
CO3	Apply build automation tools such as Maven and Gradle to manage dependencies and integrate with CI/CD pipelines.	2,3,5,9	2
CO4	Demonstrate the setup of Continuous Integration and Delivery pipelines using Jenkins for automated builds and deployments.	2,3,4,5,9	1,2
CO5	Analyse the efficiency of containerized and automated infrastructure solutions using Docker, Kubernetes, and Terraform.	1,2,3,4,5,7,8,9,10,11	2,3

COURSE CONTENT:

INTRODUCTION TO DEVOPS AND SOFTWARE DELIVERY MODELS

[6]

Software Development Life Cycle – Evolution of DevOps – DevOps culture and principles – Agile vs DevOps – Key concepts of Continuous Integration (CI), Continuous Delivery (CD), and Continuous Deployment (CDp) – DevOps lifecycle – Benefits and challenges of DevOps adoption.

VERSION CONTROL

[6]

Version control systems – Git fundamentals (init, commit, branch, merge, revert) – Local and remote repositories – GitHub / GitLab workflow – Collaboration and branching strategies – Code versioning best practices.

BUILD AUTOMATION AND DEPENDENCY MANAGEMENT

[6]

Introduction to build tools – Maven and Gradle fundamentals – Build lifecycle, dependency management – Integration of build tools with version control – Introduction to artifact repositories (Nexus, JFrog) – Build reporting and maintenance.

CONTINUOUS INTEGRATION AND DELIVERY PIPELINES

[6]

Jenkins fundamentals – CI/CD architecture – Pipeline as Code (Jenkins file) – Automated builds and testing – Environment management – Rollback and recovery strategies – Case study: CI/CD workflow implementation.

CONTAINERIZATION AND INFRASTRUCTURE AUTOMATION

[6]

Introduction to containers and Docker – Docker file creation and image management – Container orchestration with Kubernetes – Infrastructure as Code (IaC) using Terraform basics – Overview of DevOps monitoring and security practices

LAB EXPERIMENTS:**[30]**

1. Install Git and create a local repository, and to perform basic version control operations such as initialization, committing changes, and viewing repository status and history.
2. Implement branching, merging, and conflict resolution techniques in Git for effective collaborative software development.
3. Create and manage remote repositories using github or gitlab, and to practice pushing, pulling, and collaborating on source code using distributed version control workflows.
4. Automate the build process of a software application using Maven and to manage project dependencies through the Maven build lifecycle.
5. Implement build automation using Gradle, configure build scripts, and analyze the differences between Maven and Gradle build mechanisms.
6. Install and configure Jenkins and create a basic Continuous Integration job by integrating Jenkins with a version control repository.
7. Design and implement a Continuous Integration pipeline using Jenkins Pipeline as Code by defining build and test stages in a Jenkinsfile.
8. Extend the CI pipeline into a Continuous Delivery pipeline by automating testing, artifact management, and implementing rollback strategies for build failures.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Gene Kim, Jez Humble, Patrick Debois, and John Willis, *The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations*, 2nd ed., IT Revolution Press, 2021.

REFERENCE BOOKS:

- [1] Jez Humble and David Farley, *Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation*, Addison-Wesley Professional, 1st ed., Reprint 2020.
- [2] Nigel Poulton, *Docker Deep Dive*, 5th ed., Independently Published, 2023.
- [3] Yevgeniy Brikman, *Terraform: Up & Running – Writing Infrastructure as Code*, 3rd ed., O'Reilly Media, 2022.
- [4] Kelsey Hightower, Brendan Burns, and Joe Beda, *Kubernetes: Up and Running – Dive into the Future of Infrastructure*, 3rd ed., O'Reilly Media, 2021.

WEB REFERENCES:

- [1] "Professional Certificate Program in Cloud Computing & DevOps,"
<https://www.eicta.iitk.ac.in/courses/professional-certificate-program-in-cloud-computing-devops>
- [2] <https://nptel.ac.in/courses/128106012>
- [3] "DevOps Tutorial," <https://www.geeksforgeeks.org/devops/devops-tutorial/>

25CS259	INTERNET OF THINGS AND SMART SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply networking principles and addressing strategies to configure IoT systems using layered models and TCP/IP protocols.	1,5	1
CO2	Implement sensor and actuator modules in IoT devices, considering characteristics, deviations, and interfacing requirements.	1,5	1,2
CO3	Develop IoT applications using Raspberry Pi and Python, integrating cloud and fog computing platforms for data processing.	1,5	1,2,3
CO4	Utilize appropriate communication protocols and semantic frameworks to enable interoperability across diverse IoT devices.	1, 5	1,2
CO5	Design and deploy IoT solutions for real-world domains such as agriculture, healthcare, and smart environments, addressing security and privacy challenges.	1, 5	1,2,3

INTRODUCTION

[6]

Basics of Networking - Introduction – Network Types- Layered Networks Models- Addressing-TCP/IP Transport layer– Predecessors of IoT-Wireless sensor Networks-M2M communications-Cyber Physical Systems- Emergence of IoT- Evolution of IoT-Enabling IoT and complex independence of Technologies-IoT Networking Components-Addressing Strategies in IoT – IoT sensing and actuation – Sensors-Sensor characteristics-Sensorial Deviations-Sensing Types-Sensing Considerations-Actuators-Actuator Types-Actuator Characteristics.

INTERNET OF THINGS

[6]

IoT processing and topologies and types-Data Format-Importance of Processing in IoT-Processing Topologies-IoT Device Design and Selection Considerations-Processing Offloading – IoT connectivity Technologies

COMMUNICATION TECHNOLOGIES

[6]

IoT communication Technologies –Introduction-Infrastructure Protocols-Discovery Protocols-Data Protocols-Identification Protocols-Device Management-Semantic Protocols- IoT interoperability – Introduction-Standards-Frameworks

ASSOCIATED IOT TECHNOLOGIES

[6]

Cloud computing – Virtualization-Cloud Models-Service-Level Agreement in Cloud Computing-Cloud Implementation-Sensor-Cloud: Sensors as service-Fog computing and its applications- Introduction-View of Fog Computing Architecture-Fog Computing in IoT-Selected Applications of fog computing-Beginning IoT Hardware Projects –IoT Analytics

IOT CASE STUDIES AND FUTURE TRENDS

[6]

Agriculture IoT –Vehicular IoT – Healthcare IoT –Paradigms, challenges and Future

LAB EXPERIMENTS:

[30]

1. Installation and Configuration of Raspberry Pi
2. Python Programming Basics on Raspberry Pi
3. PIO Programming with LED Interfacing

4. Push Button Interfacing
5. Temperature and Humidity Monitoring using DHT11/DHT22
6. Ultrasonic Sensor Interfacing
7. PIR Motion Sensor Interfacing

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Sudip Misra, Anandarup Mukherjee – Arijit Roy – “Introduction to IoT – Cambridge University Press,2022.

REFERENCE BOOKS:

- [1] Arshdeep Bahga, Vijay Madisetti, *Internet of Things-A hands-on approach*, Universities Press, 2015.
- [2] Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key applications and Protocols*, Wiley Publications 2nd ed., 2013.
- [3] Raj Kamal, *Internet of Things – Architecture and Design Principles*, Mc Graw Hill Education Pvt. Ltd., 2017.
- [4] “Internet of Things and Data Analytics, Hwaiyu Geng, P.E, Wiley Publications, 2017.

WEB REFERENCES:

- [1] "Introduction To Internet Of Things," https://onlinecourses.nptel.ac.in/noc22_cs53/preview
- [2] "Introduction to Internet of Things," <https://nptel.ac.in/courses/106105166>
- [3] "Design for Internet of Things," <https://nptel.ac.in/courses/108108098>

25AI204	REINFORCEMENT LEARNING	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of reinforcement learning, including the agent–environment interaction, reward structures, and Markov Decision Processes, using appropriate mathematical formulations.	1,3,5	1
CO2	Analyse and solve reinforcement learning problems using dynamic programming, Monte Carlo methods, and temporal-difference learning for tabular environments.	1,3,5	1,2
CO3	Apply model-free control algorithms such as SARSA and Q-learning with suitable exploration strategies to obtain optimal policies in discrete state-action spaces.	1,3,5	1,2
CO4	Design and implement policy gradient and actor–critic methods using function approximation techniques for continuous or large-scale reinforcement learning problems.	1,3,5	2
CO5	Evaluate and implement deep reinforcement learning approaches, including Deep Q-Networks, and assess their applicability, limitations, and ethical considerations in real-world decision-making systems.	1,2,3,4	1,2,3

FUNDAMENTALS AND MATHEMATICAL TOOLS

[6]

What is Reinforcement Learning? Agent–Environment paradigm, Rewards, returns, episodic vs continuing tasks, Markov Decision Processes (MDPs): definitions, state/action spaces, Value functions (V, Q), optimality, Bellman equations for V and Basics of Probability & Dynamic Programming prerequisites

TABULAR METHODS AND PLANNING

[6]

Dynamic Programming: Policy evaluation, policy improvement, value iteration, Monte Carlo methods: prediction & control, Temporal-Difference (TD) learning (TD(0), TD(λ)), Combining planning and learning (Dyna approach basics)

CONTROL, Q-LEARNING AND FUNCTION APPROXIMATION

[6]

Control in RL: Exploration vs Exploitation, SARSA, Q-Learning, Off-Policy learning, Function approximation: linear approx. & basics, Issues in approximators (bias vs variance)

POLICY GRADIENT AND ACTOR-CRITIC METHODS

[6]

Policy parameterization and gradient theorem, REINFORCE, Actor-Critic methods, Advantage functions, Brief intro to Deep Policy Gradient

DEEP RL, MODERN TOPICS AND RESEARCH

[6]

Deep Q Networks (DQN) basics, Exploration techniques in Deep RL, Model-based RL vs Model-free, Safety, RL with Human Feedback (RLHF), offline RL (intro level)

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Richard S. Sutton & Andrew G. Barto ,”Reinforcement Learning: An Introduction (2nd Ed.)” (MIT Press, 2020).

REFERENCE BOOKS:

- [1] Belousov et al., Reinforcement Learning Algorithms: Analysis & Applications — (Springer, 2021).
[2] Graesser & Keng, Foundations of Deep Reinforcement Learning — (Addison-Wesley, 2020).

25AI257	NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of NLP including text pre-processing, language models, and vector representations.	1,2,11	1
CO2	Apply sequence labelling and parsing techniques for syntactic analysis of text.	1,2,3,4,5	1,2
CO3	Analyse semantic processing and information extraction techniques in NLP applications.	1,2,4,5	1,2
CO4	Implement neural NLP models including attention mechanisms and transformer architectures.	1,2,3,5	2
CO5	Evaluate large language models using appropriate metrics and address ethical and deployment issues.	1,2,6,8,11	1,2,3

COURSE CONTENT:

FOUNDATIONS AND TRADITIONAL METHODS

[6]

text pre-processing, tokenization, morphology, n-gram language models, smoothing, vector semantics (word embeddings, Word2Vec, Glove), classical classifiers (Naive Bayes, logistic regression)

SEQUENCE LABELLING AND PARSING

[6]

POS tagging, sequence models (HMM, CRF), sequence-to-sequence basics, constituency and dependency parsing, transition and graph-based parsers.

SEMANTICS, INFORMATION EXTRACTION AND APPLICATIONS

[6]

word sense disambiguation, lexical semantics (WordNet), semantic role labelling, coreference resolution, named entity recognition, relation extraction, information retrieval basics, topic modelling. Applications: sentiment analysis, summarization

NEURAL METHODS AND TRANSFORMERS

[6]

neural sequential models (RNN/LSTM brief), attention mechanism, Transformer architecture (encoder/decoder, self-attention), pretrained language models, fine-tuning and adapters (LoRA/PEFT), tokenization strategies. Hands-on: fine-tune a transformer (Hugging Face) for classification/generation

LARGE LANGUAGE MODELS, EVALUATION, ETHICS AND DEPLOYMENT

[6]

LLM behaviors (hallucination, calibration), prompt engineering, retrieval-augmented generation (RAG), evaluation metrics (perplexity, BLEU, ROUGE, BERT Score, human eval), bias/fairness, privacy, model compression and inference serving.

LAB MODULE:

[30]

1. Data pre-processing, tokenization, embeddings exploration (word2vec/Glove).
2. Implement HMM/CRF POS tagger on tagged corpus.
3. Train a simple sequence-to-sequence model for translation/summary (toy corpora).
4. Implement dependency parser (transition-based).
5. Fine-tune BERT/Distil BERT for classification.

6. Fine-tune a small decoder model for text generation / evaluate perplexity & generation quality.
7. Build an RAG prototype: embeddings + FAISS + small LLM.
8. Project lab: final demo + reproducible code

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS:

- [1] Daniel Jurafsky & James H. Martin, *Speech and Language Processing* — 3rd ed. (online manuscript, 2025). (Comprehensive; updated for language models.)

REFERENCE BOOKS:

- [1] Lewis Tunstall, Leandro von Werra, Thomas Wolf, *Natural Language Processing with Transformers (Revised)*, (O'Reilly, 2023/2024). O'Reilly Media
- [2] Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*.

WEB REFERENCES:

- [1] "Natural Language Processing," <https://nptel.ac.in/courses/106105158>
- [2] "Natural Language Processing," <https://nptel.ac.in/courses/106101007>
- [3] "Natural Language Processing Specialization Resources," <https://www.deeplearning.ai/resources/natural-language-processing/>

25AI215	ALGORITHM DESIGN AND PERFORMANCE	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply basic concepts of algorithm analysis, asymptotic notations, and recurrence relations to evaluate the efficiency of algorithms.	1,3,5	1
CO2	Analyse problems and design solutions using Divide-and-Conquer techniques such as Quick Sort, Merge Sort, Maximum/Minimum, Closest Pair, and Strassen's Matrix Multiplication.	1,3,5	1,2
CO3	Design and implement algorithms using Greedy and Dynamic Programming techniques to solve optimization problems including Knapsack, Dijkstra's Algorithm, Floyd's Algorithm, and Longest Common Subsequence.	1,3,5	1,2
CO4	Solve combinatorial and optimization problems using Backtracking and Branch-and-Bound approaches, including N-Queens, Sum of Subsets, Hamiltonian Cycle, and Traveling Salesman Problem.	1,3,5	2
CO5	Understand NP-Problems, NP-Complete problems, and apply Approximation Algorithms to solve computationally hard problems like Knapsack and Traveling Salesman Problem.	1,3,5	2,3

COURSE CONTENT

ALGORITHM ANALYSIS AND DIVIDE-AND-CONQUER

[6]

Algorithm analysis, Asymptotic notations, Recurrence relations, Divide-and-Conquer strategy, Merge Sort, Quick Sort.

ADVANCED DIVIDE-AND-CONQUER TECHNIQUES

[6]

Finding Maximum and Minimum, Strassen's Matrix Multiplication, Closest Pair Problem, Convex Hull.

GREEDY AND DYNAMIC PROGRAMMING

[6]

Greedy Method: Knapsack Problem, Dijkstra's Algorithm.

Dynamic Programming: Floyd's Algorithm, Longest Common Subsequence, Optimal Binary Search Trees.

BACKTRACKING AND BRANCH-AND-BOUND

[6]

N-Queens Problem, Sum of Subsets, Hamiltonian Cycle, Knapsack using Branch and Bound, Traveling Salesman Problem.

NP PROBLEMS AND APPROXIMATION ALGORITHMS

[6]

P and NP Problems, NP-Complete Problems, Cook's Theorem, Reducibility, Approximation Algorithms for Knapsack and Traveling Salesman Problems.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education, 3rd ed., 2012. (ISBN 978 0132316811)
- [2] Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, University Press, 2nd ed., 2018.

REFERENCE BOOKS:

- [1] Sridhar S, *Design and Analysis of Algorithms*, Oxford University Press, 1st ed., 2014.
- [2] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, PHI Learning, 3rd ed., 2010.
- [3] Kleinberg, *Algorithm Design*, CRC Press, 1st ed., 2013.

WEB REFERENCES:

- [1] https://onlinecourses.nptel.ac.in/noc25_cs23/preview
- [2] https://onlinecourses.nptel.ac.in/noc23_cs88/preview
- [3] "Design and Analysis of Algorithms," <https://nptel.ac.in/courses/106106131>
- [4] "Design and Analysis of Algorithms," <https://nptel.ac.in/courses/106101060>
- [5] "Fundamental Algorithms: Design and Analysis," <https://nptel.ac.in/courses/106105157>

25AI207	COMPUTER NETWORKS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the principles of data communication and layered network architectures to configure and demonstrate basic network models.	1,2,3,5	1
CO2	Apply error detection, flow control, and medium access mechanisms to enhance reliable data transfer in LAN and WLAN environments.	1,2,3,4,5	1,2
CO3	Analyze the operation of IP addressing, subnetting, and routing algorithms to interpret packet forwarding and path selection in internetworks.	1,2,3,4,5,11	2
CO4	Analyse transport and application layer protocols to evaluate performance and reliability in real-time and secure communication scenarios.	1,2,3,5,10,11	2,3
CO5	Analyse the Realtime implications of the Application protocols	1,2,3,5,10,11	2

COURSE CONTENT:

FUNDAMENTALS AND PHYSICAL LAYER

[6]

Introduction to data communications and networking – network types – OSI and TCP/IP models – signals – bandwidth – data rate limits – transmission media – line coding – modulation techniques – multiplexing – circuit and packet switching.

THE PHYSICAL AND DATA LINK LAYERS

[6]

Error detection and correction – framing – flow control – MAC sublayer – channel access methods – Ethernet IEEE 802.3 – wireless LAN IEEE 802.11 – LAN switching and VLAN concepts.

NETWORK LAYER AND INTERNETWORKING

[6]

IPv4/IPv6 addressing – subnetting – CIDR – routing principles – distance vector and link state algorithms – router architecture – ARP, ICMP, NAT and forwarding.

TRANSPORT LAYER AND CONGESTION CONTROL

[6]

Transport layer services – UDP and TCP – connection establishment and release – reliable data transfer – flow and congestion control – SCTP overview – QoS basics.

APPLICATION LAYER, NETWORK MANAGEMENT AND SECURITY

[6]

Application protocols: HTTP, DNS, SMTP, FTP, DHCP – SNMP – network management – cryptography basics – TLS/SSL – firewalls – VPNs – introduction to IoT, SDN and network virtualization.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS:

- [1] Behrouz A. Forouzan, *Data Communications and Networking*, 6th ed., McGraw-Hill Education, 2023.
- [2] James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, 8th ed., Pearson Education, 2021.
- [3] Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, 5th ed., Pearson Education, 2017.
- [4] William Stallings, *Data and Computer Communications*, 10th ed., Pearson Education, 2020.
- [5] Larry L. Peterson and Bruce S. Davie, *Computer Networks: A Systems Approach*, 6th ed., Morgan Kaufmann, 2022.

WEB REFERENCES:

- [1] "Data Communication and Computer Networks," <https://nptel.ac.in/courses/106105183>
- [2] "Computer Networks," <https://nptel.ac.in/courses/106105081>
- [3] "Computer Networks," <https://nptel.ac.in/courses/106106091>
- [4] "Computer Network Tutorial," <https://www.geeksforgeeks.org/computer-networks/computer-network-tutorials/>

25AI258	LARGE LANGUAGE MODEL	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of large language models and transformers.	1,2,11	1
CO2	Analyse tokenization methods and LLM architectures.	1,2,4	1,2
CO3	Apply fine-tuning and efficient adaptation techniques.	1,2,3,5	2
CO4	Implement prompt engineering and RAG-based applications.	1,2,3,5	1,2
CO5	Evaluate LLM performance, ethics, and deployment.	1,2,6,8,11	2,3

COURSE CONTENT:

FOUNDATIONS OF LARGE LANGUAGE MODELS AND TRANSFORMERS [6]

Introduction to Large Language Models, Transformer architecture, self-attention and multi-head attention, positional encoding, residual connections and layer normalization, basics of language modeling (causal and masked language models).

TOKENIZATION AND LLM ARCHITECTURES [6]

Tokenization techniques (BPE, SentencePiece), vocabulary design, LLM architectures: encoder-only (BERT), decoder-only (GPT), encoder–decoder (T5/BART), overview of large-scale training data and data preprocessing pipelines.

FINE-TUNING AND EFFICIENT ADAPTATION [6]

Fine-tuning approaches including full fine-tuning, adapters, LoRA, prompt and prefix tuning, efficient training techniques, domain adaptation, and instruction tuning.

PROMPTING AND RETRIEVAL-AUGMENTED GENERATION [6]

Prompt engineering methods (zero-shot, few-shot, chain-of-thought), Retrieval-Augmented Generation (RAG), vector retrieval, integration of LLMs with external tools and knowledge sources.

EVALUATION AND DEPLOYMENT OF LLM SYSTEMS [6]

Evaluation metrics (perplexity, BLEU, ROUGE), benchmark frameworks, bias and hallucination mitigation, adversarial testing, and deployment considerations including inference, serving pipelines, and model compression techniques.

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LAB EXPERIMENTS: [30]

1. Build a mini-Transformer block in PyTorch

2. Experiment with tokenization on a dataset; fine-tune a small pretrained model for classification or span generation.
3. Perform adapter/LoRA fine-tuning on a pretrained model for a downstream task; measure memory/compute trade-offs
4. Build a simple RAG system on a domain corpus; design prompting experiments and compare results; implement a small agent using an LLM with tool access.
5. Deploy a fine-tuned LLM behind an API; measure latency; perform red-teaming prompts and document failure modes.

Total Notional Hours: 90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOKS

- [1] Tunstall, L., von Werra, L., & Wolf, T., Natural Language Processing with Transformers, O'Reilly, 2022.
- [2] Jurafsky, D., & Martin, J., Speech and Language Processing, 3rd ed..

REFERENCE BOOKS

- [1] Jain, S. M., Introduction to Transformers for NLP, Springer, 2022.
- [2] Xiao, T., & Zhu, J., Natural Language Processing: Neural Networks and Large Language Models.
- [3] Paaß, G., & Giesselbach, S., Foundation Models for Natural Language Processing, Springer.

WEB REFERENCES:

- [1] "Introduction to Large Language Models (LLMs)," <https://nptel.ac.in/courses/106102576>
- [2] https://www.youtube.com/playlist?list=PLZ2ps__7DhBbaMNZoyW2Hizl8DG6ikkjo
- [3] https://www.youtube.com/watch?v=Xpr8D6LeAtw&list=PLPTV0NXA_ZSgsLAr8YCgCwhPIJN NtexWu

25AI205	PREDICTIVE ANALYTICS	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the concepts, process, and tools used in predictive analytics.	1, 2,11	1
CO2	Apply data preprocessing techniques for preparing datasets for predictive modeling.	1,2, 3, 5	1,2
CO3	Analyze regression-based statistical models for prediction tasks.	1, 2,4	1
CO4	Implement classification and machine learning models for predictive analysis.	1, 2, 3,5	1,2
CO5	Evaluate predictive models using ensemble techniques, validation methods, and performance metrics.	1,2,4,5,11	1,2,3

INTRODUCTION TO PREDICTIVE ANALYTICS

[6]

Definition and scope of predictive analytics, Predictive modelling process, Types of predictive models, Performance metrics and validation, Overview of tools (R, Python, SAS, SPSS)

DATA PREPARATION AND PREPROCESSING

[6]

Handling missing data, outliers, Data transformation and feature scaling, Variable creation and selection, Binning, encoding, normalization

REGRESSION AND STATISTICAL MODELS

[6]

Linear regression and its assumptions, Multiple regression, Logistic regression, Regression diagnostics and evaluation (R^2 , RMSE, accuracy)

CLASSIFICATION AND MACHINE LEARNING MODELS

[6]

Decision Trees, Random Forests, Support Vector Machines (SVM), k-Nearest Neighbours (kNN), Naïve Bayes classifiers

ADVANCED TOPICS AND MODEL EVALUATION

[6]

Ensemble methods (Bagging, Boosting), Cross-validation techniques, Overfitting vs. generalization, Model tuning (Grid Search, Random Search), Time-Series Forecasting basics (ARIMA)

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOKS

[1] Jeffrey Strickland, *Predictive Analytics Using R*, Lulu.com,2015

[2] Max Kuhn & Kjell Johnson, "Applied Predictive Modeling", Springer, 2013

25AI206	GENERATIVE AI	L	T	P	C
		2	0	0	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain fundamentals of generative models.	1,2	1
CO2	Analyse GANs, VAEs, diffusion, and flow models.	1,2,4	1,2
CO3	Apply generative AI for image, text, and multimodal tasks.	2,3,5	1,2
CO4	Implement LLMs and prompt engineering techniques.	3,5,10	1,2
CO5	Evaluate deployment, security, and ethics in generative AI.	6,8,11	2,3

FOUNDATIONS OF GENERATIVE MODELS

[6]

Introduction to generative vs discriminative models, probabilistic foundations, latent variable models, autoencoders and variational autoencoders (VAE), sampling methods, evaluation metrics for generative models.

GENERATIVE ADVERSARIAL NETWORKS

[6]

GAN architecture and working principle, variants such as DCGAN and Conditional GAN, basic training techniques and stabilization methods, applications in image synthesis and data augmentation.

DIFFUSION MODELS AND OTHER GENERATIVE METHODS

[6]

Overview of normalizing flows, denoising diffusion probabilistic models (DDPM), score-based models, comparison of GANs, flows, and diffusion models.

LARGE LANGUAGE MODELS AND MULTIMODAL GENERATIVE AI

[6]

Transformer architecture recap, large language models and training approaches, prompt engineering basics, multimodal generative models such as text-to-image systems.

PRODUCTION, SECURITY AND ETHICS IN GENERATIVE AI

[6]

Model fine-tuning and compression techniques, retrieval augmented generation (RAG), deployment pipelines, evaluation and monitoring of generative models, bias, hallucination, security and ethical considerations.

Total Notional Hours:60

L	T	P	TW+SL	C
30	0	0	30	2

TEXT BOOK:

[1] D. Foster, Generative Deep Learning (2nd Ed., 2024).

REFERENCE BOOKS:

- [1] Goodfellow, Y. Bengio, A. Courville "Deep Learning" — MIT Press.
(<https://www.deeplearningbook.org>)
- [2] H. Wang et al., *Transformers for Natural Language Processing*.

WEB REFERENCES:

- [1] "Generative AI for Beginners," <https://microsoft.github.io/generative-ai-for-beginners/#/>
- [2] "Generative AI Beginner's Guide," <https://cloud.google.com/vertex-ai/generative-ai/docs/learn/overview>
- [3] "What is Generative AI? - Examples, Definition & Models,"
<https://www.geeksforgeeks.org/artificial-intelligence/what-is-generative-ai/>
- [4] <https://nptel.ac.in/courses/106108703>
- [5] <https://www.youtube.com/watch?v=mEsleV16qdo>

25IT259	CRYPTOGRAPHY AND CYBERSECURITY	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Describe the fundamental concepts of cryptography.	1	1
CO2	Recall the principles of data integrity mechanisms.	1	1
CO3	Apply symmetric and asymmetric cipher techniques for secure data transmission.	1, 2, 3, 5	1
CO4	Deploy cryptographic key management and distribution methods to establish mutual trust in networked environments.	1, 2, 3, 4, 5	1
CO5	Implement network and internet security protocols to protect data in transit across various network layers.	1, 2, 3, 4, 5	1
CO6	Apply appropriate security measures for diverse technological contexts based on specific security requirements and constraints	1, 2, 3, 4, 5	1

Cryptography Fundamentals

[5]

Cybersecurity, Information Security and Network Security - OSI Security Architecture – Cryptography – Network Security – Trust and Trustworthiness – Standards – Number Theory – Divisibility and Division Algorithm – Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermat’s and Euler’s Theorem – Testing for primality – Chinese Remainder Theorem – Discrete Logarithms.

Symmetric and Asymmetric Ciphers

[7]

Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Data Encryption Standard – Block Cipher Design Principles – Finite Fields: Groups – Rings – Fields – Finite Fields of the Form $GF(p)$ – Polynomial Arithmetic – Finite Fields of the Form $GF(2^n)$ – Advanced Encryption Standard – Block Cipher Operation – Random Bit Generation and Stream Ciphers – Public Key Cryptography – RSA Algorithm – Diffie-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography.

Data Integrity

[5]

Applications of Cryptographic Hash Functions – Requirements and Security – Secure Hash Algorithm – SHA-3 – Message Authentication Codes – Digital Signatures – Lightweight Cryptography – Post-Quantum Cryptography.

Mutual Trust

[6]

Cryptographic Key Management and Distribution: Key distribution using symmetric and asymmetric encryption – Distribution of Public Keys – X.509 Certificates – Public Key infrastructure – Remote User-Authentication Principles – Remote User authentication using Symmetric and Asymmetric Encryption – Kerberos – Federated Identity Management.

Network and Internet Security

[7]

Transport-level Security: Web Security Considerations – Transport Layer Security – HTTPS – SSH – Wireless Security – Mobile Device Security – IEEE 802.11i Wireless LAN Security – Electronic Mail Security – IP Security – Network Endpoint Security – Cloud Security – Internet of Things (IoT) Security.

LAB EXPERIMENTS

1. Classical and Modern Symmetric Ciphers.
2. Number Theory and Public-Key Cryptography.
3. Hash Functions and Digital Signatures.
4. PKI and Secure Communication.
5. Network Security Protocols and Attacks.

Total Notional Hours:90

L	T	P	TW+SL	C
30	0	30	30	3

TEXT BOOK:

- [1] Stallings, William. Cryptography and Network security, 8/E. Pearson Education India, 2023.

REFERENCES:

- [1] Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (SIE), 3/E. McGraw-Hill Education, 2023.
- [2] Kahate, Atul. Cryptography and network security, 4/E. McGraw-Hill Education, 2024.
- [3] Katz, Jonathan, and Yehuda Lindell. Introduction to Modern Cryptography, 4/E. Chapman and Hall/CRC, 2025.
- [4] Dholakia, Sandip. Modern Cryptography: The Practical Guide. Rheinwerk Publishing, 2024.

WEB RESOURCES:

- [1] "Cryptography and Network Security," <https://nptel.ac.in/courses/106105162>
- [2] "Computational Number Theory & Cryptography," <https://nptel.ac.in/courses/106103015>
- [3] "Cryptography and Network Security," <https://nptel.ac.in/courses/106105031>

PROFESSIONAL ELECTIVE COURSES (PEC)
B.E. – COMPUTER SCIENCE AND ENGINEERING

25CS2E01	CLEAN CODING AND DEVOPS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand core clean coding principles and distinguish between good and bad code to write readable, maintainable software.	1,2	-
CO2	Apply meaningful naming conventions, function design principles, and code formatting standards to improve code clarity and structure.	1,2,3	-
CO3	Apply best practices for exception handling and commenting, and analyze data abstraction versus object-oriented design (DTOs, data/object antisymmetry) to build clean, robust code.	1,2,3	-
CO4	Understand DevOps principles, lifecycle stages, and CI/CD concepts, and differentiate traditional IT, Agile, and DevOps delivery models.	1,2,9	-
CO5	Design CI/CD pipelines using Git and Jenkins, and apply infrastructure-as-code, provisioning and scalability concepts for cloud-based deployment on IBM Cloud.	1,3,5	-
CO6	Develop a mini project that integrates clean coding practices with a DevOps CI/CD pipeline, and present it effectively with technical justification.	3,5,9,10,11	

Introduction to Clean Coding and Naming Conventions

[12]

Coding principles and the importance of clean code; distinguishing bad code from good code.

Clean coding fundamentals: marshalling and unmarshalling, code readability.

Naming conventions: meaningful names, distinct names, searchable names.

Functions and context: function naming, domain names, defining meaningful context.

Activities/Lab: Analyze sample bad and good code; hands-on code review exercise; refactor poorly named variables and methods; create functions following clean coding standards.

Clean Coding Practices and Object-Oriented Design

[15]

Exception handling: error codes, exception naming, best practices.

Comments in clean code: good comments vs bad comments, when to comment.

Code formatting: vertical formatting, horizontal formatting, coding standards.

Objects and data structures: data abstraction, data vs objects, Data Transfer Objects (DTOs).

Object-oriented clean coding: data and object antisymmetry, practical examples.

Activities/Lab: Implement exception handling scenarios; identify and improve comments in existing code; reformat unstructured code; design a simple DTO-based application; mini coding exercise and assessment.

DevOps Fundamentals, CI/CD and Cloud Deployment

[18]

Introduction to DevOps: what is DevOps, need for DevOps, Traditional IT vs Agile vs DevOps.

DevOps lifecycle: DevOps principles, lifecycle stages, CI/CD concepts.

CI/CD pipeline: Git, Jenkins overview, build and deployment process.

Advanced DevOps: automatic rollback, provisioning, scalability, clustering.

Infrastructure as Code (IaC) and cloud DevOps: cloud basics, IBM Cloud introduction.

DevOps on IBM Cloud: IBM Cloud services, CI/CD pipeline on cloud, course assessment and project demonstration.

Activities/Lab: DevOps workflow demonstration; create a DevOps lifecycle diagram; set up a basic CI/CD pipeline; hands-on with rollback and deployment concepts; IBM Cloud account setup and exploration; mini project presentation and final evaluation.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] R. C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, Prentice Hall, 2008.
- [2] G. Kim, P. Debois, J. Willis, and J. Humble, The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, 2nd ed., IT Revolution Press, 2021.

REFERENCE BOOKS:

- [1] J. Humble and D. Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Addison-Wesley, 2010.

WEB REFERENCES:

- [1] "Git Documentation," [Online]. Available: <https://git-scm.com/doc>
- [1] "Jenkins User Documentation," [Online]. Available: <https://www.jenkins.io/doc/>
- [1] "IBM Cloud Documentation," [Online]. Available: <https://cloud.ibm.com/docs>
- [1] "IBM SkillsBuild," [Online]. Available: <https://skillsbuild.org>

25CS2E02	ETHICAL HACKING AND PENETRATION TESTING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of ethical hacking, penetration testing methodologies, cyber threats, vulnerabilities, and attacker models.	1,2	1
CO2	Describe ethical, legal, and professional responsibilities, standards, and compliance requirements in cybersecurity and penetration testing.	1,5	1
CO3	Analyze network, system, and web application vulnerabilities using reconnaissance, scanning, enumeration, and assessment techniques.	2,4	1,3
CO4	Apply ethical hacking tools and penetration testing frameworks to identify security weaknesses and recommend appropriate countermeasures.	3,5	1,3
CO5	Design and execute penetration testing procedures, evaluate security risks, and prepare professional security assessment reports for organizational environments.	4,5,6	1,3

INTRODUCTION TO ETHICAL HACKING

[9]

Information security fundamentals– Ethical hacking concepts and scope– Types of hackers – Penetration testing lifecycle – Legal issues and cyber laws – Professional Responsibilities.

FOOTPRINTING AND RECONNAISSANCE

[9]

Information Gathering Techniques – Passive and Active Reconnaissance – DNS WHOIS – and network foot printing– Social engineering basics– Tools: Nmap, Maltego, Recon-ng.

SCANNING, ENUMERATION, AND VULNERABILITY ANALYSIS

[9]

Network scanning methods – Port scanning and OS fingerprinting – Vulnerability assessment – Enumeration of services and users – Tools: Nmap, Nessus, and OpenVAS.

SYSTEM AND NETWORK PENETRATION TESTING

[9]

Password cracking techniques – Malware and backdoors – Network-based attacks – Man-in-the-Middle attacks –Wireless network attacks – Metasploit, Hydra, Wireshark, Aircrack-ng – File inclusion and authentication attacks.

WEB APPLICATION PENETRATION TESTING

[9]

Web application architecture –OWASP Top 10 vulnerabilities –SQL Injection, XSS, CSRF –File inclusion and authentication attacks –Tools: Burp Suite, OWASP ZAP, SQL map. Post-Exploitation, Reporting, and Countermeasures –Privilege escalation- Maintaining access Log analysis and covering tracks.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXTBOOK:

- [1] Patrick Engebretson *The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy*, 2nd ed. 2013.

REFERENCE BOOKS:

- [1] EC-Council, *Ethical Hacking and Countermeasures*, Cengage Learning, 2017.
[2] Georgia Weidman, *Penetration Testing: A Hands-On Introduction to Hacking*, 2014.
[3] William Stallings and Lawrie Brown, *Computer Security: Principles and Practice*, 4th ed., Pearson, 2018.
[4] Kimberly Graves, *CEH Certified Ethical Hacker Study Guide*, Wiley, 2021.

WEB REFERENCES:

- [1] "Lecture 1 – Introduction to Ethical Hacking,"
<https://www.scribd.com/document/757946434/Lecture-1-Ethical-hacking-introduction>
[2] "Ethical Hacking," <https://nptel.ac.in/courses/106105217>
[3] "Ethical Hacking – Lecture 1," <http://digimat.in/nptel/courses/video/106105217/L01.html>

25CS2E03	ROBOTICS OPERATING SYSTEM (ROS)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain Linux operating system concepts, robotics fundamentals, and the role of ROS in robotic systems.	1	1
CO2	Apply basic C++ and Python programming concepts to develop ROS applications.	1,2,5	1
CO3	Demonstrate the use of ROS architecture, communication mechanisms, and development tools.	1,2,4	1,2
CO4	Develop and execute simple ROS nodes using publisher-subscriber communication.	1,2,4	1,2,3
CO5	Analyze and design basic robotic applications using ROS simulation and mobile robot concepts.	1,2,4	1,2,3

INTRODUCTION TO LINUX AND ROBOTICS

[9]

Introduction to GNU/Linux and Ubuntu, Linux File System, Terminal Usage, Basic Shell Commands, Package Management, Introduction to Robotics, Components and Applications of Robots, Need for ROS, Overview of ROS Architecture, ROS Installation and Setup.

PROGRAMMING FUNDAMENTALS FOR ROS

[9]

Basics of C++ Programming, Classes and Objects, Inheritance, Exception Handling, Basics of Python Programming, Variables, Control Statements, Functions, Modules, File Handling, Role of C++ and Python in ROS Applications.

CORE ROS CONCEPTS

[9]

ROS File System, ROS Workspace and Packages, Nodes, Topics, Messages, Services, ROS Client Libraries (roscpp and rospy), Publisher–Subscriber Model, ROS Parameters, Launch Files, ROS Command-Line Tools.

ROS PROGRAMMING AND SIMULATION

[9]

Creating and Executing ROS Nodes, Publisher and Subscriber Programs, Introduction to turtlesim, Robot Motion Control, Introduction to Rviz and Rqt, TurtleBot Overview, Gazebo Simulation Environment, Basic Obstacle Detection Concepts.

ROS APPLICATIONS

[9]

Introduction to Mobile Robots, Differential Drive Concept, Sensors and Actuators, Robot Modeling using URDF, Teleportation Concepts, Arduino and Raspberry Pi Overview, ROS-Based Applications and Case Studies.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

- [1] Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, Lentin Joseph and Aleena Johny, Apress, 2022.

REFERENCES:

- [1] Morgan Quigley, Brian Gerkey, and William D. Smart, *Programming Robots with ROS: A Practical Introduction to the Robot Operating System*, O'Reilly Media, 2015.
- [2] Anil Mahtani, Luis Sanchez, Enrique Fernandez, and Aaron Martinez, *Effective Robotics Programming with ROS*, 3rd ed., Packt Publishing, 2016.
- [3] Lentin Joseph, *Mastering ROS for Robotics Programming*, 2nd ed., Packt Publishing, 2018.
- [4] Wyatt Newman, *A Systematic Approach to Learning Robot Programming with ROS*, CRC Press, 2018.

WEB REFERENCES:

- [1] "Hello (Real) World with ROS – Robot Operating System," Delft University of Technology, edX, <https://www.edx.org/learn/robotics>
- [2] "Official ROS Wiki Tutorials," <https://wiki.ros.org/>
- [3] "The Construct – Free Browser-Based ROS Courses and Simulations," <https://www.theconstructsim.com>

25CS2E04	AI IN CYBERSECURITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of Artificial Intelligence, Machine Learning, and Deep Learning in cyber security applications.	1,2	1,2
CO2	Apply AI techniques for intrusion detection, anomaly detection, and threat intelligence.	1,2,5	1,2
CO3	Analyze AI-driven malware detection, predictive analytics, and risk assessment mechanisms.	2,4,5	1,2
CO4	Design AI-powered security solutions for SOCs, network security, endpoint security, and cloud environments.	3,4,5	1,2,3
CO5	Evaluate ethical, regulatory, and operational challenges of AI-based cyber security systems and propose resilient AI-enhanced security architectures.	4,5,11	1,2,3

INTRODUCTION TO AI IN CYBERSECURITY

[9]

Introduction to Artificial Intelligence, History and Evolution of AI, AI Security Strategy, Fundamentals of Machine Learning, Supervised and Unsupervised Learning, Deep Learning Concepts, Neural Networks, Cybersecurity Applications of AI, Challenges and Limitations of AI in Security

AI BASED THREAT DETECTION AND INTELLIGENCE

[9]

Artificial Intelligence in Intrusion Detection Systems, AI-Enhanced IDS Architectures, Behavioural Analysis Techniques, User and Entity Behaviour Analytics (UEBA), Anomaly Detection Methods, Natural Language Processing for Threat Intelligence, Threat Data Collection and Analysis, Security Information Correlation

AI DRIVEN CYBER DEFENSE AND MECHANISM

[9]

AI-Based Malware Detection and Classification, Static and Dynamic Malware Analysis, Predictive Analytics for Risk Assessment, Security Risk Modelling, Autonomous Response Systems, Adaptive Security Architectures, AI-Powered Security Operations Centres (SOCs), Automated Incident Response.

AI FOR ENTERPRISE SECURITY APPLICATIONS

[9]

AI-Driven Network Security Solutions, Machine Learning for Endpoint Security, Intelligent Endpoint Detection and Response (EDR), AI in Identity and Access Management (IAM), Access Governance,

Predictive Vulnerability Management, AI-Based Cloud Security, Cloud Threat Detection and Response.

ADVANCED AI SECURITY OPERATIONS AND GOVERNANCE

[9]

Security Orchestration, Automation and Response (SOAR), Continuous Monitoring and AI-Driven Response Systems, Building Resilient Infrastructures with AI, Measuring ROI and Effectiveness of AI Security Systems, Ethical Considerations, Regulatory Compliance, Future Trends and Emerging Technologies in AI Cybersecurity.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

[1] Artificial Intelligence in Cybersecurity, Lisa Ventura, Kogan Page Publishers, 2026.

REFERENCES:

[1] Machine Learning and Security, Clarence Chio and David Freeman, O'Reilly Media, 2018.

[2] Practical Machine Learning in Cybersecurity, Packt Publishing, 2019.

[3] Artificial Intelligence for Cybersecurity, Mark Stamp, Corrado Aaron Visaggio, Francesco Mercaldo, Fabio Di Troia (Eds.), Springer, 2022

[4] Hands-On Artificial Intelligence for Cybersecurity, Alessandro Parisi, Packt Publishing, 2019.

WEB REFERENCES

[1] MITRE, "MITRE ATT&CK Framework," <https://attack.mitre.org/>

[2] National Institute of Standards and Technology (NIST), "Artificial Intelligence Risk Management Framework (AI RMF)," <https://www.nist.gov/itl/ai-risk-management-framework>

[3] OWASP, "AI Security and Privacy Guide," [OWASP AI Security and Privacy Guide](#)

[4] Cybersecurity and Infrastructure Security Agency (CISA), "Cybersecurity Resources," [CISA Cybersecurity Resources](#)

[5] Google, "AI Security Resources," [Google AI Security](#)

25CS2E05	IMMERSIVE UI / UX DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Define the principles, concepts, and human factors involved in immersive UI/UX design for AR/VR systems.	1, 2, 3, 5	1
CO2	understand user-centered design principles to create intuitive and interactive immersive interfaces.	1, 2,3,4,5	1,2
CO3	Apply spatial user interfaces, navigation systems, and interaction techniques for immersive environments.	1,2,3,4,5	1, 2
CO4	Develop immersive UI/UX prototypes using Unity XR and modern design tools.	1,2,3,4,5	1, 2,3
CO5	Evaluate immersive experiences with respect to usability, accessibility, ethics, and user satisfaction.	1,2,3,4,5	1, 2

INTRODUCTION TO IMMERSIVE UI/UX DESIGN AND HUMAN PERCEPTION [9]

Introduction to UI and UX design – Evolution of immersive interfaces – Fundamentals of AR, VR, MR and XR – Human-centered design principles – User psychology and perception in immersive environments – Visual perception, depth perception and spatial awareness – Cognitive load and user comfort – Motion sickness and ergonomics – Accessibility and usability considerations in immersive systems.

DESIGN PRINCIPLES FOR IMMERSIVE INTERFACES [9]

Principles of immersive interaction design – Spatial user interfaces – 3D menus and controls – Typography and color theory in XR – Visual hierarchy and information architecture – Interaction patterns for immersive systems – Gesture-based interaction – Voice interaction – Eye tracking concepts – Navigation and locomotion techniques – Designing intuitive immersive workflows.

PROTOTYPING AND VISUAL DESIGN FOR XR SYSTEMS [9]

Wireframing and storyboarding for immersive applications – Low-fidelity and high-fidelity prototyping – UI asset creation – 3D design tools and workflows – Visual consistency and branding in XR – Scene composition and layout – Animation and transition effects – Audio integration and feedback systems – Designing responsive immersive experiences.

XR DEVELOPMENT TOOLS AND IMPLEMENTATION [9]

Unity XR toolchain overview – XR Plug-in Management – AR Foundation and OpenXR – Creating immersive UI components in Unity – Integration of interactive elements – Event systems and interaction handling – User testing and iterative design – Performance optimization for immersive interfaces – Cross-platform immersive UI deployment

EVALUATION, ETHICS AND FUTURE TRENDS IN IMMERSIVE UX

[9]

Usability testing methods for immersive systems – User experience evaluation metrics – Experimental design and feedback collection – Accessibility standards in XR – Ethical issues in immersive technologies – Privacy and security considerations – Inclusive and sustainable design – Metaverse and spatial computing UX – AI-driven immersive interfaces – Future trends in immersive UI/UX engineering.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOKS:

[1] Anna Braun and Raffael Rizzo, *XR Development with Unity*, Packt Publishing, 2024.

[2] XR Development with Unity: A beginner's guide to creating virtual, augmented, and mixed reality experiences using Unity 1st ed. by Anna Braun (Author), Raffael Rizzo (Author)

REFERENCE BOOK:

[1] John Vince, *Introduction to Virtual Reality*, Springer-Verlag, 2004

WEB REFERENCES

[1] Unity Technologies, "Unity Learn and AR Foundation Guides,"
<https://learn.unity.com/>

[2] M. Manivannan, "Foundations of Virtual Reality," NPTEL, IIT Madras,
<https://nptel.ac.in/courses/106106138>

25CS2E06	EDGE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts, characteristics, and architecture of Edge Computing, including its ecosystem and relationship with Cloud and Fog computing.	1,2,3	1
CO2	Analyze communication models, networking technologies, and architectural layers to design efficient edge-enabled systems.	2,3	1,3
CO3	Apply data processing, analytics, resource management, and virtualization techniques to implement edge computing solutions.	2,3	1,3
CO4	Evaluate the integration of IoT and AI at the edge, including Tiny ML and federated learning models for real-time and distributed applications.	2,3	1,2,3
CO5	Assess security, privacy, and access control challenges in edge computing environments and propose suitable solutions for real-world applications.	1,2,3	1,2,3

INTRODUCTION TO EDGE COMPUTING

[9]

Evolution of computing paradigms – Centralized – Distributed – Cloud – Fog – Edge – Motivation for edge computing – Latency – Bandwidth optimization – Real-time processing – Definitions and characteristics of edge computing – Edge vs fog vs cloud computing – Edge computing ecosystem – Edge devices – Gateways – Micro data centers – Challenges in edge computing – Scalability – Heterogeneity – Mobility.

EDGE ARCHITECTURE AND COMMUNICATION

[9]

Edge computing reference architectures – Layered architecture – Cloud–edge continuum – Edge node architecture – Hardware components – Software stack – Communication models – Device-to-edge – Edge-to-cloud – Edge-to-edge – Networking technologies – 5G – 6G – SDN – NFV – Edge frameworks and platforms – Case studies.

EDGE DATA, ANALYTICS AND RESOURCE MANAGEMENT

[9]

Data generation at the edge – Data acquisition – Filtering – Pre-processing – Edge data storage models – Local storage – Distributed storage – Hybrid models – Edge analytics – Stream analytics – Batch analytics – Distributed analytics – Resource management at edge – Scheduling – Load balancing – Energy-aware computing – Virtualization at edge – Virtual machines – Containers – Lightweight virtualization.

EDGE-ENABLED IOT AND AI

[9]

IoT integration with edge computing – Edge gateways – Sensors – Actuators – Device management – Machine learning at the edge – TinyML – On-device learning – Federated learning – Collaborative intelligence at edge – Edge application deployment models – Orchestration – Container management – Kubernetes at edge.

EDGE SECURITY, PRIVACY AND APPLICATIONS

[9]

Security challenges in edge computing environments – Threat models – Attacks on edge devices and networks – Identity and access management at edge – Authentication and authorization – Data privacy and trust management – Secure communication protocols – Edge computing applications – Smart cities – Healthcare – Industrial IoT – Autonomous and cyber-physical systems.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOKS:

- [1] Amir M. Rahmani, Pasi Liljeberg, Hannu Tenhunen, *Fog and Edge Computing: Key Concepts and Practical Applications*, Wiley, 2021 (ISBN: 978-1119654678)
- [2] Mauro Conti, Ahmad-Reza Sadeghi, Riccardo Spolaor, Awais Rashid (Editors), *Internet of Things Security and Edge Computing*, Springer, 2nd ed., 2022 (ISBN: 978-3030990788)

REFERENCE BOOKS:

- [1] Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, *Fog and Edge Computing: Principles and Paradigms*, Wiley, 2017 (ISBN: 978-1119473842)
- [2] Wei Yu, Nannan Wang, Lifeng Sun, Feng Xia (Editors), *Edge Computing: Models, Technologies and Applications*, Springer, 2020 (Lecture Notes in Computer Science, LNCS series)
- [3] Shanshan Yao, Yuhong Liu, Peter Zhang, Yong Xiang (Editors), *Edge Computing: A Security and Privacy Perspective*, Springer, 2021.

WEB REFERENCES:

- [1] "Edge Computing, IIT Kanpur, Prof. Rajiv Misra," <https://nptel.ac.in/courses/106104449>

25CS2E07	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamentals of Reinforcement Learning, Markov Decision Processes (MDPs), and the agent–environment interaction framework.	1	1,2
CO2	Apply dynamic programming and model-free learning techniques, including Monte Carlo and Temporal Difference methods, to solve sequential decision-making problems.	2	1,2
CO3	Analyze and implement value-based reinforcement learning algorithms such as Q-Learning and SARSA for optimal policy generation.	3	1,2
CO4	Evaluate policy-based and deep reinforcement learning techniques for complex and large-scale environments.	4,5	1,2,3
CO5	Design and develop intelligent reinforcement learning solutions for real-world applications involving multi-agent systems and autonomous decision-making.	5,6	1,2,3

INTRODUCTION TO REINFORCEMENT LEARNING

[9]

Introduction to Reinforcement learning, Markov Decision Process (MDP) – Markov Process, Markov Reward Process, Markov Decision Process and Bellman Equations, Partially Observable MDPs, Planning by Dynamic programming (DP) – Policy Evaluation, Value Iteration, Policy Iteration, DP Extensions, model-free prediction and control.

INTEGRATING PLANNING WITH LEARNING

[9]

Integrating planning with learning – Model-based RL, Integrated Architecture and Simulation-based Search, Monte-Carlo (MC) Learning, Exploration and exploitation – Multi-arm Bandits, Contextual Bandits and MDP Extensions, integrating AI search and learning – Classical Games: Combining Minimax Search and RL.

VALUE-BASED REINFORCEMENT LEARNING AND CONTROL

[9]

Hierarchical RL – Semi-Markov Decision Process, Learning with Options, Deep RL – Proximal Policy Optimization (PPO), Deep Deterministic Policy Gradient (DDPG), Double Q-Learning, Multi-agent RL – Cooperative vs. Competitive Settings, Mixed Setting.

TEMPORAL DIFFERENCE (TD) LEARNING

[9]

Introduction to Temporal-Difference learning; TD (0); SARSA; Q-Learning and their variants-Markov Reward Process (MRP); Overview of TD (1) and TD(λ).

APPROXIMATION METHODS AND POLICY GRADIENT

[9]

Deep Q-Networks (DQN) basics – experience replay, target networks; exploration techniques in Deep RL; Model-based RL vs Model-free RL. Reinforcement Learning with Human Feedback (RLHF) – reward modeling, preference-based learning, policy optimization (PPO/GRPO) for alignment; Offline RL basics – learning from fixed datasets, distributional shift, conservative Q-learning (intro level); Safety and ethical considerations in real-world RL deployment

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

[1] Richard S. Sutton and Andrew G. Barto; *Reinforcement Learning: An Introduction*; 2nd ed., MIT Press, 2018.

REFERENCE BOOKS:

[1] Dimitri P. Bertsekas; *A Course in Reinforcement Learning*; 2nd ed., Athena Scientific, 2024.

[2] Dimitri P. Bertsekas; *Dynamic Programming and Optimal Control (Vol. I and Vol. II)*; 4th ed., Athena Scientific, 2017. <https://web.mit.edu/dimitrib/www/dpbook.html>

WEB REFERENCES:

[1] R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 2nd ed., MIT Press, 2018, <http://incompleteideas.net/book/the-book-2nd.html>

[2] D. P. Bertsekas, *A Course in Reinforcement Learning*, 2nd ed., Athena Scientific, 2024, <https://www.athenasc.com/rlbook.html>

25CS2E08	VIRTUAL REALITY INTERACTION DESIGN	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the basic components of Virtual Reality Systems	1, 2, 5, 9	1,2
CO2	Explain the geometric, kinematic, and physical modelling techniques used in virtual simulations.	1, 2, 5, 9	1,2
CO3	Develop and integrate VR environments using suitable software toolkits and frameworks	3, 5, 9	1,2,3
CO4	Analyse human factors, ergonomics, usability, and ethical aspects in immersive system design.	2, 3, 5, 9	1,2
CO5	Create future immersive trends and XR frameworks	1, 5, 6, 9	1,2,3

INTRODUCTION TO VIRTUAL REALITY

[9]

Fundamentals and definitions of VR and AR- History and evolution of immersive systems- Three I's of VR: Immersion, Interaction, Imagination- VR vs. 3D Computer Graphics- Components of VR system: input, output, processing, and feedback- Tracking systems: electromagnetic, optical, inertial, hybrid- Visual displays: HMDs, CAVE systems, stereoscopic projection- Human visual and auditory systems in VR- Sound rendering and spatial audio in immersive environments.

VR MODELLING AND SIMULATION

[9]

Geometric modelling: shapes, meshes, textures, shaders- Object hierarchies and transformations- Kinematics modelling: rigid body, transformations, matrices- Physical modelling: collision detection, force computation, deformation- Behavioural modelling: real-time interaction and agent behaviours- Scene composition and management- Level of detail and optimization techniques- Environmental realism: lighting, physics, shadows.

VR SOFTWARE, PROGRAMMING AND INTERACTION DESIGN

[9]

VR toolkits and APIs: World Toolkit, Java 3D, OpenGL, Unity- Scene graphs and rendering pipeline- Input device programming and sensor data integration- Interaction paradigms: gesture, gaze, and controller-based input- Haptic feedback systems and tactile interfaces- Real-time rendering and latency handling- VR networking and collaborative virtual environments- Introduction to Cloud VR and WebXR.

HUMAN FACTORS, ETHICS, AND APPLICATIONS

[9]

Human factors: ergonomics, comfort, motion sickness- Health and safety in immersive systems- Cognitive load and usability design principles- Ethics, privacy, and psychological implications of VR- Case studies- Medical simulation and rehabilitation- Education, training, and virtual classrooms- Robotics and industrial applications.

FUTURE IMMERSIVE TRENDS

[9]

AR vs VR vs Mixed Reality vs Extended Reality (XR)- Computer vision and marker-based tracking- Interaction, modelling, and annotation- Navigation and wearable devices- AR glasses, headsets- Spatial mapping and environment understanding- Emerging AR/VR frameworks- VRCORE, VRKit, Unity VR Foundation- Future directions: Metaverse, digital twins, AI in XR environments

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOK:

[1] John Vince, *Introduction to Virtual Reality*, Springer-Verlag, 2004

REFERENCE:

[1] Grigore C. Burdea, Philippe Coiffet, *Virtual Reality Technology*, 3rd ed., Wiley-IEEE Press, 2024

ONLINE RESOURCES:

- [1] Unity Technologies, "Unity Learn and AR Foundation Guides," <https://learn.unity.com/>
- [2] M. Manivannan, "Foundations of Virtual Reality," NPTEL, IIT Madras, [NPTEL – Foundations of Virtual Reality](#)

25CS2E09	MIXED REALITY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the fundamental concepts, architectures, and human factors underlying immersive technologies	1, 2, 3, 5	1,2
CO2	Design spatial models and tracking principles to construct interactive XR environments.	1, 2,3,4,5	1,2,3
CO3	Implement visual rendering techniques and interaction methods for effective immersive experience creation.	1,2,3,4,5	1,2
CO4	Create and optimize immersive simulations using Unity and XR frameworks through integration of perception-driven design principles.	1,2,3,4,5	1,2,3
CO5	Analyze and evaluate XR applications for performance, usability, accessibility, and ethical compliance.	1,2,3,4,5	1, 2

INTRODUCTION TO IMMERSIVE TECHNOLOGIES AND GEOMETRY OF VIRTUAL WORLDS [9]

Introduction to Immersive Technologies - Reality, Virtuality and Immersion - VR, AR, MR: similarities and differences - Current trends and state of the art in immersive technologies, Developing platforms and consumer devices - Geometric modelling - Human perception (vision, depth, stereopsis), Vestibular issues, Basic psychophysics for XR, usability & accessibility.

SPATIAL MODELING, GRAPHICS & TRACKING FOR XR SYSTEMS [9]

3D coordinate systems and transformations (translation, rotation, scaling, matrices), Camera models and projections (perspective, orthographic), Scene graph structure and rendering pipeline overview, Environment modelling and lighting for immersive realism- Orientation tracking- Tilt and yaw drift correction techniques- Camera tracking- Filtering for sensor fusion- Motion tracking and navigation interfaces.

VISUAL RENDERING AND INTERACTION DESIGN FOR XR SYSTEMS [9]

Visual Rendering Pipeline Overview- Shading Models & Techniques- Pixel Shading- Distortion & Post-Rendering Image Warp- Rendering Architecture- 3D Rendering for Immersive Environments- Interaction Design Principles- Input Devices- Spatial UI & Navigation Interfaces.

HUMAN PERCEPTION AND IMPLEMENTATION [9]

Unity XR toolchain overview – XR Plug-in Management, AR Foundation, and OpenXR- Scene organization- User Centred Design - User Experience -Performance Optimization-Visual perception- Auditory perception- Multisensory integration: vision, sound, and haptic coordination.

APPLICATIONS, EVALUATION AND ETHICS

[9]

Application domains-Training & simulation- Medical- Education, Industrial design, Entertainment, Digital twins- evaluation metrics-Experimental design- privacy-ethics-safety- Cross-platform considerations, - Emerging XR frameworks- XRCore, XRKit, Unity XR Foundation -future trends (Metaverse, Spatial computing).

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOKS:

- [1] Grigore C. Burdeau, Philippe Coiffet, *Virtual Reality Technology*, 3rd ed., Wiley-IEEE Press, 2024
- [2] Alan B. Craig, *Understanding Augmented Reality: Concepts and Applications*, Morgan Kaufmann, 2013.

REFERENCE:

- [1] John Vince, *Introduction to Virtual Reality*, Springer-Verlag, 2004

ONLINE RESOURCES:

- [1] Unity Technologies, "Unity Learn and AR Foundation Guides," <https://learn.unity.com/>
- [2] M. Manivannan, "Foundations of Virtual Reality," NPTEL, IIT Madras, NPTEL – Foundations of Virtual Reality

25CS2E10	COMPUTER GRAPHICS AND VIRTUALIZATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Understand the application areas, architecture, display systems, workstations, and input devices of computer graphics.	1,2,3	1,2
CO2	Apply output primitives, drawing algorithms, and polygon filling techniques in computer graphics	1,2,3	1,2
CO3	Apply 2-D geometric viewing transformations using matrix representation and homogeneous coordinates.	1,2,3	1,2
CO4	Apply 3-D transformations, projections, and basic hidden surface elimination methods	1,3,4	1,2
CO5	Analyze visible surface detection, shading models, curve generation, visualization, animation, multimedia, and virtual reality concepts	1,3,4	1,2

OVERVIEW

[9]

Introduction: Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices. Output primitives: Points and lines, line drawing algorithms (Bresenham's and DDA Algorithm), midpoint circle and ellipse algorithms. Polygon Filling: Scan-line algorithm, boundary-fill and flood-fill algorithms.

2D GEOMETRIC TRANSFORMATIONS AND 2D VIEWING

[9]

2-D geometrical transforms: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems. 2-D viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland algorithms, Sutherland –Hodgeman polygon clipping algorithm.

3D TRANSFORMATION AND OBJECT REPRESENTATION

[9]

3-D Transformations: Translation, Rotation and Scaling. Parallel & Perspective Projection: Types of Parallel & Perspective Projection, Hidden Surface elimination: Depth comparison, Back face detection algorithm, Painter's Algorithm, Z-Buffer Algorithm. Curve generation, Bezier and B-spline methods. Basic Illumination Model: Diffuse reflection, Specular reflection, Phong Shading, Gouraud shading, Ray Tracing, Color models like RGB, YIQ, CMY, HSV.

VISIBLE SURFACE DETECTION METHODS AND VISUALIZATION

[9]

Visible Surface Detection Methods: Classification of Visible Surface Detection Algorithms, Back Face Detection, Depth Buffer Method, A-Buffer Method, Scan-Line Method, Depth Sorting Method, BSP-Tree Method & Area Subdivision Method. Visualization of Data Sets, Visual

Representations for Scalar Fields, Visual Representations for Vector Fields, Visual Representations for Tensor Fields, Visual Representations for Multivariate Data Fields.

ANIMATION AND MULTIMEDIA

[9]

Computer animation: Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications. Multimedia: Fundamentals of Multimedia: Multimedia-Overview - digital representation - text - image - audio - video. Multimedia Architecture & Virtual Reality: Animation -compression - multimedia architecture - multimedia documents -multimedia application development - virtual reality.

Total Notional Hours: 90

L	T	P	TW&SL	C
45	-	-	45	3

TEXT BOOKS:

- [1] Donald Hearn & M. Pauline Baker, *Computer Graphics -C version* 2nd ed., Pearson Education, 2024.
[2] Ranjan Parekh, *Principles of Multimedia*, Tata McGraw Hill Publications, 2012.

REFERENCE BOOKS:

- [1] Foley James D., Vandam Andries and Hughes John F., *Computer Graphics : Principles and Practice*, Pearson Education, 2013.
[2] Ralf Steinmetz, Klara Steinmetz , *Multimedia Computing , Communications and Applications*, Pearson Education, 2012.
[3] Edward Angel: *Interactive Computer Graphics- A Top Down approach with OpenGL*, 6th ed.. Pearson Education, 2012.

WEB REFERENCES:

- [1] S. Das, "Computer Graphics: Theory and Algorithms," IIT Madras,
https://www.cse.iitm.ac.in/~vplab/courses/computer_graphics.html
[2] "Computer Graphics," NPTEL, <https://nptel.ac.in/courses/106102065>

PROFESSIONAL ELECTIVE COURSES (PEC)
B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

25EE2E01	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the principles and necessity of energy storage technologies for renewable energy applications.	1,2,6	1
CO2	Apply thermal storage concepts to select suitable storage systems for renewable energy integration.	1,2,6	1
CO3	Analyze battery parameters, modelling and connection strategies for optimal performance in energy storage applications.	1,2,4	1,2
CO4	Analyze pumped energy storage systems and ultracapacitor characteristics for hybrid energy storage applications.	1,2,4	1,2
CO5	Evaluate alternative energy storage technologies including flywheel, hydrogen and compressed air systems for renewable energy conversion.	1,2,3,4,6	1,2

INTRODUCTION

[9]

Introduction to Energy Storage Technologies, Types and Necessity of Energy Storage, Application with Renewable Energy, Comparison, Emerging Needs for Electrical Energy Storage.

THERMAL STORAGE SYSTEM

[9]

Thermal Storage System – Types, Simple Water and Rock Bed Storage System, Pressurized Water Storage System, Simple Units, Packed Bed Storage Units.

BATTERIES

[9]

Battery Basics – Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction - Alternative Batteries - Battery Parameters - Series and Parallel connection -Technical Characteristics - Practical Capacity - Ragone Plots - Properties of Batteries - Battery Modelling. Applications.

PUMPED ENERGY STORAGE SYSTEM

[9] Battery

Basics – Classifications - Ragone Plots - Battery Modelling – Battery Capacity - Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction and Working – Ultracapacitor working – ECU – Battery Management System – Thermal Management System.

ALTERNATIVE ENERGY STORAGE TECHNOLOGIES

[9]

Hydrogen Energy Storage, Flywheel, Super Capacitors – Principles, Methods, Applications. Compressed Air Energy Storage, Concept of Hybrid Energy Storage.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Dinçer, Ibrahim and Rosen, Marc A., Thermal Energy Storage: Systems and Applications, 3rd ed., John Wiley & Sons, 2021.
- [2] Huggins, Robert A., Energy Storage: Fundamentals, Materials and Applications, 2nd ed., Springer, 2016.

REFERENCE BOOKS:

- [1] Reddy, Thomas B., Linden's Handbook of Batteries, 4th ed., McGraw-Hill, 2011.

- [2] Liu, Ru-Shi, Zhang, Lei, Sun, Xueliang, Liu, Hansan and Zhang, Jiujun, Electrochemical Technologies for Energy Storage and Conversion, Wiley-VCH, 2012.
- [3] Beard, Kirby W., Linden's Handbook of Batteries, 5th ed., McGraw-Hill, 2019.
- [4] U.S. Department of Energy, DOE Energy Storage Handbook, Second Release, Sandia National Laboratories, 2022.
- [5] Dell, Ronald M. and Rand, David A. J., Understanding Batteries, Royal Society of Chemistry, 2001.

WEB REFERENCES

- [1] "Electrochemical Energy Storage," <https://nptel.ac.in/courses/113105102>
- [2] "Energy conservation and waste heat recovery," https://onlinecourses.nptel.ac.in/noc20_mm20/preview
- [3] "Hydrogen Energy: Production, Storage, Transportation and Safety," <https://nptel.ac.in/courses/103101215>
- [4] "Physics of Renewable Energy Systems," https://onlinecourses.nptel.ac.in/noc22_ph44/preview
- [5] "Power Plant System Engineering," https://onlinecourses.nptel.ac.in/noc24_me57/preview

25EE2E07	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Analyze the construction, operating principles, and performance characteristics of stepper motors.	1,2	1,2
CO2	Analyze the construction, operating principles, control strategies, and performance characteristics of switched reluctance motors	1,2,4	1,2
CO3	Evaluate the operation, performance characteristics, and power converter interfaces of permanent magnet DC motors	1,2,3,4	1,2,3
CO4	Analyze the operation, control techniques, and performance characteristics of permanent magnet synchronous motors	1,2,4	1,2
CO5	Analyze the construction, operating principles, characteristics, and applications of hysteresis, synchronous reluctance, linear induction, and repulsion motors.	1,2,4	1,2

STEPPER MOTORS

[9]

Constructional Features, Principle of Operation, Types, Torque Predictions, Linear Analysis, Characteristics, Drive Circuits, Closed Loop Control, Concept of Lead Angle, Applications.

SWITCHED RELUCTANCE MOTORS

[9]

Constructional Features, Principle of Operation, Torque Prediction, Characteristics Steady State Performance Prediction, Analytical Method, Power Controllers, Control of SRM Drive, Sensor-Less Operation of SRM, Applications.

PERMANENT MAGNET BRUSHLESS D.C. MOTORS

[9]

Fundamentals of Permanent Magnets, Types, Principle of Operation, Magnetic Circuit Analysis, EMF and Torque Equations, Power Converter Circuits and Their Controllers, Characteristics and Control, Applications.

PERMANENT MAGNET SYNCHRONOUS MOTOR

[9]

Constructional Features, Principle of Operation, EMF and Torque Equations, Sine Wave Motor with Practical Windings, Phasor Diagram, Power Controllers, Characteristics, Digital Controllers, Applications.

SRM AND OTHER MACHINES

[9]

Hysteresis Motor, Synchronous Reluctance Motor, Linear Induction Motor, Repulsion Motor - Constructional Features, Principle of Operation and Characteristics, Applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Simmi P. Burman, Special Electrical Machines, S.K.Kataria & Sons, 1st ed., 2013.
- [2] E.G. Janardanan, Special Electrical machines, PHI learning Private Limited, Delhi, 1st ed., 2014.
- [3] K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 1st ed., 2009.

REFERENCE BOOKS:

- [1] R.Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 1st ed. 2001.
- [2] T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 2nd ed.,1995
- [3] B.K. Bose, Modern Power Electronics and AC Drives, Pearson Education, 1st ed., 2002.

[4] R. Krishnan, Electric Motor Drives: Modeling, Analysis, and Control, Prentice Hall, 1st ed., 2001.

WEB REFERENCES

[1] "Electrical Machines - II," https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ee53

[2] "Electrical Machines - I," https://onlinecourses-archive.nptel.ac.in/noc17_ec10/preview

[3] "Advanced Electric Drives," <https://nptel.ac.in/courses/108104011>

25EE2E13	BATTERY MANAGEMENT SYSTEM FOR EV	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the functional blocks and sensing components of a battery management system for Li-ion battery packs in EVs.	1,2	1
CO2	Analyze different BMS topologies and understand their applications.	1,2,4	1,2
CO3	Analyze voltage, temperature and current sensing hardware for BMS integration and thermal management.	1,2,4	1,2
CO4	Apply SOC and SOH estimation methods and cell balancing algorithms to monitor battery health and performance.	1,2	1
CO5	Evaluate BMS protection features and emerging trends, including wireless and AI-based battery management systems.	1,2,3,4	1,2,3

INTRODUCTION TO BATTERY MANAGEMENT SYSTEMS

[9]

Need of ESS in EV – Battery Parameters – Classifications of battery – Working of Li-ion battery – Need of BMS for Li-ion battery pack – Functional blocks of BMS - Filtering Circuit: RC Filters - Battery Balancing Circuits: Passive and Active Balancing - Charge and Discharge Control - Estimation, Communication, and Power Management.

BMS INTERNAL SYSTEM

[9]

Voltage Sensing Hardware - Temperature Sensing Hardware - Current Sensing Hardware - Communication Hardware - Charge Control Hardware - Discharge Control Hardware - Balancing Hardware - Power Management Hardware, Safety Management Hardware - Control and Computation Hardware - Thermal Management Hardware.

BMS CLASSIFICATION & TOPOLOGY

[9]

Types of BMS: Analog, Smart, Wireless, FET-based, and Contactor-based BMS; BMS Topologies: Centralized, Modular, and Distributed.

BATTERY PARAMETER ESTIMATION AND PROTECTION FEATURES

[9]

SOC Estimation: Methods, Pros and Cons, SOH Estimation: Methods, Pros and Cons, Cell Balancing: Passive and Active Algorithms, BMS Software GUI: Parameter Monitoring, Configuration, and Testing, Battery Protection Features: Over-voltage, Under-voltage, Overcurrent, Temperature Alarms, Short Circuit Protection.

BMS INTEGRATION AND EMERGING TRENDS

[9]

Cell Integration, Charger Integration, Load Integration, Pack Integration - Integration of Temperature Sensors, Current Sensors - Communication Modules, Practical Session: BMS Installation and Integration – Cloud Based BMS – Wireless BMS – ML and AI based BMS.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Iqbal Hussain, Electric and Hybrid Vehicles – Design fundamentals, 3rd ed., CRC press, 2023.

- [2] James D Halderman and Curt Ward, Electric and Hybrid Electric Vehicles, 1st ed., Pearson Education Limited, 2023.

REFERENCE BOOKS:

- [1] Eshani M, Goa Y, Longo S, Ebrahimi K, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, 2018.
- [2] Tariq Muneer and Irene Illescas García, The Automobile, in Electric Vehicles: Prospects and Challenges, Elsevier, 2017.
- [3] Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
- [4] Larminie, James, and John Lowry, Electric Vehicle Technology Explained, John Wiley and Sons, 2012

WEB REFERENCES

- [1] "Fundamentals of Electric Vehicles: Technology and Economics," <https://nptel.ac.in/courses/108106170>
- [2] "Electric Vehicles - Part 1," https://onlinecourses.nptel.ac.in/noc22_ee53/preview
- [3] "Electric Vehicles," https://onlinecourses.swayam2.ac.in/ntr25_ed127/preview
- [4] "Electric Vehicles and Renewable Energy," https://onlinecourses.nptel.ac.in/noc21_ee112/preview
- [5] "Introduction to Electric and Hybrid Electric Vehicle," https://onlinecourses.swayam2.ac.in/nou24_ec10/preview
- [6] "EV - Vehicle Dynamics and Electric Motor Drives," https://onlinecourses.nptel.ac.in/noc25_ee33/preview

25EE2E19	PLC PROGRAMMING AND INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the architecture and I/O modules of S7-1200 PLCs to configure field devices for industrial automation.	1,2	1
CO2	Apply ladder diagram and function block programming in TIA Portal using timers, counters and function blocks for discrete control.	1,2	1
CO3	Analyze HMI and VFD integration with S7-1200 PLC for monitoring and control of motor-based systems.	1,2,4	1,2
CO4	Analyze SCADA architecture and integrate S7-1200 PLCs for supervisory control and data acquisition in industrial plants.	1,2,4,5	1,2
CO5	Evaluate DCS architecture and compare its suitability with PLC and SCADA systems for process and manufacturing applications.	1,2,3,4	1,2,3

PLC FUNDAMENTALS AND S7-1200 HARDWARE [9]

Role of PLC in industrial automation; comparison with relay and microcontroller systems. S7-1200 family overview: CPU types, memory, power supply, communication ports. Digital and analog I/O modules, wiring of field devices (sensors, pushbuttons, contactors, actuators). PLC scan cycle, task organization, addressing concepts; introduction to TIA Portal project structure.

PLC PROGRAMMING WITH TIA PORTAL [9]

Programming languages: Ladder Diagram (LAD), Function Block Diagram (FBD) basics. Bit logic, timers, counters, comparators, edge detection, arithmetic, and move operations. Development of modular programs using functions, function blocks, and data blocks. Case studies: conveyor control, level control, motor interlocks, start-stop-jog, simple sequence control.

HMI WITH KTP700 AND DRIVE INTEGRATION [9]

Basics of HMI and operator panels; KTP700 hardware overview, communication with S7-1200 (PROFINET). HMI screen development in TIA Portal: tags, buttons, lamps, numeric displays, trend views, alarms. Parameterization and basic control of a VFD from S7-1200: start/stop, speed reference, status monitoring. Example application: PLC–HMI–Drive integration for a small pump/fan or conveyor system.

SCADA SYSTEMS [9]

Role of SCADA in plant-wide supervision and data acquisition. SCADA architecture: field devices, RTUs/PLCs, communication networks, SCADA servers/clients. Core functions: real-time monitoring, alarms/events, trends, data logging, user access/security. Tag database, basic graphics, and report concepts; integration of S7-1200 with a SCADA system.

DISTRIBUTED CONTROL SYSTEMS (DCS) AND INTEGRATED AUTOMATION [9]

Evolution from single-loop control to DCS; DCS vs PLC/SCADA comparison. DCS architecture: controllers, I/O subsystems, communication backbone, operator and engineering stations. Process interfacing issues: analog signals, safety, redundancy, time synchronization. Integrated automation: combining PLC cells, SCADA, and DCS; typical case studies from process and manufacturing industries.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Frank D. Petruzella, Programmable Logic Controllers, 6th ed., McGraw-Hill, 2024.

- [2] John W. Webb & Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, 5th ed., Pearson, 2015.

REFERENCE BOOKS:

- [1] S7 1200 Programmable Controller System Manual – SIEMENS
[2] Liam Bee, PLC and HMI Development with Siemens TIA Portal, Packt, 2022.
[3] Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, 4th ed., ISA, 2004.

WEB REFERENCES:

- [1] "Introduction to Industry 4.0 and Industrial Internet of Things,"
https://onlinecourses.nptel.ac.in/noc20_cs69/preview

PROFESSIONAL ELECTIVE COURSES (PEC)
B.E. – ELECTRONICS AND COMMUNICATION
ENGINEERING

25EC2E01	SMART AND ADVANCED SENSORS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the essential characteristics of sensors that enable effective energy conversion.	1	-
CO2	Apply the functionalities of various optical sensors in suitable applications.	1,2	1
CO3	Analyze the implementation of security, surveillance, and energy management systems for operation with minimal supervision.	1,2	1
CO4	Apply various chemical sensors and sensing systems in the environmental and biomedical applications.	2,3	1
CO5	Evaluate sensor performance issues such as sensitivity, accuracy, noise, drift, and reliability in real-time applications.	1,2	1

DATA ACQUISITION, SENSORS AND SYSTEM MODELING

[12]

Data Acquisition, Sensors, Signals, and Systems - Sensor Classification - Units of Measurements - Transfer Functions – Mathematical Models – Functional Approximations - Linear Regression, Polynomial Approximations - Piecewise Linear Approximations - Spline Interpolation, Multidimensional Transfer Functions - Calibration, Computation of Parameters – Iterative Computation of Stimulus.

OPTICAL SENSING

[11]

Optical Units - Effects of Optical Radiations - Photo Conducting Sensors, Photoelectric Sensors - Optical Position Sensor - Charge Coupled Device (CCD) Sensors and Detectors - Thermopile PIR - Pyro electric sensors - Active Far Infrared (AFIR) Sensors.

HUMAN DETECTORS

[11]

Ultrasonic Detectors - Microwave Motion Detectors - Capacitive Occupancy Detectors - Triboelectric Detectors - Pressure-Gradient Sensors – Gesture sensing – Tactile sensors.

CHEMICAL AND BIOLOGICAL SENSORS

[11]

Chemical Sensor and its characteristics – Biochemical Sensors – Electrochemical Sensors – Potentiometric Sensors – Metal Oxide Semiconductor (MOS) Chemical Sensors – Color Change sensors – Electronic Nose and Tongue.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Phillip A. Laplante, *Handbook of Modern Sensors – Physics Design and Applications*, 5th Edition, Springer Publication, 2015.
- 2.Nathan Ida, “Sensors, Actuators, and their Interfaces - A Multidisciplinary Introduction,” 1st Edition, SciTech Publishing, 2013.

REFERENCE BOOKS:

- [1] Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., *Smart Sensors at the IoT Frontier*, Springer International Publishing, ,” 1st ed. ,2017.

- [2] Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing, ,” 2nd ed., 2015.
- [3] Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, ,” 1st ed. ,2011.
- [4] Manoj Kumar Shukla, Praveen Kumar Malik, Anuj Jain, Neeraj Kumar Mishra ,Smart Sensors Design, Challenges, and Applications.,CRC Press, 1st ed. ,2025.

WEB REFERENCES

- [1] “Sensors and Actuators”, <https://nptel.ac.in/courses/108108147>
- [2] “Sensor Technologies: Physics, Fabrication, and Circuits” <https://nptel.ac.in/courses/108106193>
- [3] “Embedded Sensing, Actuation and Interfacing Systems” <https://nptel.ac.in/courses/108105376>

25EC2E02	WEARABLE AND IMPLANTABLE DEVICES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand the fundamentals of wearable and implantable devices, physiological signals, and the role of digital and AI-based techniques in health monitoring.	1,2	-
CO2	Apply the working principles of biomedical sensors, signal acquisition systems and power solutions in the context of wearable and implantable technologies.	1,4,5	1,2
CO3	Apply design concepts and materials knowledge to develop reliable, comfortable and safe wearable or implantable systems.	3,11	2
CO4	Analyze the applications, safety requirements, MRI compatibility and clinical case studies of modern wearable and implantable healthcare devices, including AI-supported diagnostic approaches.	2,7	2
CO5	Apply integration techniques to develop safe wearable or implantable systems.	3,11	2

WEARABLE AND IMPLANTABLE SYSTEMS

[9]

Overview of wearable and implantable devices,- role in health monitoring and medical support-Basic physiological signals - ECG, EEG, EMG and body motion- Introduction to digital systems and basic AI techniques used for analyzing and interpreting physiological signals.

SENSORS, SIGNAL ACQUISITION AND ENERGY MANAGEMENT

[9]

Biomedical sensors for heart, brain and activity monitoring- Basics of signal acquisition, conditioning and simple processing-Power sources, low-power design and energy management-Use of basic AI techniques for improving signal quality and extracting useful information.

DEVICE DESIGN, MATERIALS AND INTEGRATION

[9]

Design of wearable bands, patches and implantable systems- Biocompatible and flexible materials- miniaturization- safe packaging and integration of sensors - AI support optimization -reliability and performance.

APPLICATIONS, SAFETY AND EMERGING TECHNOLOGIES

[9]

Applications in cardiac monitoring, neurological tracking, fitness, Safety standards, data security and ethical considerations AI-enabled personalised health monitoring.

AI FOR PREDICTIVE HEALTHCARE

[9]

Fundamentals of MRI compatibility for implantable devices. Case studies - wearable ECG patches, EEG bands-AI approaches used in health prediction and early detection of abnormalities.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] M. Mithileysh Sathiyarayanan, Wearable and Implantable Medical Devices, CRC Press. 1st ed., 2020
- [2] John G. Webster, Medical Instrumentation: Application and Design, Wiley. 4th ed., 2009.
- [3] Edward Sazonov & Michael R. Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Academic Press, ,” 1st ed. ,2012.

REFERENCE BOOKS:

- [1] Amit Gefen, Implantable Medical Devices, Academic Press.1st ed. ,2019.
- [2] Mark Allen & Janusz Bryzek, Smart Sensors and Systems, Springer. 1st ed.-2016.
- [3] Barbara Christe, Introduction to Biomedical Signal Processing, Pearson. 1st ed.-2016.
- [4] R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill. 1st ed.-2014.

WEB REFERENCES

- [1] “Basic course in Biomedical Research,” <https://nptel.ac.in/courses/108108123>
- [2] “Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications :” <https://youtu.be/gPjDsJJcYIA>
- [3] “Bioengineering: An Interface with Biology and Medicine:” <https://nptel.ac.in/courses/102101068>

25EC2E03	CYBER SECURITY IN COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamentals of communication networks and cyber security principles.	1	-
CO2	Identify types of cyber threats, attacks, and basic preventive mechanisms.	2,5	3
CO3	Apply suitable security measures to protect digital communication and data.	3,5	3
CO4	Develop security plans and strategies to ensure the integrity of information within a network.	3,4	3
CO5	Demonstrate awareness of cyber laws, ethical issues, and security standards related to communication networks.	2,5	3

FUNDAMENTALS OF CYBER SECURITY AND COMMUNICATION NETWORKS [15]

Communication Networks: Components, Topologies, and Data Transmission, Introduction to Cyber Security and its Importance, Cyber Threats and Attacks: Malware, Phishing, Denial of Service, Man-in-the-Middle, Security Goals – Confidentiality, Integrity, Availability (CIA Triad), Cyber Ethics and Safe Online Practices.

NETWORK SECURITY AND CRYPTOGRAPHY BASICS

[15]

Network Security Concepts – Firewalls, IDS/IPS, VPNs, Secure Communication: Encryption and Decryption, Introduction to Cryptography – Symmetric and Asymmetric Key Techniques (Simple Examples), Authentication and Access Control, Case Studies: Email Security, Online Transactions, Secure Wi-Fi.

EMERGING TRENDS AND APPLICATIONS IN CYBER SECURITY

[15]

Security in Wireless, IoT, and Cloud Networks, Cyber security in Social Media and Mobile Devices, Overview of Cyber Forensics and Incident Response, Cyber Laws and Privacy Regulations (IT Act, Data Protection), Tiny ML and Edge Computing for Secure Intelligent Systems.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] William Stallings, Network Security Essentials: Applications and Standards, Pearson Education, 6th ed., 2018.
- [2] Nina Godbole, Sunit Belapure, Cyber Security: Understanding Cyber Crimes and Legal Perspectives, ,” 1st ed. ,Wiley, 2011.

REFERENCE BOOKS:

- [1] Atul Kahate, Cryptography and Network Security, McGraw Hill, 4th ed., 2019.
- [2] P.W. Singer and Allan Friedman, Cybersecurity and Cyberwar: What Everyone Needs to Know, Oxford University Press, ,” 1st ed., 2014.
- [3] Behrouz A. Forouzan, Data Communications and Networking, Pearson Education, 5th ed., 2017.

WEB REFERENCES

- [1] “5G Wireless Standard Design:” https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee159
- [2] “Theory and Practice of Modern Cryptography,” https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs101

25EC2E04	HYBRID INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the fundamentals of classical and intelligent optimization techniques and justify the need for hybrid intelligent systems in solving complex engineering problems.	1	-
CO2	Apply artificial neural network models for optimization tasks such as function approximation, prediction, and parameter tuning in engineering applications.	1,5	2
CO3	Analyze and integrate hybrid optimization methods to address multi-domain problems in electronics, communication, IoT, and industrial systems.	2,5	2
CO4	Evaluate and design optimized solutions for real-world engineering applications including spectrum allocation, VLSI design, smart grids, biomedical systems, and industrial processes using hybrid intelligent approaches.	1,11	1,2,3
CO5	Develop and demonstrate application-oriented hybrid intelligent solutions using suitable simulation or programming tools.	2,5	2

OPTIMIZATION AND HYBRID INTELLIGENCE

[15]

Fundamentals of optimization: linear, nonlinear, combinatorial - Classical optimization vs. intelligent optimization - Need for hybrid intelligent systems - Types of hybridization: serial, parallel, embedded, cooperative - Applications in engineering, industry, electronics, communication, and robotics

ARTIFICIAL NEURAL NETWORKS (ANN) FOR OPTIMIZATION

[15]

Neural networks as function approximators - ANN-based optimization methods - Training algorithms and convergence behaviour - ANN for predictive optimization & parameter tuning - Use cases: signal processing, communication channel prediction, hardware design.

HYBRID OPTIMIZATION

[15]

Communication system optimization (spectrum allocation, power optimization) - VLSI design optimization - IoT resource and routing optimization - Bio-inspired optimization in biomedical electronics - Industrial process optimization - Smart grid and renewable energy optimization

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] S. N. Sivanandam & S. N. Deepa, *Introduction to Genetic Algorithms*, Springer Berlin Heidelberg, ,” 1st ed. ,2007.
- [2] S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, Genetic Algorithms*, PHI Learning Pvt. Ltd., ,” 1st ed. ,2003.

REFERENCE BOOKS:

- [1] Jang, Sun & Mizutani, *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*, ,” 1st ed. ,Prentice Hall, 1997.
- [2] Kennedy & Eberhart ,”Swarm Intelligence”, Morgan Kaufmann Publishers , ,” 1st ed., 2001.
- [3] Deb,” Multi-Objective Optimization using Evolutionary Algorithms”, John Wiley & Sons ,” 1st ed.,2001.

WEB REFERENCES

- [1] “Neural Networks for Signal Processing – I:” https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee129
- [2] “Computer System Optimizations for ML,” https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs96.

25EC2E05	MULTIMEDIA COMPRESSION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	POs	PSO
CO1	Understand multimedia data characteristics and basic compression principles.	1,2	-
CO2	Analyze and apply image compression techniques and standards.	1,2	3
CO3	Explain audio compression models and evaluate audio coding standards.	2,3,4,5	3
CO4	Analyze video compression methods and multimedia coding standards.	1,2	3
CO5	Analyze lossless and lossy compression techniques used in multimedia applications.	3,4	3

FUNDAMENTALS OF MULTIMEDIA AND COMPRESSION

[12]

Multimedia data types, characteristics of text, image, audio, and video, need for compression, and basic concepts of information theory. Redundancy types, lossless and lossy compression techniques, and performance metrics such as compression ratio, MSE, and PSNR.

IMAGE COMPRESSION TECHNIQUES

[9]

Image representation and redundancy, predictive coding, transform coding using DCT and wavelets, and entropy coding techniques. JPEG and JPEG2000 standards, quantization methods, and quality evaluation of compressed images.

AUDIO COMPRESSION TECHNIQUES

[12]

Audio signal characteristics, human auditory perception, and sampling concepts. Psychoacoustic models, and audio compression standards such as MP3 and AAC with bitrate considerations.

VIDEO COMPRESSION TECHNIQUES

[12]

Video signal representation, spatial and temporal redundancy, motion estimation and compensation techniques. Video coding standards including MPEG and H.264/AVC, video compression pipeline, and applications in multimedia streaming.

CASE STUDY:

Audio Compression in Streaming, Image Compression in Practice (JPEG & JPEG2000).

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Fred Halsall, James F. Kurose, *Multimedia Communication-Applications, Networks, Protocols and standards*, Pearson Education Limited, ,” 1st ed. ,2011.
- [2] Sayood Khaleed, *Introduction to Data Compression*, Morgan Kauffman, 4th ed., 2012.

REFERENCE BOOKS: :

- [1] Tay Vaughan, *Multimedia: making it work*, 9th ed., TMH, 2014.
- [2] Marcus Goncalves, *Voice over IP Networks*, Mc Graw Hill, ,” 1st ed. ,2011.
- [3] David Solomon, *Data Compression the complete reference*, Springer, 4th ed., 2011.

WEB REFERENCES

- [1] "Digital image processing," nptel.ac.in/courses/117105135
- [2] "Introduction to Multimedia Systems and Processing," nptel.ac.in/courses/117105083

PROFESSIONAL ELECTIVE COURSES (PEC)
B.E. – MECHANICAL ENGINEERING

25ME2E01	NONDESTRUCTIVE EVALUATION (NDT) TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals and need of NDT and visual inspection techniques to ensure quality and safety in engineering components.	1,2	1
CO2	Apply liquid penetrant and magnetic particle testing methods to detect surface and near-surface defects in metallic and non-metallic materials.	1,2,4,5	1
CO3	Analyze thermography and eddy current testing techniques to evaluate material properties and detect hidden flaws in industrial applications.	1,2,4,5	1
CO4	Apply ultrasonic testing methods including phased array and TOFD to detect internal defects and measure material thickness accurately.	1,2,4,5	1
CO5	Evaluate radiographic testing techniques, including digital and computed radiography for defect detection and dimensional verification in critical engineering components.	1,2,4,5	1

INTRODUCTION AND VISUAL INSPECTION

[9]

Introduction to NDT vs mechanical testing. Need and advantages of NDT. Visual inspection techniques, microscopes, replication microscopy, holography. Applications and case studies.

LIQUID PENETRANT AND MAGNETIC PARTICLE TESTING

[9]

Principle, procedures, types, equipment, advantages, limitations, and industrial applications of LPT and MPT. Case studies.

THERMOGRAPHY AND EDDY CURRENT TESTING

[9]

Principle and methods of thermography: active/passive, liquid crystal, infrared thermography, instrumentation, advantages, and limitations. Eddy Current Testing: principle, instrumentation, applications, and case studies.

ULTRASONIC TESTING

[9]

Ultrasonic Testing (UT): principle, transducers, couplants, ultrasonic waves, pulse-echo, straight and angle beams. Scanning techniques: A-Scan, B-Scan, C-Scan, Phased Array, TOFD. Advantages, limitations, interpretation, and applications with case studies.

RADIOGRAPHY

[9]

Principle of X-ray and Gamma-ray radiography. X-ray production, interaction with matter, imaging techniques, filters, fluoroscopy, digital radiography, computed radiography, computed tomography. Industrial applications and case studies.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] ASM Metals Handbook, *Non-Destructive Evaluation and Quality Control*, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
- [2] Paul E Mix, *Introduction to Non-destructive testing: a training guide*, Wiley, 2nd ed. New Jersey, 2005.

REFERENCE BOOKS:

- [1] ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing
- [2] Baldev Raj, T.Jayakumar, M.Thavasimuthu *Practical Non-Destructive Testing*, Narosa Publishing House, 2009.
- [3] Charles, J. Hellier, *Handbook of Non-destructive evaluation*, McGraw Hill, New York 2001.
- [4] Ravi Prakash, *Non-Destructive Testing Techniques*, New Age International Publishers, 1st Rev. ed., 2010.

WEB REFERENCES

- [1] Theory and Practice of Non Destructive Testing <https://nptel.ac.in/courses/113106070>

25ME2E02	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of product design, its role in manufacturing, product life cycle, types of products, and the design process.	1,2,3	1
CO2	Analyze customer needs and market requirements to generate viable design concepts.	1,2,3,4,5	1,3
CO3	Apply creative techniques such as brainstorming, TRIZ, morphological charts, and value engineering for concept generation and selection.	1,2,3,4,5	1,3
CO4	Select appropriate materials and manufacturing processes, considering cost, manufacturability, assembly, and tolerance requirements.	1,2,3,4,5,	1
CO5	Incorporate ergonomics, human factors, aesthetics, and safety considerations into product design.	1,2,3,4,5,10	1,3
CO6	Develop prototypes and evaluate design sustainability and environmental impact.	1,2,3,4,5,11	1,3

INTRODUCTION TO PRODUCT DESIGN

[9]

Product design fundamentals, role of product design in manufacturing, product life cycle, types of products, design process overview, systems engineering approach. Customer needs and market analysis.

CONCEPT GENERATION AND CREATIVITY

[9]

Creativity in design, brainstorming techniques, TRIZ basics, morphological charts, concept screening and selection, value engineering, risk analysis.

MATERIALS AND MANUFACTURING CONSIDERATIONS

[9]

Material selection basics, manufacturing processes overview, design for manufacturability, and design for assembly, cost considerations, tolerance analysis, rapid prototyping, and additive manufacturing.

ERGONOMICS AND AESTHETICS

[9]

Human factors in design, ergonomics principles, and anthropometric data, aesthetics, and safety considerations in product design.

INTRODUCTION TO PROTOTYPING AND SUSTAINABILITY

[9]

Prototyping methods, reliability engineering rapid prototyping basics, sustainability in product design, environmental considerations, simple case studies.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	2

TEXT BOOK:

- [1] Karl T. Ulrich & Steven D. Eppinger, Product Design and Development, McGraw-Hill Education, 6th ed., 2020.
- [2] George E. Dieter & Linda C. Schmidt, Engineering Design, McGraw-Hill, 5th ed., 2017.

REFERENCESBOOKS:

- [1] Chitale and Guptha, “Product Design and manufacturing” PHI learning Pvt. Ltd, Delhi, 2013.
- [2] C. Hearn Buck, “Problems of Product Design and Development”, Elsevier Science, 2013.
- [3] Dr. Ali Jamnia, “Introduction to Product Design and Development for Engineers”, CRC Press, 2018.
- [4] Mattson, Christopher A., Sorensen, Carl, “Product Development”, Springer, 2020.

WEB REFERENCES

- [1] Product Design And Development , <https://nptel.ac.in/courses/112107217>

25ME2E03	ENERGY STORAGE AND WASTE-TO-ENERGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals and classifications of energy storage systems and waste-to-energy technologies.	1,2	1
CO2	Analyze the performance of mechanical, thermal, and electrochemical energy storage systems.	1,2	1
CO3	Apply waste processing and energy recovery techniques for sustainable energy generation.	1,2,3,5	1,3
CO4	Evaluate different waste-to-energy conversion technologies based on efficiency and environmental impact.	1,2,6,7,11	1,3
CO5	Design sustainable energy solutions integrating storage systems and waste-to-energy technologies.	1,2,3,6,7,11	1,3

INTRODUCTION TO ENERGY STORAGE

[9]

Need for energy storage - Classification of energy storage systems - Mechanical, Thermal, Chemical, Electrochemical and Electrical storage systems - Energy density and power density - Batteries: Lead-acid, Lithium-ion, Sodium Sulphur batteries - Supercapacitors and Fuel Cells - Comparison of energy storage technologies.

MECHANICAL AND THERMAL ENERGY STORAGE

[9]

Flywheel energy storage systems - Pumped hydroelectric storage - Compressed Air Energy Storage (CAES) - Thermal energy storage methods - Sensible heat storage - Latent heat storage using Phase Change Materials (PCM) - Thermochemical storage systems - Applications in renewable energy systems.

WASTE MANAGEMENT AND ENERGY RECOVERY

[9]

Sources and characteristics of municipal solid waste - Industrial and agricultural waste - Waste segregation and recycling - Waste collection and transportation systems - Waste minimization techniques - Environmental impacts of solid waste - Energy recovery potential from waste - Circular economy concepts.

WASTE-TO-ENERGY CONVERSION TECHNOLOGIES

[9]

Incineration and combustion systems - Gasification and pyrolysis - Refuse Derived Fuel (RDF) - Anaerobic digestion and biogas production - Landfill gas recovery systems - Biomass briquetting techniques - Waste-to-energy plant layout and operation - Emission control technologies.

SUSTAINABLE ENERGY SYSTEMS AND APPLICATIONS

[9]

Hybrid renewable energy systems - Hydrogen energy storage and applications - Grid integration of energy storage systems - Smart grid concepts - Economic and environmental analysis of waste-to-energy plants - Energy policies and sustainability standards - Recent advancements in energy storage technologies - Case studies on waste-to-energy projects in India.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	2

TEXT BOOKS:

- [1] I. Dinçer and M. A. Rosen, Thermal Energy Storage: Systems and Applications, 3rd ed. Hoboken, NJ, USA: Wiley, 2021.
- [2] N. B. Klinghoffer and M. J. Castaldi, Waste to Energy Conversion Technology. Cambridge, U.K.: Woodhead Publishing, 2013.

REFERENCES BOOKS:

- [1] T. M. Letcher, Storing Energy: With Special Reference to Renewable Energy Sources, 3rd ed. Oxford, U.K.: Elsevier, 2022.
- [2] B. Sørensen, Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning, 6th ed. Cambridge, MA, USA: Academic Press, 2024.
- [3] A. Karagiannidis, Waste to Energy: Opportunities and Challenges for Developing and Transition Economies. Cham, Switzerland: Springer, 2018.
- [4] A. Khan et al., Advanced Technology for the Conversion of Waste into Fuels and Chemicals. Cambridge, U.K.: Woodhead Publishing, 2021.
- [5] B. H. Khan, Non-Conventional Energy Resources, 3rd ed. New Delhi, India: McGraw Hill, 2023.

WEB REFERENCES

- [1] Waste to Energy Conversion <https://nptel.ac.in/courses/103107125>

25ME2E04	INDUSTRIAL ROBOTICS TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of robotics, robot anatomy, coordinate systems, classifications, specifications, and industrial applications of robots.	1,2,5	1
CO2	Analyze and select suitable robotic drives, actuators, and grippers based on operational requirements and design considerations.	1,2,5	1
CO3	Apply sensing and machine vision techniques for robot perception, inspection, object recognition, and navigation applications.	1,2,3,4	1,2
CO4	Develop and solve forward and inverse kinematics models, Jacobians, trajectories, and robot programming problems for robotic manipulators.	1,2,3,4,5,6,11	1
CO5	Evaluate the implementation of robotic systems in industries considering automation, safety, economic analysis, AGV/RGV systems, and real-time applications.	1,2,3,4,5,6,11	1,2

INTRODUCTION

[9]

Robot definition – Robot anatomy – Coordinate systems and work envelope – Robot classification and specifications – Pitch, yaw, roll, joint notations – Speed of motion and payload – Robot components and functions – Need for robots and industrial applications.

TYPES OF GRIPPERS

[9]

Robot drives: Pneumatic, hydraulic, mechanical and electrical drives – D.C. servo, A.C. servo and stepper motors – Features and applications – End effectors and grippers – Mechanical, pneumatic, hydraulic, magnetic and vacuum grippers – Two fingered and three fingered grippers – Internal and external grippers – Selection and design considerations.

SENSORS IN ROBOTS

[9]

Sensor requirements – Position and range sensors – Piezoelectric sensor, LVDT, resolvers and optical encoders – Touch, wrist, compliance and slip sensors – Camera and frame grabber – Image sensing and digitization – Image processing fundamentals – Segmentation, feature extraction and object recognition – Applications in inspection and navigation.

KINEMATICS

[9]

Forward and inverse kinematics – Kinematics of manipulators with 2, 3 and 4 degrees of freedom – Jacobians, velocity and force analysis – Manipulator dynamics and trajectory generation – Robot programming concepts – VAL programming, motion and sensor commands – Simple robot programs.

APPLICATIONS OF ROBOTICS

[9]

RGV and AGV systems – Industrial robot implementation – Safety considerations in robot operation – Economic analysis and applications of robotics in industries.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	2

TEXT BOOKS:

- [1] Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, Industrial Robotics: Technology, Programming and Applications, 2nd ed., McGraw Hill Education, 2017.
- [2] John J. Craig, Introduction to Robotics: Mechanics and Control, 4th ed., Pearson Education, 2019.

REFERENCES:

- [1] Kevin M. Lynch and Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, 1st Edition, Cambridge University Press, 2017.
- [2] S. K. Saha, Introduction to Robotics, 2nd Edition, Tata McGraw Hill, 2017.
- [3] Bruno Siciliano and Lorenzo Sciavicco, Robotics: Modelling, Planning and Control, 3rd Edition, Springer, 2020.
- [4] K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision, and Intelligence, 1st Edition reprint, McGraw Hill, 2019.
- [5] Larry T. Ross, Stephen W. Fardo and Michael F. Walach, Industrial Robotics Fundamentals, 4th Edition, Goodheart-Willcox, 2021.

WEB REFERENCES

- [1] Industrial Robotics: Theories for Implementation , <https://nptel.ac.in/courses/112105319>

PROFESSIONAL ELECTIVE COURSES (PEC)
B.Tech. – INFORMATION TECHNOLOGY

25IT2E01	HARDWARE SECURITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Recall the basic taxonomy of hardware attacks, vulnerabilities, and countermeasures.	1	1
CO2	Use hardware Trojan taxonomy to classify and detect malicious modifications in RTL/FPGA designs and trust benchmarks.	2, 4	1
CO3	Perform side-channel analysis and test-oriented attacks to extract secret keys or compromise hardware IP.	2, 4	1
CO4	Deploy hardware security primitives and design-for-security techniques to develop countermeasures for pre-silicon and post-silicon threats.	3	1
CO5	Implement hardware obfuscation and PCB-level security methods to prevent Trojan insertion, IP theft, and counterfeiting.	3	1

Electronic Hardware

[9]

Computing System – Electronic Hardware – Types of Electronic Hardware – Hardware Security vs Hardware Trust – Attacks, Vulnerabilities and Countermeasures – Conflict between Security and Test/Debug – Evolution of Hardware Security – Nanoscale Technologies – Digital Logic – Circuit Theory – ASICs and FPGAs – Printed Circuit Board – Embedded Systems – Hardware – Firmware – Software Interaction – SoC Design and Test: Test Cost and Product Quality – Test Generation – IP-based SoC life-cycle – SoC Design Flow – SoC Verification Flow – SoC Test Flow – Design for Debug – At-Speed Delay Test – PCB Life cycle – Reverse Engineering Attacks.

Hardware Attacks

[9]

Hardware Trojans – SoC Design Flow – Hardware Trojans – Hardware Trojans in FPGA Designs – Activation Characteristic – Payload Characteristics – Hardware Trojans Taxonomy: Insertion Phase – Abstraction Level – Activation Mechanism – Payload – Location – Trust Benchmarks – Countermeasures against Hardware Trojans – Electronic Supply Chain: Modern Electronic Supply Chain – Electronic Components Supply Chain Issues – Security Concerns – Trust Issues – Potential Countermeasures.

Reverse Engineering and Side-Channel Attacks

[9]

Hardware Intellectual Property – Security Issues in IP-based SoC Design – Security Issues in FPGA – Side-Channel Attacks: Background – Power Analysis Attacks – Electromagnetic Side-channel Attacks – Fault Injection Attacks – Timing Attacks – Covert Channels – Test-oriented Attacks: Scan-based attacks – JTAG-Based Attacks – Reverse Engineering – Probing Attack – Invasive Fault Injection Attack – Attacks on PCB – Attack Models.

Security Primitives and Design for Security

[9]

Hardware Security Primitives – Physical Unclonable Function – PUF Classifications – Quality Properties – Common PUF Architectures – PUF Applications – True Random Number Generator – Design for Anti-counterfeit – Existing Challenges and Attacks – Primitive Design with emerging nanodevices – Security assets and Attack Models – Pre-silicon Security and Trust Assessment for SoCs

– Post-silicon Security and Trust Assessment for ICs – Design for Security: Architecture – Policy Enforcer – Side-channel resistant design – Trojan insertion prevention.

Hardware Obfuscation and PCB Security

[9]

Software vs Hardware Obfuscation – Obfuscation Techniques – Hardware obfuscation methods – Emerging Obfuscation Approaches – Obfuscation against Trojan Attacks – PCB authentication – sources of PCB Signature – Signature Procurement and Authentication methods – Signature assessment metric – System-level mutual authentication – authentication using resonance frequency – PCB integrity validation – SoC Design – SoC Security Requirements – Security Policy Enforcement – Secure SoC design process – Threat modeling.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Swarup Bhunia and Mark Tehranipoor. Hardware Security: A Hands-on Learning Approach. Morgan Kaufmann Publishers, 2019.

REFERENCE BOOKS:

[1] Mark Tehranipoor, Kimia Zamiri Azar, Navid Asadizanjani, Fahim Rahman, Hadi Mardani Kamali, and Farimah Farahmandi. Hardware Security: A Look into the Future. Springer, 2024.

WEB REFERENCES:

[1] "Trust Hub," <https://trust-hub.org>

25IT2E02	USABLE SECURITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental relationship between usability and security.	1	1
CO2	Describe the design principles, quality criteria, and environmental considerations for various authentication mechanisms.	1	1
CO3	Apply user-centered design strategies and guidelines to create usable secure systems.	2, 3	1
CO4	Recommend privacy frameworks and anonymity systems to identify, design pitfalls, and propose privacy-preserving solutions	2, 3	1
CO5	Design usable security products for consumers in collaborative applications.	3	1

Usability and Security

[10]

Psychological Acceptability – Passwords – Patching – Need for considering usability – Product: Human Factors – Policies – Security Mechanisms – Impossible Demands – Beyond User Interface – Process: Applying Human Factors Knowledge and User-centered Approaches to Security Design – Designing Usable Secure Systems – Importance of the Environment – Role of Education, Training, Motivation and Persuasion – Design for Usability – Death by Security – Balancing Security and Usability – User vs Bad Guys – vary security with the task – increasing partnership with user – achieving balanced authentication design – balancing privacy and security – usability in the software and hardware life cycle – aspects of HCI in Privacy and Security – Usability in requirements – Usability in Design and Development – Case Studies – Trust-Risk relationship – Time-course of trust – Models of Trust – Trust Designs.

Authentication Mechanisms

[10]

Evaluating Authentication Mechanism: Authentication – Authentication Mechanisms – Quality Criteria – Environmental Considerations – Memorability and Security of Passwords: Existing advice on password selection – experimental studies – Designing Authentication Systems with Challenge Questions: Challenge Questions as a form of authentication – criteria for building and evaluating a challenge question system – types of questions and answers – designing a challenge question authentication system – Graphical Passwords – Usable Biometrics – Users and Typing patterns: Typing pattern biometrics – applications – privacy and security issues – usability of security devices – usability testing.

Secure Systems

[10]

Guidelines and strategies for secure interaction design: design guidelines – design strategies – fighting phishing at the user interface – attack techniques – defenses – sanitization and usability – remembrance of data passed study – clean computing – Usable PKI – Desktop Security with Chameleon – Chameleon User Interface – Interface development – implementation – security administration tools and practices – attacks, detection and prevention – security administrators – case studies.

Privacy and Anonymity Systems

[10]

Privacy and HCI – User-centric Privacy Space Framework – Security and Privacy Frameworks – Privacy as a process – Five pitfalls in the design for privacy – Privacy policies and privacy preferences: platform for privacy preferences – Privacy Bird Design – Privacy Bird Evaluation – Beyond the browser – Privacy analysis for the casual user with bugnosis: audience for bugnosis – cookies, web bugs and user tracking – graphic identity – making it simple is complicated – informed consent by design – model of informed consent for information systems – cookie handling in web browsers – Usability and Network Effect.

Commercializing Usability

[5]

Creating Usable Security Products for consumers – Worry-free web: The Five Golden Rules – Users and Trust – Consent Dialogs – Pop-up blocking – Embedding Security in Collaborative Applications – Usable Secure Collaboration – Embedding and Simplifying Public Key Security – Designing Security Displays – User control of active content security – Usable security in virtual office.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Lorrie Faith Cranor, Simson Garfinkel. Security and Usability. O'Reilly Publishers, 2005 (2025 Reprint).

REFERENCE BOOKS:

[1] Markus Jakobsson. Understanding Social Engineering-Based Scams. Springer, 2016.

WEB REFERENCES:

[1] "Usable Security," <https://www.coursera.org/learn/usable-security>

25IT2E03	DATA MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of cloud-native data infrastructure.	1	1
CO2	Describe the mechanisms for automating database deployment and management in cloud-native environments.	1,2	1
CO3	Explain the integration of data infrastructure with native databases.	1,2	1
CO4	Implement streaming data pipelines and analytics workloads.	1,2,4	1
CO5	Design and deploy cloud-native AI/ML data infrastructure incorporating efficient data movement.	1,2,3,4	1

Data Infrastructure, Storage and Databases

[9]

Cloud Native Data – Infrastructure Problem – Cloud Native Data Components – Docker, Containers and State – Resources for Data Storage – Storage Architecture – Prerequisites for running Data Infrastructure – Running MySQL – Running Apache Cassandra.

Automating Database Deployment and Management

[9]

Deploying application with Helm Charts – Using Helm to deploy MySQL – Using Helm to deploy Apache Cassandra – Helm, CI/CD and Operations – Extending control plane – The Operator Pattern – Managing MySQL using Vitess Operator – Growing Ecosystem of Operators.

Integrating Data Infrastructure and Native Database

[9]

Production-ready Cassandra – Managing Cassandra with Cass Operator – Enabling Developer Productivity with Stargate APIs – Unified Monitoring Infrastructure with Prometheus and Grafana – Performing repairs with Cassandra Reaper – Backing Up and Restoring Data with Cassandra Medusa – Deploying Multi-cluster Applications – Need for Native Approach – Hybrid Data Access – Serverless Cassandra with DataStax Astra DB.

Streaming Data and Analytics

[9]

Streaming – Role of Streaming – Streaming with Apache Pulsar – Stream analytics with Apache Flink – Analytics – Deploying Analytic Workloads – Apache Spark – Deploying Apache Spark – Operator for Apache Spark – Alternative Schedulers – Analytic Engines.

Machine Learning and Data Workload Migration

[9]

Cloud Native AI/ML Stack – Efficient Data Movement with Apache Arrow – Versioned Object Storage with lakeFS – Application-aware platforms – future of Cloud Native data.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Jeff Carpenter, Patrick McFadin. Managing Cloud Native Data on Kubernetes. O'Reilly, 2022.

REFERENCE BOOKS:

- [1] Francesco Diaz, Roberto Freato. Cloud Data Design, Orchestration, and Management Using Microsoft Azure: Master and Design a Solution Leveraging the Azure Data Platform. Apress, 2018.

WEB REFERENCES:

- [1] "Cloud Data Management,"
<https://edu.alibabacloud.com/course/333/lesson/list?spm=a2c4d.8764728.aliyun-edu-course-tab.2.59bf71cf0GnUfm>
- [2] "Cloud Computing," <https://nptel.ac.in/courses/106105167>

25IT2E04	INFRASTRUCTURE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental concepts of cloud native infrastructure.	1	1
CO2	Describe the evolution of cloud native deployments from infrastructure as a diagram to infrastructure as code (IaC) and infrastructure as software.	1,2	1
CO3	Explain the design and development of infrastructure applications.	1,2,3	1
CO4	Implement testing and management strategies for cloud native applications.	1,2,3,4	1
CO5	Implement security and operational controls for cloud native infrastructure.	1,2,3,4	1

Cloud Native Infrastructure

[9]

Cloud Native Benefits – Servers – Virtualization - Infrastructure as a Service - Platform as a Service - Cloud Native Infrastructure - Cloud Native Applications – People –Systems - Business.

Evolution of Cloud Native Deployments

[9]

Representing Infrastructure - Infrastructure as a Diagram - Infrastructure as a Script - Infrastructure as Code - Infrastructure as Software - Deployment Tools – Idempotency - Handling Failure.

Designing and Developing Infrastructure Applications

[9]

The Bootstrapping Problem - The API - The State of the World - The Reconciler Pattern - The Reconciler Pattern's Methods - The Auditing Relationship - Designing an API - Adding Features - Deprecating Features - Mutating Infrastructure.

Testing and Managing Cloud Native Applications

[9]

Writing Testable Code – Validation - Entering Your Codebase - Self-Awareness - Types of Tests - Infrastructure Assertions - Integration Testing - Unit Testing - Mock Testing - Chaos Testing - Application Design - Implementing Cloud Native Patterns - Application Life Cycle – Deploy – Run – Retire - Application Requirements on Infrastructure - Application Runtime and Isolation - Resource Allocation and Scheduling - Environment Isolation - Service Discovery - State Management - Monitoring and Logging - Metrics Aggregation - Debugging and Tracing - Monitoring Infrastructure

Securing and Implementing Cloud Native Infrastructure

[9]

Policy as Code - Deployment Gating - Conformity Testing - Compliance Testing - Activity Testing - Auditing Infrastructure - Immutable Infrastructure – People - Architecture - Chaos Management - Applications.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Justin Garrison, Kris Nova. Cloud Native Infrastructure. O'Reilly, 2017.

REFERENCE BOOKS:

- [1] Jeevan Gheevarghese Joseph, Adao Oliveira Junior, Mickey Boxell. Oracle Cloud Infrastructure - A Guide to Building Cloud Native Applications. Oracle Press, 2023.
- [2] Buyya, Rajkumar, Christian Vecchiola,, S. Thamarai Selvi, Shivananda Poojara, Dr. Satish Narayana Srirama. Mastering Cloud Computing: foundations and applications programming. McGraw Hill, 2024.

WEB REFERENCES:

- [1] "Cloud Data Management,"
<https://edu.alibabacloud.com/course/333/lesson/list?spm=a2c4d.8764728.aliyun-edu-course-tab.2.59bf71cf0GnUfm>
- [2] "Cloud Computing," <https://nptel.ac.in/courses/106105167>

25IT2E05	INFORMATION AND TECHNOLOGY LAW	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the key data security laws and litigation concepts.	1,4	1
CO2	Describe the cybersecurity requirements and corporate governance obligations for financial institutions, healthcare, energy, nuclear, insurance, and publicly traded companies.	1,2,4	1
CO3	Identify major anti-hacking laws and international cybercrime treaties.	1	1
CO4	Apply key privacy laws and compare international cybersecurity legal frameworks.	1,2,3	1
CO5	Analyze surveillance laws to real-world compliance and litigation scenarios.	1,2,3	1

Data Security Laws and Litigation

[9]

FTC Data Security – State Data Breach Notification Laws – State Data Security Laws – State Data Disposal Laws – Common causes of action arising from data breaches – class action certification in data breach litigation – Insurance coverage for Cybersecurity Incidents – Protecting Cybersecurity Work Product and Communication from Discovery.

Cybersecurity requirements and corporate governance

[9]

Financial Institutions: Gramm-Leach-Bliley Act Safeguards rule – New York Department of Financial Services Cybersecurity Regulations – Red Flags Rule – Payment Card Industry Data Security Standard – California Internet of Things Cybersecurity Law – Health Insurance Portability and Accountability Act – Federal Energy Regulatory Commission Critical Infrastructure Protection Reliability Standards – Nuclear Regulatory Commission Cybersecurity Regulations – South Carolina Insurance Cybersecurity Law – Securities and Exchange Commission Cybersecurity Expectations for Publicly Traded Companies – Fiduciary Duty to Shareholders and Derivative Lawsuits Arising from Data Breaches – Committee on Foreign Investment in the United States and Cybersecurity.

Anti-Hacking Laws and Cyber Structure

[9]

Computer Fraud and Abuse Act – State Computer Hacking Laws – Section 1201 of the Digital Millennium Copyright Act – Economic Espionage Act – Budapest Convention on Cybercrime – U.S. Government's Civilian Cybersecurity Organization – Department of Homeland Security Information Sharing under the Cybersecurity Act of 2015 – Critical Infrastructure Executive Order and the National Institute of Standards and Technology's Cybersecurity Framework – Posse Comitatus Act – Vulnerabilities Equities Process.

Surveillance and Federal Government Contractors

[9]

Electronic Communications Privacy Act – Communications Assistance for Law Enforcement Act (CALEA) – Encryption and the All Writs Act – Encrypted Devices and the Fifth Amendment – Federal Information Security Management Act – NIST Information Security Controls for Government Agencies and Contractors – Classified Information Cybersecurity – Covered Defense Information and Controlled Unclassified Information.

Privacy and International Cybersecurity Law

[9]

Section 5 of the FTC Act and Privacy - CAN-SPAM Act - Video Privacy Protection Act - Children's Online Privacy Protection Act - California Online Privacy Laws - California Consumer Privacy Act - Illinois Biometric Information Privacy Act - European Union – Canada – China – Mexico – Japan - India.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Jeff Kosseff. Cybersecurity Law, 2/E. Wiley, 2019.

REFERENCE BOOKS:

[1] Shimon Brathwaite. Cybersecurity Law: Protect Yourself and Your Customers. Business Expert Press, 2019.

[2] Walter Rocchi. Cybersecurity and Privacy Law Handbook. Packt Publishing, 2022.

WEB REFERENCES:

[1] "The Information Technology Act, 2000,"
https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf

25IT2E06	DATA ETHICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the evolution of privacy and technology, key ethical theories, and contemporary concepts.	1	1
CO2	Describe the core ethical principles for data management.	1	1
CO3	Apply data governance, data quality management, data modeling, and data warehousing concepts to design ethical data management practices.	1,2,3	1
CO4	Implement the Ethical Enterprise Information Management (E2IM) framework to manage ethical risks in big data environments.	1,2,3	1
CO5	Integrate data governance with ethics by designing data review boards, using storytelling to communicate values, and applying Privacy by Design	1,2,3,4	1

Ethics and Data Management

[9]

Ethics and Evolution of Technology – Privacy and the Environment – Evolution of Privacy and Technology – Data Ethics and Environmental Concerns – Volkswagen’s ‘dieseldgate’ scandal – ethical dilemmas – ethics in information management – Ethical theories – Relational Ethics – Data Colonialism and Ethics Washing – Elements of Ethical Frameworks.

Ethical Principles, privacy and analytics

[9]

Principles – developing ethical data principles – data ethics principles in practice – ethics in society – analytics and data science: an ethical challenge – Data Analytics – Ethical issues in data analytics.

Data and Information Management

[9]

Data Management – Data Governance – Data Quality Management – Data Modeling – Data Warehousing and Business Intelligence – Big Data, AI and Machine Learning – Data literacy and data acumen in data ethics – data-enabled actions – data ethics and architecture – implementing ethical architecture – challenges – Zachman ethical architecture.

Ethical Enterprise Information Management framework

[9]

Model for ethical enterprise information management – ethics and big data – ethics as a quality system – applying quality management principles to ethical information management.

Information Ethics and Data Governance

[9]

Data Governance and ethics – Principles and modes of governance – stewardship and governance – storytelling to communicate values – data review boards – change management – parallel models – Privacy by Design – Ethics by Design – Privacy Engineering – E2IM ethical impact assessment model.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Katherine O'Keefe and Daragh O'Brien. Data Ethics, 2/E. Kogan Page Publishers, 2023.

REFERENCE BOOKS:

[1] Kord Davis, Doug Patterson. Ethics of Big Data. O'Reilly Media, 2012.

WEB REFERENCES:

[1] "The Digital Personal Data Protection Act, 2023,"
<https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

25IT2E07	INFRASTRUCTURE DESIGN AND OPERATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental Quality of Service (QoS) concepts.	1	1
CO2	Describe the QoS design considerations and recommended practices for campus and wireless LAN environments.	1,2	1
CO3	Explain the QoS design considerations and tools for data center networks.	1,2	1
CO4	Implement QoS strategies for WAN and branch networks.	1,2,3,4	1
CO5	Design QoS policies for MPLS VPN and IPsec VPN environments.	1,2,3,4	1

QoS Design and Strategies

[9]

History of QoS and QoE – IOS-Based QoS Architectural Framework and Syntax Structure - Classification and Marking - Policing, Shaping, and Markdown Tools - Congestion Management and Avoidance Tools - Bandwidth Reservation Tools - QoS in IPv6 Networks – Medianet - Application Visibility Control (AVC) - Business and Application QoS Requirements - QoS Design Principles and Strategies - Strategic QoS Design Case Study.

Campus and Wireless LAN QoS Design

[9]

Campus QoS Design Considerations and Recommendations - Campus Access QoS Design - Campus Distribution QoS Design - Campus Core QoS Design - Case Study - Wireless LAN QoS Considerations and Recommendations - Centralized (Cisco 5500 Wireless LAN Controller) QoS Design - Converged Access QoS Design – Case Study.

Data Center QoS Design

[9]

Data Center QoS Design Considerations and Recommendations - Data Center Architectures - Data Center QoS Tools - NX-OS QoS Framework - Data Center QoS Models - Data Center Port QoS Roles - Data Center Virtual Access QoS Design - Data Center Access/Aggregation QoS Design – Data Center Core QoS Design – Case Study.

WAN and Branch QoS Design

[9]

WAN and Branch QoS Design Considerations and Recommendations - WAN and Branch Architectures - Hardware Versus IOS Software QoS - Latency and Jitter - Tx-Ring – CBWFQ – LLQ – WRED – RSVP – AutoQoS – Control Plane Policing – Link Types and Speeds – WAN and Branch QoS Models – WAN and Branch Interface QoS Roles – WAN Aggregator QoS Design – Branch Router QoS Design – Case Study.

MPLS VPN and IPsec QoS Design

[9]

MPLS VPN QoS Design Considerations and Recommendations - Enterprise Customer Edge QoS Design - Service Provider Edge QoS Design - Service Provider Core QoS Design – Case Study - IPsec VPN QoS Considerations and Recommendations - DMVPN QoS Design - GET VPN QoS Design - Home Office VPN QoS Case Study.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Tim Szigeti, Christina Hattingh, Robert Barton, Kenneth Briley Jr., End-to-End QoS Network Design: Quality of Service for Rich-Media & Cloud Networks, 2/E. Cisco Press, 2013 (2024 Reprint).

REFERENCE BOOKS:

- [1] Saida Helali. Systems and Network Infrastructure Integration. Wiley, 2020.
[2] Silvano Gai. Building a Future-Proof Cloud Infrastructure: A Unified Architecture for Network, Security, and Storage Services. Addison-Wesley Professional, 2020.

WEB REFERENCES:

- [1] "Data Center Infrastructure & Design: Operation & Maintenance," <https://www.udemy.com/course/data-center-infrastructure-design-datacenter/>

25IT2E08	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the limitations of traditional network architectures and the fundamental advantages of SDN.	1	1
CO2	Describe the architecture, features, benefits, and implementation challenges of SD-WAN and SD-LAN technologies.	1	1
CO3	Implement OpenFlow-based switching solutions by configuring flow tables, flow entries, and switch management operations.	2, 4	1
CO4	Design network virtualization solutions using NFV and VXLAN overlay technologies.	2, 3, 4	1
CO5	Construct automated network orchestration workflows using Ansible and SDN orchestrators.	3, 4	1

Network Programming and Automation

[9]

Traditional Network Architectures – Limitations – SDN Network Overview – Advantages – Components – API North and South – SDN Network Models – SDN Controllers – SDN multi-controller Network – Network Programming and SDN Networks – Network Programmability Models – Imperative and Declarative Programming Models – APIs – Network Automation via RESTful API.

Openflow Protocol and SD-WAN Technology

[9]

Benefits of OpenFlow Protocol – Versions – Components – Management and Role of Tables in OpenFlow Switching – Flow Table and Flow Entries – Messages – Ecosystem and Switch Management – Other SDN protocols – SD-WAN – SD-WAN Features – SD-WAN Architecture – Issues and Challenges of SD-WAN technology.

SD-LAN and Group-based policy Management

[9]

Campus Networks – Key Requirement for Campus Network Optimization – SD-LAN Technology – Segmentation – Architecture – Components – AAA Servers – Group-based Policy Management – Presentation – Micro-segmentation – Zero Trust Approach – Components of GBP – GBP management with SDN Controller – Automated Campus Network Solutions.

NFV and SDN Overlay Networks

[9]

Network Virtualization Standards – Data Center Optimization through NFV – Interaction between NFV and SDN – Diversified applications of overlay networks – technologies and methods – VXLAN network Overlay – VXLAN and SDN – VXLAN Management Methods – Technical Challenges.

Orchestration

[9]

Definition and role of SDN orchestrators – advantages of SDN Orchestrators – General architecture of an SDN orchestrator – Leading SDN orchestrators – orchestrating with Ansible – Synergy between Ansible and SDN networks – SD-Access Solution – SD-ACCESS architecture – Platform and Management Tools – Integration in external networks.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Ali Sadiqui, Moulay Rachid Filali. Fundamentals of Software-Defined Networking: Towards Intelligent and Flexible Networks. CRC Press, 2026.

REFERENCE BOOKS:

- [1] Paul Goransson, Chuck Black, Timothy Culver. Software Defined Networks: A Comprehensive Approach. Morgan Kaufmann Publishers, 2016.
- [2] Thomas D. Nadeau and Ken Gray, Timothy Culver. Software Defined Networks. O'Reilly, 2025.

WEB REFERENCES:

- [1] "SDN Resources," https://github.com/sadiqui-ali/SDN_resources
- [2] "Open Networking Foundation," <https://opennetworking.org/sdn-definition/>

PROFESSIONAL ELECTIVE COURSES (PEC)
**B.Tech. – ARTIFICIAL INTELLIGENCE AND DATA
SCIENCE**

25AI2E01	FEATURE ENGINEERING FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the significance of feature engineering and perform data cleaning, pre-processing, and transformation of raw data.	1,2,4,5	1,2
CO2	Apply numerical and categorical feature engineering techniques to construct meaningful features for machine learning models.	1,2,3,4,5	1,2
CO3	Engineer features from text, date-time, and time-series data for predictive analytics applications.	1,2,3,4,5,11	1,2
CO4	Select relevant features and apply dimensionality reduction techniques to improve model performance and interpretability.	1,2,4,5,11	1,2
CO5	Design end-to-end feature engineering pipelines and evaluate advanced feature engineering methods in production environments.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF FEATURE ENGINEERING AND DATA PREPROCESSING [9]

Introduction to feature engineering; role of features in machine learning; data types and feature characteristics; data quality assessment; missing value treatment; outlier detection and handling; data leakage; train-test separation; exploratory data analysis for feature discovery; preprocessing workflows.

NUMERICAL AND CATEGORICAL FEATURE ENGINEERING [9]

Numerical feature transformation: scaling, normalization, standardization, robust scaling, log and power transformations, discretization and binning; interaction and polynomial features. Categorical feature encoding: label encoding, one-hot encoding, ordinal encoding, count/frequency encoding, target encoding, feature hashing.

TEXT, DATE-TIME AND TIME-SERIES FEATURE ENGINEERING [9]

Text preprocessing: tokenization, stop-word removal, stemming, lemmatization; Bag of Words, n-grams, TF-IDF, word embeddings overview. Date-time features: extracting year, month, day, weekday, quarter; cyclical encoding. Time-series features: lag features, rolling statistics, expanding windows.

FEATURE SELECTION AND DIMENSIONALITY REDUCTION [9]

Filter methods: variance threshold, correlation analysis, chi-square test, mutual information. Wrapper methods: recursive feature elimination. Embedded methods: L1 regularization, tree-based importance. Dimensionality reduction: Principal Component Analysis (PCA), Singular Value Decomposition (SVD), overview of t-SNE and UMAP.

ADVANCED FEATURE ENGINEERING AND PRODUCTION PIPELINES [9]

Automated feature engineering; Deep Feature Synthesis; feature crosses; clustering-based features; handling class imbalance and synthetic features; building reusable pipelines using scikit-learn; feature validation, monitoring and drift detection; feature stores; MLOps considerations and case studies.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Feature Engineering for Machine Learning, Alice Zheng and Amanda Casari, O'Reilly Media, 2018.
- [2] Python Feature Engineering Cookbook, Soledad Galli, 3rd ed., Packt Publishing, 2023.

REFERENCE BOOKS:

- [1] Feature Engineering and Selection, Max Kuhn and Kjell Johnson, CRC Press, 2019.
- [2] Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 3rd ed., O'Reilly Media, 2022.
- [3] Designing Machine Learning Systems, Chip Huyen, O'Reilly Media, 2022.

WEB REFERENCES:

- [1] "scikit-learn Documentation," <https://scikit-learn.org/stable>
- [2] "Feature-engine Documentation," <https://feature-engine.trainindata.com>
- [3] "Pandas Documentation," <https://pandas.pydata.org/docs>
- [4] Google Machine Learning Feature Engineering Guide

25AI2E02	INFORMATION RETRIEVAL AND SEARCH ENGINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of information retrieval systems, document representation, and indexing techniques.	1,2,4,5	1,2
CO2	Apply term weighting models, vector space models, and query processing techniques for effective retrieval.	1,2,3,4,5	1,2
CO3	Design and evaluate web search engines, crawling strategies, and link analysis algorithms.	1,2,3,4,5,11	1,2
CO4	Analyze ranking methods, relevance feedback, and retrieval effectiveness using standard evaluation metrics.	1,2,4,5,11	1,2
CO5	Develop intelligent search applications incorporating semantic search, recommendation, and ethical considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF INFORMATION RETRIEVAL

[9]

Introduction to information retrieval; information retrieval versus database systems; architecture of IR systems; document representation; tokenization; stop-word removal; stemming and lemmatization; inverted index; dictionary structures; postings lists; index construction and compression techniques.

RETRIEVAL MODELS AND QUERY PROCESSING

[9]

Boolean retrieval model; ranked retrieval; term frequency and inverse document frequency (TF-IDF); vector space model; cosine similarity; probabilistic retrieval; BM25 ranking model; query parsing and optimization; phrase and proximity queries; spelling correction and query expansion.

WEB SEARCH ENGINES AND LINK ANALYSIS

[9]

Web structure and characteristics; web crawling; crawler architecture; URL frontier and politeness policies; duplicate detection; web indexing; hyperlink analysis; PageRank; HITS; anchor text and metadata usage; focused crawling.

RELEVANCE FEEDBACK AND EVALUATION

[9]

User interaction and relevance feedback; Rocchio Algorithm; pseudo relevance feedback; learning to rank overview; evaluation metrics: precision, recall, F1-score, MAP, NDCG; test collections; significance testing; search quality assessment.

ADVANCED SEARCH AND MODERN INFORMATION RETRIEVAL

[9]

Semantic search; word embeddings; dense retrieval; transformer-based retrieval; question answering and retrieval-augmented generation (RAG); recommender systems and personalization; multilingual and cross-lingual retrieval; privacy, fairness, and ethics in search engines.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, Cambridge University Press.
- [2] Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson.

REFERENCE BOOKS:

- [1] Modern Information Retrieval, Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Addison-Wesley.
- [2] Neural Search, Tommaso Teofili, Manning Publications, 2024.

WEB REFERENCES:

- [1] "Apache Lucene Documentation," <https://lucene.apache.org/core>
- [2] "Elasticsearch Guide," <https://www.elastic.co/guide/en/elasticsearch/reference/current/index.html>
- [3] "Stanford IR Book Resources," <https://nlp.stanford.edu/IR-book>
- [4] "OpenSearch Documentation," <https://opensearch.org/docs/latest>

25AI2E03	MACHINE TRANSLATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of machine translation, linguistic representations, and traditional translation models.	1,2,4,5	1,2
CO2	Apply statistical and phrase-based machine translation techniques for bilingual text processing.	1,2,3,4,5	1,2
CO3	Design and implement neural machine translation systems using recurrent and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyze translation quality using automatic and human evaluation metrics and error analysis techniques.	1,2,4,5,11	1,2
CO5	Develop multilingual translation applications incorporating large language models, deployment strategies, and ethical considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF MACHINE TRANSLATION

[9]

Introduction to machine translation; challenges in translation; linguistic levels: morphology, syntax, semantics and pragmatics; rule-based machine translation; transfer-based and interlingua approaches; parallel corpora; tokenization; subword segmentation; alignment concepts.

STATISTICAL AND PHRASE-BASED MACHINE TRANSLATION

[9]

Noisy channel model; word alignment; IBM Models overview; expectation maximization; phrase extraction; phrase-based translation; language models; decoding algorithms; reordering models; domain adaptation for statistical translation systems.

NEURAL MACHINE TRANSLATION

[9]

Sequence-to-sequence models; encoder-decoder architecture; attention mechanism; recurrent neural networks; transformer architecture; self-attention; positional encoding; multilingual and low-resource neural machine translation; transfer learning and fine-tuning.

TRANSLATION EVALUATION AND ERROR ANALYSIS

[9]

Automatic evaluation metrics: BLEU, METEOR, TER, chrF; human evaluation methods; adequacy and fluency assessment; confidence estimation; error categorization; bias and hallucination analysis; robustness and quality assurance.

ADVANCED MACHINE TRANSLATION AND APPLICATIONS

[9]

Pretrained multilingual models; large language models for translation; retrieval-augmented translation; speech translation overview; document-level translation; deployment and optimization; privacy, fairness, ethics, and real-world translation applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Neural Machine Translation, Philipp Koehn, Cambridge University Press, 2020.
- [2] Statistical Machine Translation, Philipp Koehn, Cambridge University Press, 2010.

REFERENCE BOOKS:

- [1] Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd ed., 2025.
- [2] Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

WEB REFERENCES:

- [1] Hugging Face Transformers Documentation
- [2] OpenNMT Documentation
- [3] Marian NMT Documentation
- [4] SacreBLEU Evaluation Toolkit Documentation

25AI2E04	NATURAL LANGUAGE GENERATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of natural language generation, linguistic representations, and text generation paradigms.	1,2,4,5	1,2
CO2	Apply template-based, rule-based, and statistical methods to generate coherent text from structured data.	1,2,3,4,5	1,2
CO3	Design and implement neural text generation systems using recurrent, attention-based, and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyse generated text using automatic evaluation metrics and human-centered quality assessment methods.	1,2,4,5,11	1,2
CO5	Develop advanced NLG applications using large language models while addressing ethical, safety, and deployment considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF NATURAL LANGUAGE GENERATION

[9]

Introduction to natural language generation; NLG pipeline; content determination; document planning; sentence aggregation; lexicalization; referring expression generation; surface realization; applications of NLG in dialogue systems, summarization, and report generation.

TEMPLATE-BASED, RULE-BASED AND STATISTICAL NLG

[9]

Template-based generation; grammar-based approaches; feature structures; statistical language models; n-gram models; probabilistic text generation; data-to-text generation; domain-specific report and description generation.

NEURAL NATURAL LANGUAGE GENERATION

[9]

Sequence-to-sequence models; encoder-decoder architecture; recurrent neural networks; attention mechanism; transformer architecture; self-attention; positional encoding; decoding strategies: greedy search, beam search, top-k and nucleus sampling.

EVALUATION AND CONTROL OF GENERATED TEXT

[9]

Automatic evaluation metrics: BLEU, ROUGE, METEOR, BERTScore; human evaluation for fluency, coherence, relevance, and factuality; controllable text generation; style transfer; hallucination detection and mitigation; bias and fairness assessment.

LARGE LANGUAGE MODELS AND ADVANCED NLG APPLICATIONS

[9]

Pretrained language models; instruction tuning; prompt engineering; retrieval-augmented generation; multilingual and multimodal generation; conversational agents; deployment and optimization; privacy, ethics, safety, and real-world NLG applications.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Building Natural Language Generation Systems, Ehud Reiter and Robert Dale, Cambridge University Press.

[2] Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

REFERENCE BOOKS:

[1] Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd ed., 2025.

[2] Foundations of Statistical Natural Language Processing, Christopher D. Manning and Hinrich Schütze, MIT Press.

WEB REFERENCES:

[1] Hugging Face Transformers Documentation

[2] OpenAI API Documentation

[3] LangChain Documentation

[4] Stanford Natural Language Processing Resources

25AI2E05	NATURAL LANGUAGE UNDERSTANDING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of natural language understanding, linguistic structures, and semantic representations.	1,2,4,5	1,2
CO2	Apply syntactic and semantic analysis techniques for extracting meaning from text.	1,2,3,4,5	1,2
CO3	Design and implement neural language understanding models using recurrent and transformer architectures.	1,2,3,4,5,11	1,2
CO4	Analyze model performance using standard evaluation metrics and interpretability techniques for language understanding tasks.	1,2,4,5,11	1,2
CO5	Develop advanced NLU applications using large language models while addressing ethical, privacy, and deployment considerations.	3,4,5,9,10,11	1,2,3

FOUNDATIONS OF NATURAL LANGUAGE UNDERSTANDING

[9]

Introduction to natural language understanding; levels of linguistic analysis; morphology, syntax, semantics, and pragmatics; ambiguity and disambiguation; tokenization; part-of-speech tagging; named entity recognition; lexical resources and ontologies.

SYNTACTIC AND SEMANTIC ANALYSIS

[9]

Constituency and dependency parsing; semantic role labeling; word sense disambiguation; coreference resolution; relation extraction; semantic parsing; knowledge representation; discourse analysis and contextual understanding.

STATISTICAL AND NEURAL METHODS FOR NLU

[9]

Feature-based models; probabilistic classifiers; word embeddings; recurrent neural networks; LSTM and GRU; attention mechanisms; transformer architecture; pretrained language models such as BERT, RoBERTa, and T5.

NLU TASKS AND EVALUATION

[9]

Text classification; sentiment analysis; intent detection; question answering; natural language inference; evaluation metrics: accuracy, precision, recall, F1-score, exact match, and calibration; error analysis and explainability techniques.

LARGE LANGUAGE MODELS AND ADVANCED NLU APPLICATIONS

[9]

Instruction tuning; prompt engineering; retrieval-augmented understanding; multilingual and multimodal language understanding; conversational agents; privacy, fairness, robustness, ethics, and deployment of NLU systems.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd ed. (Draft), 2025.
- [2] Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

REFERENCE BOOKS:

- [1] Foundations of Statistical Natural Language Processing, Christopher D. Manning and Hinrich Schütze, MIT Press.
- [2] Transformers for Natural Language Processing, Denis Rothman, Packt Publishing, 2024.

WEB REFERENCES:

- [1] Hugging Face Transformers Documentation
- [2] Stanford Natural Language Processing Resources
- [3] spaCy Documentation
- [4] TensorFlow Text Documentation

25AI2E06	NEURAL NETWORK FOR NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundations of neural networks and distributed representations used in natural language processing.	1,2,4,5	1,2
CO2	Apply recurrent and convolutional neural networks to solve sequence modeling and text classification tasks.	1,2,3,4,5	1,2
CO3	Design and implement attention-based and transformer models for advanced NLP applications.	1,2,3,4,5,11	1,2
CO4	Analyze model performance using standard evaluation metrics, error analysis, and interpretability methods.	1,2,4,5,11	1,2
CO5	Develop large language model applications with fine-tuning, retrieval, and ethical deployment considerations.	3,4,5,9,10,11	1,2,3

COURSE CONTENT:

FOUNDATIONS OF NEURAL NETWORKS FOR NLP

[9]

Introduction to neural networks; perceptron and multilayer perceptron; activation functions; backpropagation; optimization algorithms; word representations; one-hot encoding; distributed embeddings; Word2Vec, GloVe, and FastText; sequence representation fundamentals.

RECURRENT AND CONVOLUTIONAL MODELS FOR NLP

[9]

Recurrent neural networks; vanishing and exploding gradients; LSTM and GRU architectures; bidirectional recurrent networks; convolutional neural networks for text classification; character-level and word-level models; sequence labeling applications.

ATTENTION MECHANISMS AND TRANSFORMER ARCHITECTURES

[9]

Attention mechanisms; self-attention; multi-head attention; positional encoding; encoder and decoder architectures; transformer models; pretrained transformers including BERT, GPT, T5, and RoBERTa; transfer learning in NLP.

TRAINING, EVALUATION AND FINE-TUNING

[9]

Tokenization and subword methods; masked language modeling; causal language modeling; fine-tuning for classification, question answering, and generation; evaluation metrics; hyperparameter tuning; interpretability and error analysis.

LARGE LANGUAGE MODELS AND ADVANCED NLP APPLICATIONS

[9]

Instruction tuning; prompt engineering; parameter-efficient fine-tuning (LoRA and adapters); retrieval-augmented generation; multilingual and multimodal models; model compression and deployment; privacy, bias, fairness, and ethics.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Neural Network Methods in Natural Language Processing, Yoav Goldberg, Morgan & Claypool Publishers.

[2] Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.

REFERENCE BOOKS:

[1] Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd ed., 2025.

[2] Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.

WEB REFERENCES:

[1] Hugging Face Transformers Documentation

[2] PyTorch Documentation

[3] Stanford CS224N Course Materials

[4] TensorFlow Tutorials for Natural Language Processing

25AI2E07	RETRIEVAL AUGMENTED GENERATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the foundations of retrieval-augmented generation, information retrieval, and large language models.	1,2,4,5	1,2
CO2	Apply document processing, embedding, indexing, and vector search techniques to build retrieval systems.	1,2,3,4,5	1,2
CO3	Design and implement end-to-end RAG pipelines using large language models and prompt orchestration frameworks.	1,2,3,4,5,11	1,2
CO4	Analyze retrieval and generation quality using standard evaluation metrics, tracing, and error analysis.	1,2,4,5,11	1,2
CO5	Develop production-grade RAG applications addressing scalability, privacy, security, and ethical considerations.	3,4,5,9,10,11	1,2,3

COURSE CONTENT:

FOUNDATIONS OF RETRIEVAL-AUGMENTED GENERATION

[9]

Introduction to retrieval-augmented generation; limitations of standalone large language models; information retrieval fundamentals; dense and sparse retrieval; embeddings and semantic similarity; vector databases; chunking strategies; document ingestion and metadata management.

DOCUMENT INDEXING AND RETRIEVAL TECHNIQUES

[9]

Text preprocessing; tokenization; TF-IDF and BM25; sentence and document embeddings; approximate nearest neighbor search; hybrid search; reranking models; filtering and faceted retrieval; incremental indexing and update strategies.

RAG PIPELINE DESIGN AND IMPLEMENTATION

[9]

Prompt templates; context construction; query rewriting; multi-query retrieval; compression and contextual summarization; orchestration using LangChain and LlamaIndex; grounding and citation; conversational memory; agentic retrieval workflows.

EVALUATION, MONITORING AND OPTIMIZATION

[9]

Retrieval metrics: Recall@k, MRR, NDCG; generation metrics: faithfulness, relevance, answer correctness; hallucination detection; tracing and observability; latency and cost optimization; caching; hyperparameter tuning; benchmark datasets.

PRODUCTION RAG, SECURITY AND ADVANCED APPLICATIONS

[9]

Parameter-efficient fine-tuning; domain adaptation; multimodal RAG; graph-based retrieval; enterprise knowledge assistants; privacy-preserving retrieval; access control; prompt injection defense; responsible AI, ethics, and governance.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

[1] Designing Large Language Model Applications, Chip Huyen, O'Reilly Media, 2025.

[2] AI Engineering, Chip Huyen, O'Reilly Media, 2025.

REFERENCE BOOKS:

- [1] Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, O'Reilly Media, 2022.
- [2] Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson.

WEB REFERENCES:

- [1] LangChain Documentation
- [2] LlamaIndex Documentation
- [3] Pinecone Learning Center
- [4] Weaviate Documentation

INNOVATION AND PROJECT WORK (IPW)

25CS272	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a real-world or domain-specific engineering problem relevant to Information Technology through a comprehensive literature survey.	2,4,6,11	1
CO2	Apply fundamental mathematical, scientific, and engineering principles to design software architecture or an algorithmic solution for the identified problem, ensuring compliance with standard design specifications and realistic constraints.	1,3	1,2
CO3	Select appropriate modern frameworks, programming languages, libraries, and integrated development environments (IDEs) to develop the solution.	5	2
CO4	Function effectively both as an individual contributor and as a collaborative team member within a group.	8	3
CO5	Manage the project lifecycle efficiently by applying appropriate planning, resource estimation, and milestone-scheduling techniques.	10	3
CO6	Communicate technical findings effectively by compiling a structured project report.	7,9	1

The student in a group of 2 or 3, works on a specific topic approved by the project review committee constituted by the head of the department, under the guidance of a faculty member familiar with the area of interest. The students shall select any topic relevant to the applications of Computer Science and Engineering. The mini project aims to provide students with an opportunity to apply the fundamental concepts learned in the program to solve a real-world or domain-specific engineering problem of moderate scope. At the end of the semester, a concise project report should be submitted, containing a clear definition of the identified problem, a brief literature survey related to the area of work, and the methodology adopted for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and a viva-voce examination conducted by a panel of examiners.

Total Notional Hours: 60

L	T	P	TW+SL	C
0	0	60	0	2

25CS273	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a complex, real-world computing problem through literature review.	2,4,6,11	1
CO2	Design and develop an innovative, secure, and scalable software/algorithmic solution using computing principles.	1,3	1,2
CO3	Administer appropriate modern computing frameworks, platforms, and secure development tools to build the system.	5	2
CO4	Function effectively as a member/leader in a larger team.	8,10	3
CO5	Disseminate novel research findings by presenting a research paper and documenting the project report.	7,9	1,3
CO6	Conduct rigorous investigations to validate the proposed solution.	4,11	1,2

The student, in a group of 3 to 4, works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar with this area. The students can select any topic that is relevant to Computer Science and Engineering. At least one conference or journal paper based on the project work must be published or submitted for publication. At the end of the semester, a detailed report on the work done should be submitted, which contains a clear definition of the identified problem, a detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and the viva-voce examination by a panel of examiners, including one external examiner.

Total Notional Hours: 240

L	T	P	TW+SL	C
0	0	240	0	8

25EE278	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify an engineering problem in the EEE domain through literature survey and define the problem scope.	1,2,6,7,8,9,10	-
CO2	Select appropriate tools and techniques for implementing the mini project with cost and sustainability considerations.	1,2,4,5,6,7,8,9,10	1,2
CO3	Apply engineering knowledge to analyze and address the identified problem.	1,2,3,4,5,6,7,8,9,10,11	1,2,3
CO4	Design a hardware prototype or simulation model incorporating sustainability and cost estimation.	1,2,3,4,5,6,7,8,9,10,11	1,2,3
CO5	Implement, test and present the mini project outcomes with reference to technical performance and feasibility.	1,2,3,4,5,6,7,8,9,10,11	1,2,3

The student, individually or in a group of 2, works on a specific topic approved by the project review committee constituted by the head of the department, under the guidance of a faculty member familiar with the area of interest. The students may select any topic relevant to the field of Electrical and Electronics Engineering. The mini project aims to provide students with an opportunity to apply the fundamental concepts learned in the programme to solve a real-world or domain-specific engineering problem of moderate scope. At the end of the semester, a concise project report should be submitted, containing a clear definition of the identified problem, a brief literature survey related to the area of work, and the methodology adopted for carrying out the work. The progress of the project is evaluated based on a minimum of two reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and a viva-voce examination conducted by a panel of examiners.

Total Notional Hours:60

L	T	P	TW+SL	C
0	0	60	0	2

25EE279	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify and define an engineering problem in EEE domain through literature review.	1,2,6,7,9,10	
CO2	Select appropriate tools and techniques for project implementation considering cost and environmental impact.	1,2,4,5,6,7,9,10	1,2
CO3	Apply engineering knowledge to solve the identified problem with financial and sustainability considerations.	1,2,3,4,5,6,7,9,10,11	1,2,3
CO4	Work effectively in a multidisciplinary team with ethical responsibility and individual accountability.	8	
CO5	Design and implement a hardware prototype incorporating sustainability metrics and cost estimation.	1,2,3,4,5,6,7,9,10,11	1,2,3
CO6	Evaluate project outcomes in terms of technical performance, financial viability and sustainability impact.	1,2,3,4,5,6,7,9,10,11	1,2,3

The student, in a group of 3 to 4, works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar with this area. The students can select any topic that is relevant to the area of Electrical and Electronics Engineering. Hardware implementation is mandatory, and each group must demonstrate a working hardware prototype as part of their project. Additionally, at least one conference or journal paper based on the project work must be published or submitted for publication. At the end of the semester, a detailed report on the work done should be submitted, which contains a clear definition of the identified problem, a detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and the viva-voce examination by a panel of examiners, including one external examiner.

Total Notional Hours:240

L	T	P	TW+SL	C
0	0	240	0	8

25EC278	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

At the end of the course, the students will have an ability to

COs	COURSE OUTCOMES	POs	PSOs
CO1	Identify the real time problem based on recent technologies	1,2	1,2,3
CO2	Formulate a real-world problem, identify the requirement and develop the design solutions for the identified problem	1,2,3	1,2,3
CO3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.	1,2,3,4,5,6	1,2,3
CO4	Present the findings of the work conducted by comparing several existing solutions for the problems identified.	2,6,9,11	1,2,3
CO5	Work collaboratively in multidisciplinary teams and exhibit leadership, interpersonal, and project management skills in professional settings and enhance students skills pertaining to scientific and technical report writing.	7,8,10	1,2,3

COURSE CONTENT:

The students in a group of 3 to 4 works on a topic approved by the Head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Notional Hours:60

L	T	P	TW+SL	C
0	0	60	0	2

25EC279	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES:

At the end of the course, the students will have an ability to

COs	COURSE OUTCOMES	POs	PSOs
CO1	Identify technical ideas, strategies and methodologies.	1,2	1,2,3
CO2	Articulate a real-world problem, identify the requirement and develop the design solutions ethically and establish workplace discipline, safety practices, and social responsibility while carrying out assigned tasks and projects.	1,2,3	2
CO3	Apply the new tools, algorithms, techniques that contribute to obtain the solution of the project.	1,2,3,4,5,6	2
CO4	Report and present the findings of the work conducted by comparing several existing solutions for the problems identified.	2,6,9,11	1
CO5	Take up any challenging practical problems and find solution by formulating proper methodology.	7,8,10	1
CO6	Formulate and propose a plan for creating a solution for the research plan identified for enhancing their life-long learning capability.	7,8	2

COURSE CONTENT:

The students in a group of 3 to 4 works on a topic approved by the Head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Notional Hours:240

L	T	P	TW+SL	C
0	0	240	0	8

25ME273	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Identify and formulate engineering problems through literature review and feasibility analysis.	1,2,3,4	1
CO2	Design mechanical systems/components using appropriate engineering principles and modern tools.	1,2,3,4,5	1
CO3	Fabricate and assemble a functional prototype by applying manufacturing and quality practices	1,2,3,4,5,9	1,2
CO4	Conduct testing, analyze performance data, and validate the developed system.	1,2,3,4,5,6,7,8	1,2
CO5	Demonstrate teamwork, project management, communication, and professional ethics through project execution and presentation.	6,7,8,9,10,11	3

The Design and Fabrication Project course enables students to apply engineering knowledge and skills to solve real-world mechanical engineering problems through the complete product development cycle. The course begins with problem identification, literature survey, feasibility analysis, project planning, and resource allocation. Students generate and evaluate design concepts, perform engineering calculations, create CAD models, and conduct engineering analysis to develop an optimized design solution. Emphasis is placed on systematic design methodologies, innovation, and addressing societal and industrial needs.

The course further involves material selection, fabrication, assembly, testing, and performance evaluation of the developed prototype or system. Students gain practical experience in manufacturing processes, quality assurance, safety practices, data analysis, and design optimization. The project culminates in the preparation of a comprehensive technical report, cost analysis, project management activities, and awareness of intellectual property and entrepreneurship. Through project demonstration, presentation, and viva-voce examination, students develop technical competence, teamwork, communication skills, professional ethics, and project management capabilities.

Total Notional Hours: 60

L	T	P	TW+SL	C
0	0	60	0	2

25ME274	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES

At the end of the course, students will have the ability to:

CO	COURSE OUTCOMES	PO	PSO
CO1	Identify, formulate, and analyze a complex engineering problem through literature review and systematic investigation.	1,2,3,4	1
CO2	Design and develop an appropriate engineering solution using engineering principles and modern tools.	1,2,3,4,5	1,2
CO3	Conduct experiments, simulations, or investigations and interpret the results to validate the proposed solution.	1,2,3,4,5	2
CO4	Apply project management principles, teamwork, professional ethics, and sustainability considerations during project execution.	6,4,7,8,9,10,11	3
CO5	Prepare technical reports and effectively communicate project outcomes through presentations and viva-voce examinations.	8,9,10,11	3

The Final Year Project Work provides students with an opportunity to undertake an in-depth investigation of a complex engineering problem and develop an innovative solution. The project involves problem identification, literature review, objective formulation, methodology development, design and analysis, experimentation, simulation, data collection, interpretation of results, and validation of outcomes. Students are encouraged to apply engineering principles, modern tools, and research methodologies to address industrial, societal, environmental, or technological challenges.

The project also emphasizes teamwork, project planning, resource management, professional ethics, and effective communication. Students are required to prepare periodic progress reports, maintain proper documentation, and present their work at various review stages. The course culminates in the submission of a detailed project report, demonstration of the developed solution or findings, and a viva-voce examination. The project experience aims to strengthen problem-solving ability, innovation, research aptitude, and professional competence.

Total Notional Hours: 240

L	T	P	TW+SL	C
0	0	240	0	8

25IT271	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a real-world or domain-specific engineering problem relevant to Information Technology through a comprehensive literature survey.	2,4,6,11	1
CO2	Apply fundamental mathematical, scientific, and engineering principles to design software architecture or an algorithmic solution for the identified problem, ensuring compliance with standard design specifications and realistic constraints.	1,3	1,2
CO3	Select appropriate modern IT frameworks, programming languages, libraries, and integrated development environments (IDEs) to develop the solution.	5	2
CO4	Function effectively both as an individual contributor and as a collaborative team member within a group.	8	3
CO5	Manage the project lifecycle efficiently by applying appropriate planning, resource estimation, and milestone-scheduling techniques.	10	3
CO6	Communicate technical findings effectively by compiling a structured project report.	7,9	1

The student in a group of 2 or 3, works on a specific topic approved by the project review committee constituted by the head of the department, under the guidance of a faculty member familiar with the area of interest. The students shall select any topic relevant to the applications of Information Technology. The mini project aims to provide students with an opportunity to apply the fundamental concepts learned in the program to solve a real-world or domain-specific engineering problem of moderate scope. At the end of the semester, a concise project report should be submitted, containing a clear definition of the identified problem, a brief literature survey related to the area of work, and the methodology adopted for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and a viva-voce examination conducted by a panel of examiners.

Total Notional Hours: 60

L	T	P	TW+SL	C
0	0	60	0	2

25IT273	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a complex, real-world IT problem through literature review.	2,4,6,11	1
CO2	Design and develop an innovative, secure, and scalable software/algorithmic solution using IT principles.	1,3	1,2
CO3	Administer appropriate modern IT frameworks, platforms, and secure development tools to build the system.	5	2
CO4	Function effectively as a member/leader in a larger team.	8,10	3
CO5	Disseminate novel research findings by presenting a research paper and documenting the project report.	7,9	1,3
CO6	Conduct rigorous investigations to validate the proposed solution.	4,11	1,2

The student, in a group of 3 to 4, works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar with this area. The students can select any topic that is relevant to Information Technology. At least one conference or journal paper based on the project work must be published or submitted for publication. At the end of the semester, a detailed report on the work done should be submitted, which contains a clear definition of the identified problem, a detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and the viva-voce examination by a panel of examiners, including one external examiner.

Total Notional Hours: 240

L	T	P	TW+SL	C
0	0	240	0	8

25AI272	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a real-world or domain-specific engineering problem relevant to Data Science through a comprehensive literature survey.	2,4,6,11	1
CO2	Apply fundamental mathematical, scientific, and engineering principles to design software architecture or an algorithmic solution for the identified problem, ensuring compliance with standard design specifications and realistic constraints.	1,3	1,2
CO3	Select appropriate modern data processing frameworks, programming languages, libraries, and integrated development environments (IDEs) to develop the solution.	5	2
CO4	Function effectively both as an individual contributor and as a collaborative team member within a group.	8	3
CO5	Manage the project lifecycle efficiently by applying appropriate planning, resource estimation, and milestone-scheduling techniques.	10	3
CO6	Communicate technical findings effectively by compiling a structured project report.	7,9	1

The student in a group of 2 or 3, works on a specific topic approved by the project review committee constituted by the head of the department, under the guidance of a faculty member familiar with the area of interest. The students shall select any topic relevant to the applications of Data Science. The mini project aims to provide students with an opportunity to apply the fundamental concepts learned in the program to solve a real-world or domain-specific engineering problem of moderate scope. At the end of the semester, a concise project report should be submitted, containing a clear definition of the identified problem, a brief literature survey related to the area of work, and the methodology adopted for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and a viva-voce examination conducted by a panel of examiners.

Total Notional Hours: 60

L	T	P	TW+SL	C
0	0	60	0	2

25AI273	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Identify a complex, real-world AI problem through literature review.	2,4,6,11	1
CO2	Design and develop an innovative, secure, and scalable software/algorithmic solution using ai principles.	1,3	1,2
CO3	Administer appropriate modern Data processing frameworks, platforms, and secure development tools to build the system.	5	2
CO4	Function effectively as a member/leader in a larger team.	8,10	3
CO5	Disseminate novel research findings by presenting a research paper and documenting the project report.	7,9	1,3
CO6	Conduct rigorous investigations to validate the proposed solution.	4,11	1,2

The student, in a group of 3 to 4, works on a specific topic approved by the project review committee constituted by the head of the department under the guidance of a faculty member who is familiar with this area. The students can select any topic that is relevant to Data Science. At least one conference or journal paper based on the project work must be published or submitted for publication. At the end of the semester, a detailed report on the work done should be submitted, which contains a clear definition of the identified problem, a detailed literature review related to the area of work and methodology for carrying out the work. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, students will be evaluated based on the report and the viva-voce examination by a panel of examiners, including one external examiner.

Total Notional Hours: 240

L	T	P	TW+SL	C
0	0	240	0	8

OPEN ELECTIVE COURSES (OPC)

25AI2E51	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Outcomes:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the basic concepts, history, and applications of Artificial Intelligence in various domains.	1,2,5	1
CO2	Apply fundamental AI problem-solving techniques and knowledge representation methods.	1,2,3,4	1,2
CO3	Illustrate machine learning concepts and intelligent systems used in real-world applications.	1,2,4,5	1,2
CO4	Analyse AI technologies such as natural language processing, computer vision, and robotics.	1,2,4,5,11	1,2
CO5	Evaluate ethical, societal, and industrial implications of AI and emerging intelligent technologies.	6,7,8,9,10,11	1,2,3

COURSE CONTENT:

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

[9]

Introduction to AI; history and types of AI; intelligent agents; AI versus Machine Learning and Deep Learning; applications of AI in healthcare, agriculture, manufacturing, education, and smart systems; AI tools and future trends.

PROBLEM SOLVING AND KNOWLEDGE REPRESENTATION

[9]

AI problem-solving methods; state space representation; uninformed and informed search techniques; heuristic search; game playing concepts; knowledge representation; propositional and predicate logic; semantic networks; expert systems.

FUNDAMENTALS OF MACHINE LEARNING

[9]

Introduction to machine learning; supervised and unsupervised learning; classification and regression; clustering basics; training and testing datasets; model evaluation; applications of machine learning in engineering.

INTELLIGENT SYSTEMS AND EMERGING TECHNOLOGIES

[9]

Basics of Natural Language Processing; speech and image recognition; computer vision fundamentals; robotics and automation; recommender systems; generative AI and large language models; AI-based virtual assistants.

AI APPLICATIONS, ETHICS AND SOCIETY

[9]

AI in Industry 4.0 and IoT; predictive analytics; autonomous systems; ethical issues in AI; fairness, privacy, and security; responsible AI; societal impact and career opportunities in AI.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
- [2] Ethem Alpaydin, Introduction to Machine Learning, MIT Press.

REFERENCE BOOKS:

- [1] Elaine Rich and Kevin Knight, Artificial Intelligence, McGraw Hill.

[2] Margaret A. Boden, Artificial Intelligence: A Very Short Introduction, Oxford University Press.

WEB REFERENCES:

- [1] "TensorFlow Documentation," <https://www.tensorflow.org/learn>
- [2] "Google AI Resources," <https://ai.google/education>
- [3] "OpenAI Learning Resources," <https://openai.com>
- [4] "IBM AI Education," <https://www.ibm.com/artificial-intelligence>

25AI2E52	INTRODUCTION TO MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the basic concepts and applications of machine learning.	1,2	1
CO2	Apply simple supervised learning techniques for prediction and classification.	1,2,3	1,2
CO3	Illustrate unsupervised learning methods for grouping and pattern identification.	1,2,4	1,2
CO4	Analyse machine learning model performance using basic evaluation metrics.	1,2,4,5	1,2
CO5	Identify real-world applications and ethical aspects of machine learning systems.	6,7,8,9	1,2

COURSE CONTENT

BASICS OF MACHINE LEARNING

[9]

Introduction to machine learning; AI versus ML and Deep Learning; types of machine learning; data collection and preprocessing; features and datasets; applications of machine learning in engineering and industry.

SUPERVISED LEARNING

[9]

Introduction to supervised learning; classification and regression concepts; linear regression; decision trees; k-nearest neighbors; training and testing data; applications of supervised learning.

UNSUPERVISED LEARNING

[9]

Introduction to unsupervised learning; clustering concepts; k-means clustering; dimensionality reduction basics; anomaly detection; applications of unsupervised learning.

MODEL EVALUATION AND NEURAL NETWORKS

[9]

Model evaluation metrics; confusion matrix; accuracy, precision, recall, and F1-score; overfitting and underfitting; introduction to neural networks and deep learning basics.

MACHINE LEARNING APPLICATIONS AND ETHICS

[9]

Machine learning applications in healthcare, agriculture, finance, manufacturing, and smart systems; recommender systems; ethical issues in ML; fairness, privacy, and future trends.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Ethem Alpaydin, Introduction to Machine Learning, MIT Press.
- [2] Tom M. Mitchell, Machine Learning, McGraw Hill.

REFERENCE BOOKS:

- [1] Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.
- [2] Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Publications.

WEB REFERENCES:

- [1] "Scikit-learn Documentation," <https://scikit-learn.org/stable>
- [2] "TensorFlow Tutorials," <https://www.tensorflow.org/tutorials>
- [3] "Kaggle Learn," <https://www.kaggle.com/learn>
- [4] "Google Machine Learning Crash Course," <https://developers.google.com/machine-learning/crash-course>

25AI2E53	DEEP LEARNING FOUNDATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of deep learning and artificial neural networks.	1,2	1
CO2	Apply basic neural network models for classification and prediction tasks.	1,2,3	1,2
CO3	Illustrate deep learning architectures such as CNN and RNN.	1,2,4	1,2
CO4	Analyse deep learning model performance and optimization techniques.	1,2,4,5	1,2
CO5	Identify real-world applications and ethical issues related to deep learning systems.	6,7,8,9	1,2

COURSE CONTENT:

FUNDAMENTALS OF DEEP LEARNING

[9]

Introduction to deep learning; AI, machine learning, and deep learning; biological neuron and artificial neuron; perceptron model; activation functions; introduction to neural networks; applications of deep learning.

ARTIFICIAL NEURAL NETWORKS

[9]

Structure of neural networks; feedforward neural networks; multilayer perceptron; forward and backward propagation; loss functions; gradient descent; training and testing neural networks.

CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS

[9]

Introduction to Convolutional Neural Networks (CNN); image recognition basics; pooling and convolution operations; introduction to Recurrent Neural Networks (RNN); sequence data and time-series applications.

DEEP LEARNING OPTIMIZATION AND EVALUATION

[9]

Model evaluation metrics; overfitting and underfitting; dropout and regularization; hyperparameter tuning; optimization techniques; introduction to transfer learning and pretrained models.

APPLICATIONS OF DEEP LEARNING

[9]

Deep learning applications in healthcare, autonomous systems, speech recognition, natural language processing, computer vision, and smart industries; ethical issues in deep learning; fairness, privacy, and future trends.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.
- [2] Francois Chollet, Deep Learning with Python, Manning Publications.

REFERENCE BOOKS:

- [1] Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
- [2] Josh Patterson and Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Publications.

WEB REFERENCES:

- [1] "TensorFlow Tutorials," <https://www.tensorflow.org/tutorials>
- [2] "PyTorch Tutorials," <https://pytorch.org/tutorials>
- [3] "DeepLearning.AI," <https://www.deeplearning.ai>
- [4] "Keras Documentation," <https://keras.io>

25AI2E54	APPLICATIONS OF GENERATIVE AI	L	T	P	C
		3	0	0	3

Course Outcomes:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals and working principles of Generative AI models.	1,2	1
CO2	Apply generative AI tools for text, image, audio, and content generation tasks.	1,2,3	1,2
CO3	Illustrate the use of large language models and prompt engineering techniques.	1,2,4	1,2
CO4	Analyse Generative AI applications in various engineering and industrial domains.	1,2,4,5	1,2
CO5	Evaluate ethical, societal, and security issues related to Generative AI technologies.	6,7,8,9	1,2

COURSE CONTENT:

INTRODUCTION TO GENERATIVE AI

[9]

Introduction to Generative AI; AI versus Generative AI; evolution of generative models; fundamentals of transformers and large language models; applications of Generative AI; overview of popular Generative AI tools and platforms.

TEXT GENERATION AND PROMPT ENGINEERING

[9]

Text generation concepts; large language models; prompt engineering techniques; conversational AI; chatbots and virtual assistants; AI-assisted content creation; summarization and translation; code generation basics.

IMAGE, AUDIO AND VIDEO GENERATION

[9]

Image generation models; AI-based image editing; text-to-image generation; audio and speech synthesis; music generation basics; video generation concepts; deepfake technology and its implications.

GENERATIVE AI APPLICATIONS

[9]

Generative AI in healthcare, education, manufacturing, agriculture, finance, media, and software development; AI for design and creativity; recommendation systems; personalized learning and intelligent automation.

ETHICS, SECURITY AND FUTURE TRENDS

[9]

Ethical issues in Generative AI; bias and fairness; privacy and intellectual property concerns; misinformation and deepfakes; responsible AI practices; future trends and career opportunities in Generative AI.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] David Foster, Generative Deep Learning, O'Reilly Publications.
- [2] Bernard Marr, Generative AI in Practice, Wiley Publications.

REFERENCE BOOKS:

- [1] Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.
- [2] Russel Kaplan, Christopher D. Manning, and Noah Goodman, Generative AI: Foundations and Applications, Springer.

WEB REFERENCES:

- [1] "OpenAI Documentation," <https://platform.openai.com/docs>
- [2] "Google Generative AI Resources," <https://ai.google/discover/generativeai>
- [3] "Hugging Face Documentation," <https://huggingface.co/docs>
- [4] "DeepLearning.AI Generative AI Courses," <https://www.deeplearning.ai>

25AI2E55	AI TOOLS	L	T	P	C
		3	0	0	3

Course Outcomes:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals of AI tools and intelligent systems used in various applications.	1,2	1
CO2	Apply AI tools for data analysis, content generation, and automation tasks.	1,2,3	1,2
CO3	Illustrate the usage of machine learning and generative AI platforms for solving real-world problems.	1,2,4	1,2
CO4	Analyse AI-based applications in engineering, business, healthcare, and education.	1,2,4,5	1,2
CO5	Evaluate ethical, societal, and security issues related to AI tools and technologies.	6,7,8,9	1,2

COURSE CONTENT:

INTRODUCTION TO AI TOOLS

[9]

Introduction to Artificial Intelligence; AI tools and platforms; AI versus Machine Learning and Deep Learning; overview of intelligent systems; applications of AI in engineering, healthcare, education, agriculture, and business.

AI TOOLS FOR PRODUCTIVITY AND AUTOMATION

[9]

AI tools for document generation, presentation creation, coding assistance, automation, and communication; AI-powered chatbots and virtual assistants; AI-based search and recommendation systems; workflow automation concepts.

MACHINE LEARNING AND DATA ANALYTICS TOOLS

[9]

Introduction to machine learning tools; data pre-processing and visualization tools; no-code and low-code AI platforms; predictive analytics; dashboard and reporting tools; AI for decision making.

GENERATIVE AI TOOLS AND APPLICATIONS

[9]

Generative AI concepts; text generation tools; image and video generation tools; speech and audio synthesis; prompt engineering basics; applications of Generative AI in design, education, media, and software development.

ETHICS, SECURITY AND FUTURE TRENDS

[9]

Ethical issues in AI tools; bias and fairness; privacy and cybersecurity concerns; responsible AI practices; societal impact of AI; future trends and career opportunities in AI technologies.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Bernard Marr, Artificial Intelligence in Practice, Wiley Publications.
- [2] David Foster, Generative Deep Learning, O'Reilly Publications.

REFERENCE BOOKS:

- [1] Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.

[2] Ethem Alpaydin, Introduction to Machine Learning, MIT Press.

WEB REFERENCES:

[1] "OpenAI," <https://openai.com>

[2] "Google AI Resources," <https://ai.google>

[3] "Microsoft AI Learning," <https://learn.microsoft.com/ai>

[4] "Hugging Face Documentation," <https://huggingface.co/docs>

25EE2E51	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the architecture and working principles of electric and hybrid electric vehicles to compare their environmental and economic impacts.	1,2	1
CO2	Apply vehicle dynamics equations to determine effort, power and characteristics of EVs.	1,2	1
CO3	Analyze motor selection criteria and converter topologies for powertrain and charging applications in EVs.	1,2,4	1,2
CO4	Analyze battery characteristics, modelling and battery management systems for energy storage in EV applications.	1,2,4,5	1,2
CO5	Evaluate charging infrastructure standards and smart grid integration strategies, including V2G and AI-based vehicular electrification.	1,2,3,4	1,2,3

INTRODUCTION TO EV

[9]

History of EV – Major Components in EV and working – Introduction to HEV - Environmental impacts on EVs and HEVs – Social impacts on EVs and HEVs – Economic impacts on EVs and HEVs - Recent EVs and HEVs – efficiency comparison – pollution comparison – Government policies and Incentives – Pros and Cons of EV.

VEHICLE MECHANICS AND ELECTRICAL BRAKING

[9]

Laws Governing Vehicle Movement – Forces acting on Vehicle – Rolling Resistance force, Aerodynamic force, Hill climbing force, and acceleration force - Total Tractive Effort – Roadway Fundamentals – Propulsion Power – Force vs Velocity characteristics – Velocity vs Acceleration. Electrical Braking – Regenerative Braking, Dynamic Braking and Plugging.

MOTORS AND CONVERTERS FOR CHARGING

[9]

Motor Selection parameters - Induction Motor and Control for EVs – PMSM and Control for EVs - BLDC Motor and Control for EVs – Switched Reluctance Motor and Control for EVs. AC-DC converter with PFC for Charging - DC-DC converter with controls for Charging – RES integration for Charging – Wireless Charging.

ENERGY STORAGE SYSTEM AND MANAGEMENT SYSTEM FOR EVs

[9]

Battery Basics – Classifications - Ragone Plots - Battery Modelling – Battery Capacity - Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction and Working – Ultracapacitor working – ECU – Battery Management System – Thermal Management System.

CHARGING INFRASTRUCTURE AND ITS STANDARDS

[9]

Battery swapping - V2G - G2V- V2V - V2H - integration of EVs in smart grid – Role of AI in Vehicular Electrification – Policy Standards and Guidelines for EV - Policy Standards and Guidelines for EV charging station.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Iqbal Hussain, Electric and Hybrid Vehicles – Design fundamentals, 3rd ed., CRC press, 2023.
- [2] James D Halderman Curt Ward, Electric and Hybrid Electric Vehicles, 1st ed., Pearson Education Limited, 2023.

REFERENCE BOOKS:

- [1] Eshani M, Goa Y, Longo S, Ebrahimi K, Modern electric hybrid electric and fuel cell vehicles, CRC Press, 2018.
- [2] Tariq Muneer and Irene Illescas García, The automobile, In Electric Vehicles: Prospects and Challenges, Elsevier, 2017.
- [3] Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
- [4] Larminie, James, and John Lowry, Electric Vehicle Technology Explained John Wiley and Sons, 2012

WEB REFERENCES

- [1] "Fundamentals of Electric Vehicles: Technology and Economics,"
<https://nptel.ac.in/courses/108106170>
- [2] "Electric Vehicles - Part 1," https://onlinecourses.nptel.ac.in/noc22_ee53/preview
- [3] "Electric Vehicles," https://onlinecourses.swayam2.ac.in/ntr25_ed127/preview
- [4] "Electric Vehicles and Renewable Energy," https://onlinecourses.nptel.ac.in/noc21_ee112/preview
- [5] "Introduction to Electric and Hybrid Electric Vehicle,"
https://onlinecourses.swayam2.ac.in/nou24_ec10/preview
- [6] "EV - Vehicle Dynamics and Electric Motor Drives,"
https://onlinecourses.nptel.ac.in/noc25_ee33/preview

25EE2E52	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply the concepts of energy forms, sustainability and renewable energy policies to assess the global and Indian energy scenario.	1,2	1
CO2	Apply the working principles of solar PV and thermal systems to determine performance indicators and system sizing.	1,2	1
CO3	Analyze wind and small hydro energy conversion systems for site selection, grid integration and component configuration.	1,2,4	1,2
CO4	Analyze biomass and waste-to-energy technologies to evaluate their environmental benefits and operational limitations.	1,2,4,5	1,2
CO5	Evaluate geothermal, ocean, hydrogen and fuel cell technologies and assess their role in hybrid renewable energy systems.	1,2,3,4	1,2,3

RENEWABLE ENERGY

[9]

Energy forms, units and basic terminology (power, energy, efficiency, load profile). Environmental impact of fossil fuels, climate change, and air pollution. Need for renewable energy, sustainability concepts, UN SDGs. Overview of Indian and global energy mix; policies and targets for renewable energy.

SOLAR PV AND THERMAL SYSTEMS

[9]

Solar radiation, estimation of solar potential. Working principle of solar photovoltaic (PV) cells. PV system configurations: stand-alone, grid-connected, rooftop systems; components: modules, inverter, battery, charge controller. Performance indicators: I–V and P–V characteristics, capacity factor, energy yield, simple sizing ideas for small loads. Solar thermal concepts: flat-plate collectors, solar water heating, solar thermal power plants.

WIND AND SMALL HYDRO ENERGY

[9]

Wind resource, estimation of wind power potential. Basic working of horizontal-axis wind turbines: rotor, gearbox, generator, tower, and control. Types of wind farms, siting considerations (speed, terrain, environmental aspects). Grid integration issues: variability, forecasting, storage support. Mini/micro hydro: concept, classification of schemes, essential components (weir, penstock, turbine, generator) from a system-level view.

BIOMASS ENERGY

[9]

Biomass resources: agricultural residues, forest residues, organic wastes. Working principles: combustion, biogas (anaerobic digestion), gasification. Biomass cogeneration in sugar and agro-industries. Environmental benefits and limitations (emissions, land use, logistics). Municipal solid waste-to-energy options.

OTHER ENERGY SOURCES

[9]

Geothermal energy: basic concepts, direct use and power generation. Ocean energy: tidal, wave, and ocean thermal concepts. Hydrogen production and storage challenges. Fuel cells: working principle, types and applications. Energy storage (batteries, pumped hydro, other options) in renewable systems; hybrid systems (e.g., solar-wind-battery microgrids).

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Joshua Earnest, Tore Wizeliu, Wind Power Plants and Project Development, PHI Learning Pvt.Ltd, New Delhi, 2011.
- [2] D. P. Kothari, K. C. Singal, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning Pvt. Ltd, New Delhi, 2013.

REFERENCE BOOKS:

- [1] A .K. Mukerjee and Nivedita Thakur, Photovoltaic Systems: Analysis and Design, PHI Learning Private Limited, New Delhi, 2011
- [2] Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning Private Limited, New Delhi, 2011
- [3] Shobh Nath Singh, Non-conventional Energy Resources, Pearson Education, 2015.

WEB REFERENCES:

- [1] "Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems,"
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ch26

25CS2E51	INTRODUCTION TO AUGMENTED AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamentals, concepts, and technologies of Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR).	1,2	
CO2	Analyze hardware components, interaction techniques, and immersive environments used in AR/VR systems.	1,2,4	
CO3	Apply 3D modelling, visualization, and development tools for creating AR/VR applications.	1,2,3,5	
CO4	Develop simple AR/VR applications using modern frameworks and development platforms.	3,4,5	
CO5	Evaluate usability, ethical issues, and future trends in immersive technologies.	2,4	

FUNDAMENTALS OF AR AND VR

[9]

Introduction to AR, VR and MR – Evolution of immersive technologies – Reality-Virtuality Continuum – Components of AR/VR systems – Applications in education, healthcare, gaming, manufacturing and defence – Challenges and opportunities.

AR/VR HARDWARE AND INTERACTION

[9]

Display technologies – Head Mounted Displays (HMDs) – Sensors and tracking systems – Motion controllers – Input and interaction techniques – Gesture recognition – Spatial mapping – Human-computer interaction in immersive environments.

3D GRAPHICS AND VISUALIZATION

[9]

Fundamentals of 3D graphics – Coordinate systems – Geometric transformations – 3D modelling concepts – Rendering techniques – Animation – Lighting and shading – Visualization techniques for AR/VR applications.

AR/VR DEVELOPMENT PLATFORMS

[9]

Unity 3D fundamentals – Unreal Engine overview – ARCore and ARKit – Scene creation – Object interaction – User interface design – Marker-based and marker less AR – Mobile AR application development.

APPLICATIONS, ETHICS AND FUTURE TRENDS

[9]

Industrial and educational applications – Medical and healthcare applications – Metaverse concepts – Digital twins – User experience evaluation – Privacy and security concerns – Ethical considerations – Future trends in immersive computing.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Steven M. LaValle, Virtual Reality, Cambridge University Press, 2023.

REFERENCES:

[1] Dieter Schmalstieg and Tobias Hollerer, Augmented Reality: Principles and Practice, Addison-Wesley, 2016.

[2] Alan B. Craig, Understanding Augmented Reality, Morgan Kaufmann, 2018.

[3] Tony Parisi, Learning Virtual Reality, O'Reilly Media, 2019.

ONLINE RESOURCES

[1] Unity Technologies, "Unity Learn Portal," <https://learn.unity.com/>

[2] Epic Games, "Unreal Engine Documentation," <https://dev.epicgames.com/documentation/en-us/unreal-engine>

[3] Google, "ARCore Documentation," <https://developers.google.com/ar>

[4] Apple, "ARKit Documentation," <https://developer.apple.com/augmented-reality/>

25CS2E52	INTRODUCTION TO CYBERSECURITY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental principles of cybersecurity, information security, and cyber threats.	1,2	
CO2	Analyze common cyberattacks, vulnerabilities, and security risks in computing environments.	1,2,4	
CO3	Apply basic security mechanisms and cryptographic techniques to protect digital assets.	1,2,3,5	
CO4	Examine cybercrime, digital forensics, and incident response procedures in cybersecurity investigations.	3,4,5	
CO5	Evaluate ethical, legal, privacy, and emerging cybersecurity challenges in modern digital systems.	2,4	

FUNDAMENTALS OF CYBERSECURITY

[9]

Introduction to cybersecurity – Information security concepts – CIA triad – Security goals and principles – Threats, vulnerabilities and risks – Attack surface – Cybersecurity domains – Security policies and standards.

CYBER THREATS AND ATTACK TECHNIQUES

[9]

Malware types – Viruses, worms, ransomware and spyware – Phishing and social engineering – Password attacks – Denial of Service attacks – Web application attacks – Insider threats – Cyber kill chain.

SECURITY MECHANISMS AND CRYPTOGRAPHY

[9]

Authentication and authorization – Access control models – Fundamentals of cryptography – Symmetric and asymmetric encryption – Hashing and digital signatures – Public Key Infrastructure (PKI) – Secure communication protocols.

CYBERCRIME AND DIGITAL FORENSICS

[9]

Cybercrime classification – Cyber laws and regulations – Digital evidence – Evidence acquisition and preservation – Forensic investigation process – Incident response lifecycle – Cybercrime investigation case studies.

EMERGING CYBERSECURITY TRENDS

[9]

Cloud security – IoT security – Mobile security – Artificial Intelligence in cybersecurity – Zero Trust Architecture – Privacy and data protection – Ethical hacking concepts – Future trends and challenges.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] Charles J. Brooks, Christopher Grow, Philip Craig and Donald Short, Cybersecurity Essentials, Wiley, 2023.

REFERENCES:

- [1] William Stallings, Network Security Essentials, Pearson, 2022.
[2] Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2021.
[3] Joseph Migga Kizza, Guide to Computer Network Security, Springer, 2020.

ONLINE RESOURCES

- [1] NPTEL, "Cyber Security Courses," <https://nptel.ac.in/courses>
[2] OWASP Foundation, "OWASP Resources," <https://owasp.org/>
[3] Cybersecurity and Infrastructure Security Agency (CISA), "Cybersecurity Resources," <https://www.cisa.gov/topics/cybersecurity-best-practices>
[4] EC-Council, "Cybersecurity Learning Resources," <https://www.eccouncil.org/>

25EC2E51	NEXT-GEN COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

Cos	COURSE OUTCOMES	POs	PSO
CO1	Explain the evolution, fundamentals, and performance metrics of wireless communication systems.	1,2	-
CO2	Describe core technologies used in emerging and next-generation wireless communication systems.	1,2,3	3
CO3	Analyze and visualize wireless communication concepts using MATLAB simulations.	2,4,5	3
CO4	Identify applications, challenges, and future trends in wireless communication systems.	1,6,7,8	3
CO5	Describe next-generation network architectures and assess next-generation communication solutions for applications	1,2	3

FUNDAMENTALS OF WIRELESS COMMUNICATIONS

[15]

Multiple Access techniques – FDMA, TDMA, CDMA – Capacity calculations – Cellular concept
Frequency reuse – channel assignment– hand off– interference & system capacity – trunking & grade of service – Coverage and capacity improvement.

CORE TECHNOLOGIES IN EMERGING WIRELESS SYSTEMS

[15]

Vision of Beyond-5G wireless networks –frequency spectrum : millimetre-wave and Terahertz communications – fundamentals of multiple antenna systems – principles of Massive MIMO – role of Artificial Intelligence and Machine Learning in wireless networks – fundamentals of Internet of Things (IoT) – overview of satellite communication systems.

PERFORMANCE AND FUTURE TRENDS IN WIRELESS COMMUNICATION

[15]

Modern and next-generation wireless communication systems – service requirements and performance characteristics of enhanced mobile broadband, ultra-reliable low-latency communications and massive machine- security and privacy issues in wireless communication systems MATLAB Visualization: Cell coverage visualization – throughput versus reliability analysis – network load versus delay characteristics.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Erik Dahlman, Stefan Parkvall and Johan Skold, 5G NR: The Next Generation Wireless Access Technology, 3rd ed., Academic Press (Elsevier), 2023.
- [2] Andrea Goldsmith, Wireless Communications, 2nd ed., Cambridge University Press, 2020.

REFERENCE BOOKS:

- [1] T. S. Rappaport et al., Wireless Communications: Principles and Practice, 3rd ed., Pearson Education, 2021.
- [2] Afif Osseiran, Jose F. Monserrat and Patrick Marsch, 5G Mobile and Wireless Communications Technology, 2nd ed., Cambridge University Press, 2021.

- [3] Mikko Valkama, Antti Tölö and Markku Juntti, Fundamentals of 5G Mobile Networks, Wiley, 1st ed., 2022.
- [4] William Stallings, Wireless Communications and Networks, Pearson Education, 2nd ed., 2020.

WEB REFERENCES

- [1] “Connecting the world and beyond ,”<https://www.itu.int>
- [2] “Communication Networks ,”<https://nptel.ac.in/courses/117105148>

25EC2E52	VISUAL INTELLIGENCE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will have an ability to

COs	COURSE OUTCOMES	POs	PSO
CO1	Explain the concepts of machine vision, image fundamentals and the related image processing operations.	1	-
CO2	Apply various Image processing and Computer vision algorithms to solve real time problems	1,2	2
CO3	Analyze the importance of various image pre-processing algorithms to determine their suitability for specific tasks.	1,2,3	2
CO4	Analyze the image processing operations using spatial and frequency domain techniques for a given problem.	2,6,11	1
CO5	Apply machine learning models in conjunction with image processing techniques to enhance performance.	1,2	1

INTRODUCTION

[12]

Machine vision - Differences between machine vision and computer vision - Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images - Relationships Between Pixels (Neighbours and Connectivity), Introduction to Fourier Transform - 1-D and 2-D DFT and its inverse transform

Colour image processing: Colour Fundamentals, Colour Models.

IMAGE ENHANCEMENT

[12]

Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Frequency Domain: Image Smoothing and Image Sharpening using Frequency Domain Filters.

IMAGE RESTORATION AND SEGMENTATION

[12]

A Model of Image degradation/Restoration process - Noise models – Restoration in the presence of Noise (Spatial Filtering Only)

Segmentation: Detection of Discontinuities (Point, Line and Edge detection) – Thresholding and Region based Segmentation

APPLICATIONS

[9]

Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing, Industrial automation, Agriculture, Artificial Intelligence & Smart Systems, Typical computer vision system - OpenCV (Open Source Computer Vision Library)

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOKS:

- [1] Rafael C. Gonzales and Richard E. Woods, *Digital Image Processing*, 4th ed., Pearson Education, 2018.
- [2] Anil K Jain. *Fundamentals of Digital Image Processing*, PHI Learning Pvt. Ltd., 1st ed. ,2011.

REFERENCE BOOKS:

- [1] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, *Digital Image Processing Using MATLAB*, Tata McGraw Hill Pvt. Ltd., 3rd ed., 2011.
- [2] Willlliam K Pratt, *Digital Image Processing*, John Willey, 1st ed. , 2010.
- [3] Malay K. Pakhira, *Digital Image Processing and Pattern Recognition*, PHI Learning Pvt. Ltd., 1st ed., 2011.
- [4] John C.Russ, *The Image Processing Handbook*, 6th ed., CRC Press, 2011.

WEB REFERENCES

- [1] “Digital image processing ,”“<https://nptel.ac.in/courses/117105135>
- [2] “Digital Image Processing ,”https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee116

25IT2E51	PRINCIPLES OF UNIVERSAL ACCEPTANCE	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the fundamental need for Unicode over legacy encoding schemes.	1	-
CO2	Describe the purpose, limitations, and evolution of IDNA standards.	1,2	-
CO3	Apply Unicode normalization forms, string comparison techniques, and libraries to process and compare Unicode strings across different scripts and platforms..	1, 2, 3	-
CO4	Interpret the technical requirements for Email Address Internationalization.	1, 2	-
CO5	Implement Unicode, IDN, and EAI support in mobile applications using relevant libraries and development frameworks.	1, 2, 3	-

UNICODE

[9]

Introduction to encoding schemes – Need for Unicode - Character data type for Unicode code points - Unicode code charts - Processing Unicode Strings - Store Unicode data - The character-glyph model - difference between processing textual information and displaying text - Displaying text - use of text engines, fonts, glyph shapers

UNICODE OPERATIONS

[9]

Normalization of Unicode strings - NFC and NFD - Comparing Unicode strings - bidirectional and shaped scripts: Display format, File storage in key-press order, Glyph Shapers - Unicode libraries - ICU and others.

INTERNATIONALIZED DOMAIN NAMES (IDNS)

[9]

Introducing the root zone: TLD, gTLD, ccTLD – Need for IDNs - Unicode-based domain names: U-label - Need for A-labels - Punycode algorithm (RFC 3492) - IDNA2003 and its limitations - IDNA2008 - Limitations of protocols on IDNs: FTP, HTTP, HTTPS - Pitfalls of Using the IDNA2003 Library: Avoiding IDNA2003 libraries - Limitations of IDNA2008.

EMAIL ADDRESS INTERNATIONALIZATION (EAI)

[9]

Need for EAI - Storing EAI mail - Email protocol changes for EAI - SMTP - signaling flag - POP/IMAP - EAI and Mail message formats - EAI and MIME standard - Adoption challenges - Technical Compatibility Issues – Technical Solutions - Email and Anti-spam measures - EAI and cross-cultural email communication skills - Email address parsing for internationalized email addresses - Considerations for setting up email mailbox names.

IDN MOBILE APPS, SECURITY AND SUPPORT

[9]

Unicode Character set support - Unicode Text layout and rendering - Unicode Support in Mobile Apps Development Frameworks - iconv/ICU Converter APIs - Processing IDNs on mobile devices - relevant libraries - Processing EAI on mobile devices - relevant libraries.

Total Notional Hours: 90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Jukka K Korpela. Unicode Explained: Internationalize Documents, Programs, and Web Sites. O'Reilly Media, 2006.

REFERENCE BOOKS:

[1] Richard Gillam. Unicode Demystified: A Practical Programmer's Guide to the Encoding Standard. Addison Wesley, 2002.

[2] The Unicode® Standard Version 17.0 – Core Specification. Unicode Consortium, 2025.

WEB REFERENCES:

[1] "ICANN Universal Acceptance," <https://www.icann.org/ua>

[2] "Unicode," <https://home.unicode.org/>

25IT2E52	DIGITAL PRIVACY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Explain the core concepts of data governance, simple privacy approaches, and differential privacy.	1	-
CO2	Describe the legal frameworks governing data privacy and their implications for internal policies, contracts, and privacy risk management.	6	-
CO3	Build privacy-aware data pipelines by integrating differential privacy libraries, anonymization techniques, and data governance controls.	1,2,3,4	-
CO4	Implement privacy-preserving machine learning (PPML) using open-source libraries, and design federated learning architectures.	1,2,3	-
CO5	Apply encrypted computation techniques to real-world privacy scenarios	1,2,3,4	-

Data Governance, Simple Privacy Approaches and Anonymization

[9]

Data Governance – Identifying Sensitive Data – Identifying PII – Documenting Data for Use – Basic Data Documentation – Finding and Documenting Unknown Data – Tracking data Lineage – Data Version Control – Pseudonymization for Privacy by Design - Anonymization – Differential Privacy – Privacy Loss – Understanding differential privacy – Laplace Mechanism – Gaussian Noise for Differential Privacy – Sensitivity and Privacy Units – k-Anonymity.

Privacy in Data Pipelines and Privacy Attacks

[9]

Building Privacy into Data Pipelines – Engineering Privacy and Data Governance into Pipelines – Using Differential Privacy Libraries in Pipelines – Collecting Data Anonymously - Privacy Attacks: Analyzing Common Attack Vectors – Data Security – Probabilistic Reasoning about Attacks – Data Security Mitigations.

Privacy-aware Machine Learning and Federated Learning

[9]

Using Privacy-preserving techniques in Machine Learning – Open-Source Libraries for PPML – Architecting Privacy in Data and Machine Learning Projects - Distributed Data – Federated Learning – Architecting Federated Systems – Open Source Federated libraries.

Encrypted Computation

[9]

Encrypted Computation – Privacy versus Secrecy – Threat Modeling – Secure Multiparty Computation – Homomorphic Encryption – Private Set Intersection – Private Join and Compute – Secure Aggregation – Encrypted Machine Learning – PSI and Moose.

Legal Side of Privacy and Practicality

[9]

GDPR – CCPA – DPDP Act, 2023 – HIPAA – LGPD – PIPL – Internal Policies and Contracts – Data Governance 2.0 – Managing Privacy and Security Risk – Practical Privacy Technology: Use Case – Integrating and Automating Privacy in ML.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

[1] Katharine Jarmul. Practical Data Privacy. O’Reilly Publishers, 2023.

REFERENCE BOOKS:

[1] Sanjay Sharma. Data Privacy and GDPR Handbook. Wiley, 2019.
 [2] Nishant Bhajaria. Data Privacy. Manning Publishers, 2022.

WEB REFERENCES:

[1] "The Digital Personal Data Protection Act, 2023,"
<https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf>

25IT2E53	DATA SCIENCE AND AI FOUNDATION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

At the end of the course, students will have the ability to:

COs	COURSE OUTCOMES	PO	PSO
CO1	Apply Python programming fundamentals for data science tasks.	1,2	-
CO2	Apply Python data structures and NumPy array operations to organize and manipulate data efficiently.	1,2,3	-
CO3	Apply Pandas for data handling, and perform data cleaning, preprocessing and exploratory data analysis (EDA) using statistical and descriptive techniques.	1,2,3,5	-
CO4	Design data visualizations and dashboards using Matplotlib and Seaborn to communicate insights drawn from data.	1,2,3,10	-
CO5	Apply supervised learning and unsupervised learning techniques to build machine learning models.	1,2,3,5	-
CO6	Develop an end-to-end data science mini project using Generative AI.	3,5,9,10,11	

Foundations of Data Science and Python Programming

[12]

Introduction to Data Science & AI: data science lifecycle, AI vs ML vs DL, applications.

Python fundamentals for data science: variables, data types, operators, input/output.

Control statements and functions: conditional statements, loops, functions.

Python data structures: lists, tuples, sets, dictionaries.

Activities/Lab: Case study discussion on real-world AI applications; Python programming exercises; develop Python programs using functions; data manipulation exercises.

Data Handling, Analysis and Visualization

[15]

NumPy fundamentals: arrays, array operations, indexing, slicing.

Pandas basics: Series, DataFrames, importing and exporting datasets.

Data cleaning and preprocessing: missing values, duplicates, data transformation.

Exploratory Data Analysis (EDA): statistical analysis, descriptive statistics.

Data visualization: Matplotlib, Seaborn, charts and graphs.

Activities/Lab: Hands-on with NumPy arrays; load and explore datasets; clean a real-world dataset; EDA on a student performance dataset; create visualizations and dashboards.

Machine Learning and Generative AI

[18]

Introduction to Machine Learning: types of ML, workflow, model building process.

Supervised learning: regression and classification concepts.

Classification models: Decision Tree, K-Nearest Neighbours (KNN), Naïve Bayes.

Unsupervised learning: clustering, K-Means, dimensionality reduction.

Introduction to Generative AI: Large Language Models (LLMs), prompt engineering, AI tools.

Mini project and assessment: end-to-end data science project.

Activities/Lab: Build first ML model using Scikit-Learn; linear regression implementation; classification model development; customer segmentation project; prompt engineering exercises; project presentation and final evaluation.

Total Notional Hours:90

L	T	P	TW+SL	C
45	0	0	45	3

TEXT BOOK:

- [1] W. McKinney, Python for Data Analysis, 3rd ed., O'Reilly Media, 2022.
- [2] J. VanderPlas, Python Data Science Handbook, 2nd ed., O'Reilly Media, 2023.
- [3] A. Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd ed., O'Reilly Media, 2022.

REFERENCE BOOKS:

- [1] T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning, 2nd ed., Springer, 2009.

WEB REFERENCES:

- [1] "NumPy Documentation," <https://numpy.org/doc/>
- [1] "Pandas Documentation," <https://pandas.pydata.org/docs/>
- [1] "Scikit-learn Documentation," <https://scikit-learn.org/stable/>
- [1] "IBM SkillsBuild," <https://skillsbuild.org>