JNIESTR TRUST'S
SMT. INDIRA GANDHI COLLEGE OF ENGINEERING
An Autonomous Institute with NAAC 'A' Grade
Approved by AICTE, Affiliated to the University of Mumbai

DEPARTMENT OF COMPUTER ENGINEERING

Department of Computer Engineering

CURRICULUM AND SYLLABI

EXIT DEGREE	B.TECH (CSE IOTCSBT)
CURRICULUM STRUCTURE:	For All Semester
DETAILED SYLLABI:	For SEM III, SEM IV
BATCH:	2025-2028
WITH EFFECT FROM:	AY 2026-27
VERSION:	SIGCE-NEP-R25-Y2

Board of Studies Approval Date:	15 May 2026
Academic Council Approval Date:	30 June 2026

Dr. K. T. Patil	**Dr. V. P. Patil**	**Dr. Sunil Chavan**
HOD (Comp. Engg.)	**Dean (Academics)**	**Principal**

Document Control

a. Document History

Ver.	Effective Date	Compiled By	Approved by	Description
0.0	8 May 2026	NEP Cell	AC	Initial Version and template and Curriculum Structure (Version SIGCE-NEP-R25-Y2 – III and IV Sem 2026-27)
1.0	15 May 2026	BoS	AC and GB	Detailed Syllabus (Version SIGCE-NEP-R25-Y2 – III and IV Sem 2026-27)

b. Document Approvals

i) The latest version is :- **Version 1.0 (SIGCE-NEP-R25-Y2)**

ii) COMPILED by :- **NEP Cell and BOS**

iii) APPROVED by :-
a) **BOS** in its meeting held on 15th May 2026
b) **Academic Council** in its meeting held on 30 June 2026
c) **Governing Body** in its meeting held on ----

Dr. Sunil Chavan
Member Secretary
Governing Body / CDC

Table of Contents

Chapter 1: Preamble

Ensuring excellence in engineering education in alignment with the National Education Policy (NEP) 2020 requires continuous emphasis on academic quality, innovation, flexibility, and outcome-based learning. In the era of rapid technological transformation and evolving industry expectations, engineering education must bridge the gap between theoretical knowledge and practical application while nurturing socially responsible and ethically grounded professionals.

Smt. Indira Gandhi College of Engineering, through its autonomous curriculum framework, is committed to developing competent, innovative, and industry-ready engineers capable of contributing effectively to society and technological advancement. The curriculum has been designed in accordance with the guidelines of NEP 2020 and relevant directives of the Directorate of Technical Education (DTE), ensuring a learner-centric, multidisciplinary, and holistic educational experience.

The syllabus framework is developed with a strong focus on flexibility, experiential learning, skill enhancement, and outcome-based education. The curriculum aims to transform learners from passive recipients of knowledge into creative thinkers, problem solvers, and placement-ready professionals. It emphasizes the development of scientific temper, analytical ability, communication skills, vocational competencies, and ethical values among students.

To address current and future industry requirements, the curriculum integrates vocational and skill-based learning through courses such as programming practices, workshops, placement-oriented training, community engagement, and co-curricular activities. Open elective courses and choice-based topic pools provide students with opportunities to explore interdisciplinary domains and pursue their individual interests aligned with emerging technological trends.

In accordance with NEP 2020, the curriculum adopts a learner-centric credit framework where credits are assigned based on the total learning effort rather than only classroom teaching hours. The teaching-learning process is structured over a 15-week semester model, wherein the syllabus delivery is completed within 12–13 weeks, allowing the remaining period for tutorials, self-learning, review sessions, guest lectures, project-based learning, and topics beyond the syllabus.

The curriculum also incorporates Universal Human Values (UHV), Indian Knowledge System (IKS), Environmental Science, and Professional Communication to nurture ethical responsibility,

sustainability awareness, leadership qualities, and social sensitivity among learners. Clearly defined Course Objectives (COs) and Course Outcomes (COs) ensure uniformity in academic delivery and facilitate effective attainment of Program Outcomes.

The overall curriculum framework is designed to provide a balanced blend of fundamental sciences, core engineering principles, emerging technologies, vocational skills, liberal learning, and professional development. It promotes multidisciplinary exposure and supports academic mobility through multiple entry and exit provisions as envisioned in NEP 2020.

The curriculum structure enables students to acquire industry-relevant competencies at different stages of their academic journey through modular learning pathways. The inclusion of core courses, professional electives, open electives, vocational skill enhancement courses, community engagement projects, and placement-oriented courses ensures holistic development of learners.

Special emphasis has been placed on practical learning, innovation, entrepreneurship, research orientation, and employability enhancement. The curriculum is designed to support evolving domains such as IoT, Cybersecurity, Blockchain, Artificial Intelligence, and other emerging technologies while simultaneously strengthening the learners' foundational engineering knowledge.

The Second Year Engineering curriculum has been carefully designed to support students in their transition from foundational studies to discipline-specific engineering education. Recognizing the academic and psychological adjustment required at this stage, the curriculum strategically reduces excessive syllabus burden and credit load while maintaining academic rigor and quality.

The curriculum provides opportunities for students to strengthen their core technical knowledge along with vocational, computational, communication, and professional skills. Through open electives, co-curricular courses, placement-oriented training, and skill enhancement modules, students are encouraged to develop creativity, innovation, and practical problem-solving abilities.

The curriculum framework for Second Year Engineering for the academic year 2026–27 has been structured to align with the autonomous academic model and NEP 2020 guidelines. This framework will subsequently be extended to Third Year Engineering in the academic year 2027–28 and Final Year Engineering in the academic year 2028–29, ensuring a smooth and progressive implementation of the autonomous curriculum structure across all years of engineering education.

Chapter 2
Vision, Mission and Outcomes

2.1 Vision and Mission of SIGCE

Vision

- To serve and have a transformative impact on society by constantly pursuing excellence in technical education, innovation, and entrepreneurship for human development with strong ethical values.

Mission

- Serve and help transform society by graduating talented, broadly educated engineers, equipped with state of art technology resources for developing sustainable solutions.
- Academic excellence in Science, Engineering and Technology through dedication to duty, commitment to research, innovation in learning and faith in human values.
- Cultivate the spirit of entrepreneurship and the connection between academia and industry that fosters problem solving through collaboration
- Enable the students to develop into outstanding professionals with high ethical standards capable of creating, developing, and managing global engineering enterprises.

2.2 Vision and Mission of the Department

Vision of the Department

- To be recognized in the industry and society as an excellent centre of education in computer engineering.

Mission of the Department

- To provide an encouraging environment for teaching learning process
- To empower Computer Engineering knowledge of the students to meet the needs of industry and society.
- To build overall personality of the students through technical, social and holistic activities.

2.3 Program Education Outcomes

1. **PEO1:** Successful Career: Graduate will analyze the requirements of the problem in computer engineering, understand the technical feasibility, design and provide efficient solutions with ethical values.
2. **PEO2:** Lifelong learning: Graduate will engage in lifelong learning by doing higher studies and adapt for ever changing industrial and social demands.
3. **PEO3:** Social Awareness: To train the graduates for career and work through ethical and social concern.

a. Program Outcomes

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, making effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

a. Program Specific Outcomes

1. **PSO1:** To apply the principles of mathematics, data structure and algorithm to solve the problem.
2. **PSO2:** To understand the functionality of hardware and software computer system and its applications.

b. Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline. engineering

WK3: A systematic, theory-based formulation of fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Chapter 3
Curriculum Structure and Scheme

3.1 Nomenclature of the Course Categories

Abbreviation	Course Category	Description
BSES	Basic Science and Engineering Sciences	Consist of Basic Science (BS) and Engineering Sciences (ES) which serves as foundation of Engineering
PRC	Program Related Courses	Consists of: **Program Core** (the primary, in-depth subject of study which ensures foundational knowledge and expertise in a chosen discipline. **Program Elective** (an optional course a student chooses that directly aligns with, supports, or deepens their specific field of study or major)
MDM	Multi-Disciplinary Minor	A structured, secondary area of study taken alongside a student's primary major to gain foundational knowledge in a different field. It fosters interdisciplinary expertise, employability, and holistic skill sets.
OE	Open Elective	Institute level course chosen from outside a student's main department or discipline
SEC	Skill Enhancement Courses	A specialized, practical training program designed to provide students with industry-relevant skills, value-based knowledge, and hands-on experience, aimed at increasing employability
HSSM	Humanities, Social Sciences, and Management	Academic disciplines focused on understanding human culture, behaviour, society, and organizational leadership. They foster critical thinking, communication, and ethical perspectives.
CC (LLC)	Co-Curricular Courses (Liberal Learning Courses)	Structured educational experiences that take place outside the traditional classroom but are intentionally designed to complement, supplement, and enhance the academic curriculum

3.2 Credit Distribution Structure

Broad Category Code	Course Catg. Code	Semester→ Course Type	1	2	3	4	5	6	7	8	Sub-Total	Tot	%
BSES	BS	Basic Science	07	07	03	03					20	**29**	**18.13**
	ES	Engineering Science	06	03							09		
PRC (Program Related Courses)	PC	Program Core		03	11	11	08	08	04		45	**80**	**50**
	PE	Program Elective					04	03	06		13		
	RM	Research Methodology							02		02		
	CP	Community Engagement							02		02		
	PR	Project				01	01	02	02		06		
	IN	Internship / OJT								12	12		
MDM + OE	MM	Multidisciplinary Minor					03	03	04	04	14	**22**	**13.75**
	OE	Open Elective			02	02	02	02			08		
SEC (Skill Enhance-ment Courses)	VS	Voc. and Skill Enhancement	02	04	02	03		01			12	**22**	**13.75**
	AE	Ability Enhancement	02		01		01				04		
	IK	Indian Knowledge System		02							02		
	VE	Value Education	02	02							04		
HSSM	EM	Entrepreneurship / Mgmt.			02	02					04	**04**	**2.50**
CC (LLC)	CC	Co-Curricular	02		01						03	**03**	**1.87**
Total			21	21	22	22	19	19	20	16	160	**160**	**100**

3.3 Components of Curriculum

Curriculum Component	Curriculum Content %	Total number of contact hours	Total number of credits
Basic Science	12.5	6,00	20
Engineering Science	5.63	270	09
Program Core	28.13	1,350	45
Program Elective	8.13	390	13
Research Methodology	1.25	60	02
Community Engagement	1.25	60	02
Project	3.75	180	06

Internship / OJT	7.5	360	12
Multidisciplinary Minor	8.75	420	14
Open Elective	5	240	08
Voc. and Skill Enhancement	6.25	360	12
Ability Enhancement	2.5	120	04
Indian Knowledge System	1.25	60	02
Value Education	2.5	120	04
Entrepreneurship / Mgmt.	2.5	120	04
Co-Curricular	1.88	90	03
Any other (Please specify)	-	-	
Total	**100**	**4800**	**160**

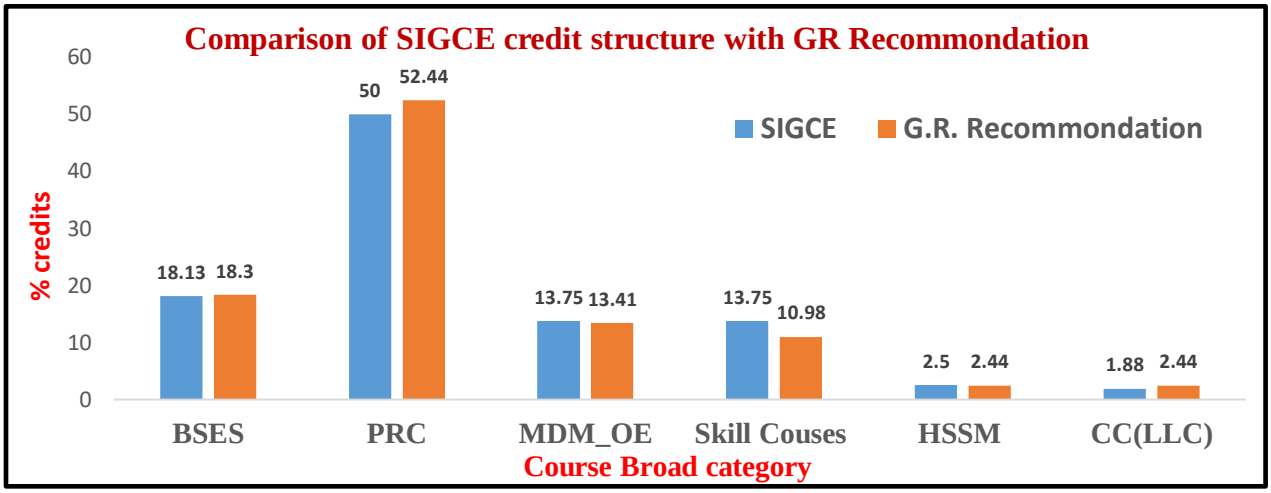
3.4 Course Codes – Letter Placement and Meaning

COURSE CODES - LETTER PLACEMENT						
1	2	3	4	5	6	7
Department / Program Name		**Course Category Code**		**Course Level ***	**Course Number****	
AD - AI and Data Science **AS -** Applied Science & Humanities **CA -** CSE-AIML **CE -** Computer Engg. **CI -** CSE-IOTCSBT **EE -** Electrical Engg **IG** - SIGCE (Institute Level) **ME** - Mechanical Engg		**AE** - Ability Enhancement **BS -** Basics Sciences **CC -** Cocurricular Course **CP** - Community Engaged Project **EM** - Entrepreneurship/Economics/ Management **ES -** Engineering Sciences **HS** - Humanities Social Sciences **IK -** Indian Knowledge System **IN -** Internship/On job Training **MM -** Multi-Disciplinary Minor **OE -** Open Elective **PC -** Program Core **PE -** Program Elective **PR -** Project **RM -** Research Methodology **VE –** Value Education **VS -** Vocational and skill enhancement course		**0** - Pre-requisite **1** - Foundation **2** - Intermediate **3** - Higher-level **4** - Advanced	**0**	**1**

**** Course Level :*** *Please refer NEP GR to determine the levels*

***** Course Number:*** *Sequence number of course in that Course Category offered by a specific department*

3.5 Comparison of SIGCE credit structure with the G.R recommendation



3.6 Semester wise allocation of credits

Semester III

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme (Hrs)						Credit Assigned			
				CR		Lab							
				L	T	P	D	SL	TE	L	T	P/D	TC
CEBS231	BS	Discrete Structure and Graph Theory	Compulsory	3	-	-	-	3	**6**	3	-	-	**3**
CEPC231	PC	Analysis of Algorithm	Compulsory	3	-	2	-	3	**8**	3	-	1	**4**
CEPC232	PC	Computer System Design	Compulsory	2	-	2	-	2	**6**	2	-	1	**3**
CEPC233	PC	Operating System	Compulsory	3	-	2	-	3	**8**	3	-	1	**4**
IGOE23x	OE	Open Elective	Choice Based*	2	-	-	-	2	**4**	2	-	-	**2**
CEVS231	VS	Advanced Java	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
IGAE231	AE	Comprehensive Soft Skill and Professional Development	Compulsory	-	-	-	2	-	**2**	-	-	1	**1**
IGEM231	EM	Entrepreneurship and Business Model Development	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
IGCC23x	CC	Cocurricular Course	Choice Based*	-	-	2	-	-	**2**	-	-	1	**1**
TOTAL				**13**	**-**	**12**	**6**	**13**	**44**	**13**	**-**	**9**	**22**

**Students will have to do one course from the Basket. Refer to Indicative Open Elective and Indicative Cocurricular Course in Chapter 4.*

Semester IV

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme (Hrs)						Credit Assigned			
				CR		Lab							
				L	T	P	D	SL	TE	L	T	P/D	TC
CEBS241	BS	Mathematics for Computer Engineering	Compulsory	2	1	-	-	3	**6**	2	1	-	**3**
CEPC241	PC	Computational Theory	Compulsory	3	-	-	-	3	**6**	3	-	-	**3**
CEPC242	PC	Database Management System	Compulsory	3	-	2	-	3	**8**	3	-	1	**4**
CEPC243	PC	Computer Networks	Compulsory	3	-	2	-	3	**8**	3	-	1	**4**
IGOE24x	OE	Open Elective	Choice Based*	2	-	-	-	-	**2**	2	-	-	**2**
IGVS241	VS	AI Tools	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
IGVS241	VS	Basic Technical Training	Compulsory	-	-	-	2	-	**2**	-	-	1	**1**
IGEM241	EM	Design Thinking	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
CEPR241	PR	Mini Project-I	Compulsory	-	-	2	-	-	**2**	-	-	1	**1**
TOTAL				**13**	**1**	**10**	**6**	**12**	**42**	**13**	**1**	**8**	**22**

**Students will have to do one course from the Basket. Refer to Indicative Open Elective and Indicative Cocurricular Course in Chapter 4.*

3.7 Program Examination Scheme

Semester III

Course Code	Category	Course Name	Course Choice	Evaluation Scheme (Marks)										Evaluation Scheme (%)							
				Theory						LAB			TH+LAB	Theory					LAB		
				IA1	IA2	FA	ESE	Tot	ESE Hrs	CIE	ESE	Tot	GT	IA1	IA2	FA	ESE	Total	CIE	ESE	Total
CEBS231	BS	Discrete Structure and Graph Theory	Compulsory	15	15	10	60	100	2.5	-	-	-	100	15	15	10	60	100	-	-	-
CEPC231	PC	Analysis of Algorithm	Compulsory	15	15	10	60	100	2.5	25	25	50	150	15	15	10	60	100	50	50	100
CEPC232	PC	Computer System Design	Compulsory	15	15	10	60	100	2.5	25	-	25	125	15	15	10	60	100	100	-	100
CEPC233	PC	Operating System	Compulsory	15	15	10	60	100	2.5	25	25	50	150	15	15	10	60	100	50	50	100
IGOE23x	OE	Open Elective	Choice – Based	15	15	10	60	100	2.5	-	-	-	100	15	15	10	60	100	-	-	-
CEVS231	VS	Advanced Java	Compulsory	-	-	-	-	-	-	50	25	75	75	-	-	-	-	-	50	50	100
IGAE231	AE	Comprehensive Soft Skill and Proff. Development	Compulsory	-	-	-	-	-	-	25	-	25	25	-	-	-	-	-	100		100
IGEM231	EM	Entrepreneurship and Business Model Development	Compulsory	-	-	-	-	-	-	50	-	50	50	-	-	-	-	-	100	-	100
IGCC231	CC	Cocurricular Course	Choice – Based	-	-	-	-	-	-	25	-	25	25	-	-	-	-	-	100		100
TOTAL				75	75	50	300	500		225	75	300	800								

Semester IV

Course Code	Category	Course Name	Course Choice	Evaluation Scheme (Marks)										Evaluation Scheme (%)							
				Theory						LAB			TH+ LAB	Theory					LAB		
				IA1	IA2	FA	ESE	Tot	ESE Hrs	CIE	ESE	Tot	GT	IA1	IA2	FA	ESE	Total	CIE	ESE	Total
CEBS241	BS	Mathematics for Computer Engineering	Compulsory	15	15	10	60	100	2.5	25	-	25	125	15	15	10	60	100	100	-	100
CEPC241	PC	Computational Theory	Compulsory	15	15	10	60	100	2.5	-	-	-	100	15	15	10	60	100	-	-	-
CEPC242	PC	Database Management System	Compulsory	15	15	10	60	100	2.5	25	25	50	150	15	15	10	60	100	50	50	100
CEPC243	PC	Computer Networks	Compulsory	15	15	10	60	100	2.5	25	25	50	150	15	15	10	60	100	50	50	100
IGOE24x	OE	OPEN ELECTIVE	Choice – Based	15	15	10	60	100	2.5	-	-	-	100	15	15	10	60	100	-	-	-
IGVS241	VS	AI Tools	Compulsory	-	-	-	-	-	-	25	25	50	50	-	-	-	-	-	50	50	100
IGVS241	VS	Engg. Fundamentals and Tech Skills	Compulsory	-	-	-	-	-	-	25	-	25	25	-	-	-	-	-	100	-	100
IGEM241	EM	Design Thinking	Compulsory	-	-	-	-	-	-	50	-	50	50	-	-	-	-	-	100	-	100
CEPR241	PR	Mini Project-I	Compulsory	-	-	-	-	-	-	25	25	50	50	-	-	-	-	-	50	50	100
Total				75	75	50	300	500		200	100	300	800								

3.8 Assessment Instruments and Methods

At SIGCE, alignment with NEP 2020 and targeting Outcome based education, assessment instruments and methods go beyond traditional written examination.

Assessment instruments and methods and evaluation mechanism should be multi-dimensional and should measure leanings of students through various ways as all students may not demonstrate their learning if only limited instruments and methods are used. Faculty members are encouraged to use various combination of Instruments, Methods and Evaluation and just not rely on traditional tools. Following section list some "suggested" Assessment instruments, methods and mechanism. However, teachers are encouraged to be creative in using different assessment instruments and methods to evaluate learners.

Assessment Instruments

Assessment Instruments define "what evidence-producing task has been given to student to evaluate his/her learning. Following is the indicative list of Assessment Instruments.

SN	ASSESSMENT INSTRUMENTS	Description
1	Paper – Pen/Pencil	Students are assessed through written examinations, tests, assignments, numerical problems, or analytical exercises. It evaluates conceptual understanding, problem-solving ability, application of knowledge, and written communication skills
2	Quiz	Short, focused assessments conducted in oral, written, or digital mode to evaluate understanding of specific concepts and topics. Quizzes provide timely feedback and support continuous monitoring of student learning.
3	Case Studies	Students analyze real-world or simulated situations to identify problems, evaluate alternatives, and propose justified solutions. It assesses analytical thinking, decision-making, application of interdisciplinary knowledge, and professional judgement
4	Presentation	Students communicate technical, conceptual, or project-based content through structured oral and visual presentations. It evaluates subject understanding, communication skills, logical organization, confidence, and ability to respond to questions.
5	Attendance	Student participation is assessed based on regularity, punctuality, and consistent engagement in scheduled academic activities. It reflects continuity in the learning process; however, its weightage should be governed by institutional academic regulations.

6	Portfolio / e-Portfolio	A systematic collection of student work demonstrating learning progress, achievements, competencies, and reflections over a defined period. It enables longitudinal assessment of knowledge, skills, creativity, and continuous improvement.
7	Teachers Observation	Faculty systematically observe student performance, participation, practical skills, teamwork, professional behaviour, and learning engagement. Assessment should be based on predefined criteria, checklists, rating scales, or rubrics to ensure objectivity.
8	e-Parikshak	A technology-enabled assessment instrument used for conducting, evaluating, and analyzing student performance through digital platforms for programing (coding) subjects.
9	Mini Project	Students undertake a limited-scope project to apply theoretical knowledge to a defined engineering or interdisciplinary problem. It assesses problem identification, design thinking, technical implementation, teamwork, documentation, and presentation skills.
10	Major Project	Students undertake a comprehensive project involving problem formulation, design, development, experimentation, analysis, and validation. It assesses integration of disciplinary knowledge, innovation, project management, teamwork, ethics, and professional competence.
11	Field Project	Students engage with real-world environments, industries, communities, or field settings to investigate and address practical problems. It evaluates experiential learning, observation, data collection, contextual analysis, stakeholder interaction, and solution development.
12	Dissertation / Report	Students prepare a structured academic or technical document presenting objectives, methodology, analysis, findings, conclusions, and recommendations. It assesses depth of study, research ability, technical writing, critical analysis, and adherence to academic integrity.
13	Oral Examination	Students respond verbally to questions related to concepts, experiments, projects, design work, or practical applications. It evaluates depth of understanding, clarity of thought, technical articulation, reasoning ability, and ability to defend decisions.
14	Group Discussion	Students collaboratively discuss a given technical, social, ethical, or contemporary topic within a structured setting. It assesses communication, teamwork, listening skills, critical thinking, leadership, reasoning, and respect for diverse perspectives.
15	Role Play	Students enact assigned roles in simulated professional, technical, managerial, or societal situations to demonstrate applied understanding. It evaluates communication, decision-making, empathy, teamwork, ethical reasoning, and response to real-world scenarios.

Assessment Methods / Mode

Assessment Methods or Modes are methods / mode which define "WHERE, WHEN, and under WHAT condition is assessment conducted".

SN	ASSESSMENT METHODS / MODE	DESCRIPTION
1	Supervised In-Class Mode	Assessment is conducted physically during scheduled academic time under faculty or authorized supervision.
2	Open book Mode	Students are permitted to consult specified books, notes, standards, or approved resources during the assessment. Tasks should emphasis application, analysis, synthesis, and judgement rather than direct recall.
3	Closed-Book Mode	Students complete the assessment without access to external learning resources, except specifically permitted materials. This mode is generally used to assess retained understanding, procedural fluency, and independent application.
4	Online Assessment	Assessment is conducted through an approved digital platform under defined access, duration, submission, and authentication conditions. It may be synchronous or asynchronous and supervised or unsupervised.
5	Take home Test	Students complete an assessment outside scheduled classroom conditions within a specified submission period. Permitted resources, collaboration rules, originality requirements, and academic integrity expectations are clearly defined
6	In Class Assignment	Students complete a defined assignment during scheduled class time under specified conditions and with stated levels of faculty guidance. The mode enables immediate application of concepts and controlled completion of learning tasks.
7	Field Based Mode	Assessment is conducted in authentic environments such as industries, communities, laboratories, sites, or field locations. Students generate evidence through observation, investigation, data collection, interaction, or practical engagement.
8	Peer Assessment	Students evaluate the work or performance of their peers using faculty-approved criteria, checklists, rating scales, or rubrics. Peer judgements may be used for formative feedback or controlled scoring, with appropriate faculty moderation to ensure fairness and consistency
9	Self-Assessment	Students evaluate their own learning, performance, or work against predefined criteria, expected outcomes, checklists, or rubrics. The

		process is used to identify strengths, gaps, learning needs, and improvement actions, with faculty validation where required.

Evaluation Mechanism

Evaluation mechanism define "How the performance of the learners is Judged, scored or interpreted"

	EVALUATION MECHANISM	DESCRIPTION
1	Answer Key-Based Evaluation	Student responses are evaluated against predetermined correct answers or acceptable response options. It is most appropriate for objective based assessment instruments
2	Model Answer / Model Solution-Based Evaluation	Responses are compared with an approved model answer or solution indicating expected content, methodology, steps, and outcomes. Marks are awarded according to the extent and quality of demonstrated achievement
3	Rubric-Based Evaluation	Performance is judged against predefined criteria with clearly described levels of achievement. Scores or grades are assigned by matching demonstrated performance with descriptors for each criterion
4	Checklist-Based Evaluation	Performance is evaluated by recording the presence, absence, or completion of predefined behaviours, steps, features, or requirements. It is particularly suitable for practical tasks, procedures, and compliance-oriented performance.
5	Milestone-Based Evaluation	Performance is evaluated at predefined stages of a project, dissertation, design activity, or extended task. Each milestone is judged against specified deliverables, progress expectations, and achievement criteria.

Chapter 4
Indicative List of Courses

Apart from Program related courses, students are expected to take Basic Science and Engineering courses, Humanities, Social Science and Management courses and co-curricular courses. Indicative list of these courses which are offered in III and IV Sem are as follows.

4.1 BSE Courses

SN	COURSE NAME	COURSE CODE	Semester
1	Discrete Structure and Graph Theory	CEBS231	III
2	Mathematics for Computer Engineering	CEBS241	IV

4.2 Humanities Courses

Following courses are offered in Sem III and IV from the basket of HSSM (Humanities, Social Science and Management). Students should refer HSSM syllabus document for the detailed syllabus

Link for HSSM syllabus:

SN	COURSE NAME	COURSE CODE	Semester
1	Entrepreneurship and Business Model development	IGEM231	III
2	Design Thinking	IGEM242	IV

4.3 Co-Curricular Courses

Following courses are offered in Sem III and IV from the basket of CC (Co-Curricular). Students should refer CC syllabus document for the detailed syllabus

Link for CC syllabus:

SN	LIST OF SUGGESTED OPEN ELECTIVES	COURSE CODE	Semester
1	Theater Drama	IGCC231	III
2	Social Science and Community Services	IGCC232	III
3	Analytical and Aptitude Skills	IGCC233	III

4.4 Open Elective

Following courses are offered in Sem III and IV from the basket of OE (Open Electives). Students should refer OE syllabus document for the detailed syllabus

Link for OE syllabus:

SN	LIST OF SUGGESTED OPEN ELECTIVES	COURSE CODE	Semester
1	Financial Management	IGOE231	III
2	Financial Literacy	IGOE232	III
3	Fin Tech	IGOE233	III
4	Disaster Management and Mitigation Measures	IGOE234	III
5	Leadership Management	IGOE241	IV
6	Waste Management	IGOE242	IV
7	Principles and Practices of Management	IGOE243	IV
8	Cyber and Digital safety	IGOE244	IV

Chapter 5
Mapping and Justification

5.1 Indicative Mapping of Courses to PO

All the courses are mapped to PO by taking average of CO-PO mapping from individual courses. These values are just indicative, and individual faculty can change it based on the depth of coverage and pedagogical tools used which will be reflected in the lesson plans.

Mapping of 3 signifies “High Correlation”, Mapping of 2 signifies “Medium Correlation” and mapping of 1 signifies “Low Correlation”

Semester III

Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEBS231	Discrete Structure and Graph Theory	3.0	3.0	3.0	-	-	-	-	-	-	-	3.0	3.0	3.0
CEPC231	Analysis of Algorithm	3.0	3.0	2.0	-	3.0	-	-	-	2.0	2.0	3.0	3.0	3.0
CEPC232	Computer System Design	2.5	2.6	3.0	-	2.0	-	-	-	-	-	-	2.0	2.0
CEPC233	Operating System	3.0	3.0	2.5	3.0	3.0	-	-	-	-	-	-	3.0	3.0
CEVS231	Advanced Java	2.3	2.7	2.7	2.7	2.6	2.0	-	-	-	-	-	3.0	2.7
IGAE231	Comprehensive Soft Skill and Proff. Development	2.0	2.3	2.5	2.0	2.0	2.3	-	2.3	2.8	3.0	2.0	2.7	2.0
IGEM231	Entrepreneurship and Business Model Development	2.2	2.2	3.0	2.0	2.0	2.3	2.0	2.3	2.2	2.3	2.0	2.0	3.0

Semester IV

Course Code	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEBS241	Mathematics for Computer Engineering	3.0	3.0	2.0	2.0	2.3	-	-	-	-	-	-	2.0	3.0
CEPC241	Computational Theory	3.0	3.0	3.0			-	-	-	-	-	3.0	3.0	3.0
CEPC242	Database Management System	3.0	2.6	2.6	-	2.8	-	-	3.0	2.6	-	3.0	3.0	3.0
CEPC243	Computer Networks	2.7	2.2	2.3	2.0	3.0	-	-	3.0	2.0	2.0	2.0	3.0	-
CEVS241	AI Tools	2.6	2.0	2.6	3.0	2.4	2.3	2.8	-	-	-	-	3.0	3.0
IGVS241	Engg. Fundamentals and Tech Skills	2.0	2.5	2.0	-	2.0	2.2	-	2.3	2.8	3.0	2.0	2.3	2.0
IGEM241	Design Thinking	2.5	2.6	3.0	-	2.0	-	-	-	-	-	-	2.0	2.0
CEPR241	Mini Project-I	-	-	2.0	2.3	2.5	-	-	2.2	2.2	2.3	2.5	2.0	2.8

5.2 Indicative Mapping of Courses to WK

Semester III

Course Code	Course Name	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CEBS231	Discrete Structure and Graph Theory	✓	✓	✓	✓				✓	
CEPC231	Analysis of Algorithm		✓	✓		✓				
CEPC232	Computer System Design			✓	✓	✓	✓			
CEPC233	Operating System		✓	✓			✓			
CEVS231	Advanced Java	✓	✓	✓	✓					
IGVE231	Comprehensive Soft Skill and Proff. Development	✓					✓	✓	✓	
IGEM231	Entrepreneurship and Business Model Development		✓		✓	✓		✓		

Semester IV

Course Code	Course Name	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CEBS241	Mathematics for Computer Engineering		✓	✓	✓				✓	
CEPC241	Computational Theory	✓	✓	✓	✓				✓	
CEPC242	Database Management System	✓	✓	✓	✓	✓	✓		✓	
CEPC243	Computer Networks	✓	✓	✓	✓	✓				
IGVE241	AI TOOLS	✓		✓	✓		✓			✓
IGVE241	Engg. Fundamentals and Tech Skills	✓	✓	✓	✓	✓	✓	✓	✓	✓
IGEM241	Design Thinking		✓			✓		✓	✓	
CEPR241	Mini Project-I					✓	✓		✓	✓

Chapter 6
Discrete Structure and Graph Theory

Overview			
Course code:	**CEBS231**	**Course Category:**	Basic Science
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

6.1 Teaching & Learning Scheme

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

Components	Classroom Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	-	-	3	**6**
Hours/Sem	45	-	-	-	45	**90**
Credits	3	-	-	-	-	**3**

6.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	-	-	**-**	**-**

6.3 Course Objectives

Pre-requisite Course / Knowledge	Set Theory, Propositional Logic, Mathematical Induction, Basic Algebra and Number Theory, Fundamental Counting Principle, Permutations, Combinations. Graph Basics.

Course Overview:

The study of Discrete Structures and Graph Theory enables students to develop strong logical reasoning, combinatorial techniques, and mathematical structures that are essential in programming, algorithm design, networking, database design, artificial intelligence, and cryptography.

Course Objective:

1. Cultivate clear thinking and creative problem solving.
2. Thoroughly prepare for the mathematical aspects of other Relations and Functions in Computer Engineering course.
3. Solve real-world problems using counting principles, recurrence relations.
4. Use of graph theory in solving practical problems.
5. Strengthen mathematical foundations for research and higher studies in Computer Engineering.

6.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEBS231.1	Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving using set theory and logic.	Apply (L3)
CEBS231.2	Apply properties of Relation sets in real-life problem-solving domains.	Apply (L3)
CEBS231.3	Apply properties of function sets in real-life problem-solving domains.	Apply (L3)
CEBS231.4	Apply counting principles, Pigeon hole principle, Inclusion Exclusion principle solve combinatorial problems.	Apply (L3)
CEBS231.5	Apply algebraic structure for a given mathematical problem.	Apply (L3)
CEBS231.6	Apply graph theory in solving computing problems.	Apply (L3)

6.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**SET THEORY &LOGIC**	**CO1**	**L3**	**T3, T4, T1, R3 , R4**	**7**
	1.1	**Set Theory:** Sets, Subsets, Universal and Empty sets, Set Operations, Set Representation, Laws of Set theory.				
	1.2	**Logic :** Propositional logic, Predicate logic, Quantifiers (Universal and Existential)				
	1.3	**Types of Mathematical Proof** : Direct proof, Proof by contradiction, Proof by deduction, Proof by cases, Proof by exhaustion, Proof by counterexample, Mathematical Induction				
2	**Title**	**RELATIONS**	**CO2**	**L3**	**T3,T1,T2, R1,R4**	**8**
	2.1	**Relations:** Definition, Representation of Relations, Properties of relations, Equivalence relations , Equivalence Classes, Closures of Relations, Warshall's algorithm.				
	2.2	**Posets and Lattice :**Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice				

3	**Title**	**FUNCTIONS**	**CO3**	**L3**	**T3, T4, T1, R3 , R4**	**3**
	3.1	**Function**s: Definition, Types of functions, Composition of functions, Identity and Inverse function , Real life applications of functions.				
4	**Title**	**COUNTING**	**CO4**	**L3**	**T2,T4**	**6**
	4.1	Pigeonhole Principle, Inclusion-Exclusion Principle				
	4.2	Recurrence relations, Solving recurrence relations , Applications of Recurrence relations				
5	**Title**	**ALGEBRAIC STRUCTURES**	**CO5**	**L3**	**T2,T4, R3,R4**	**7**
	5.1	Algebraic structures with one binary operation: Semi group, Monoid.				
	5.2	Groups, Subgroups, Abelian Group, and Cyclic group				
	5.3	Algebraic structures with two binary operations: Ring , Applications of algebraic structures.				
6	**Title**	**GRAPH THEORY**	**CO6**	**L3**	**T3,T4, R1,R3**	**8**
	6.1	Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs				
	6.2	Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, Real life applications of graph theory				
Self Study Topics	SS.1	PROLOG / LISP programming to create expert system using Propositional and Predicate Logic, Practical applications of Logic in Computer Engineering.				**2 hours / week**
	SS.2	Practical applications of relations in real life in the field of Database Management, Economics, Social Network, Sports, Medical Diagnosis, Weather, etc				
	SS.3	Practical applications of function in Neural Network, Determining risk factors for insurance rates, Taxes and tax brackets, Vending machines, etc				
	SS.4	Applications of Recurrence Relations – Analysis of recursive algorithms in computing. Combinatorial Problem Solving – Using counting techniques in probability and decision-making.				

	SS.5	Error Correcting codes.	
	SS.6	Network Flow Problems – Understanding flow in networks and its optimization. Graph Coloring Applications in Scheduling – Use of graph coloring in timetabling and resource allocation. Optimization Techniques – Application of graphs in shortest path problems, spanning trees, and clustering.	

6.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA 1	1	CAT	Paper – Pen	Class Room Test	15	15	1 Hr
2	IA 2	1	CAT	Paper – Pen	Class Room Test	15	15	1 Hr
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	-
4	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5 Hrs

IA* = Internal Assessment; **FA = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of next 3 modules
Assessment Instruments → **What Tools and instruments used for the assessment.*
Assessment Methods → **How Are assessments evaluated and/or executed.*
** Refer section 3.8*

6.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEBS231.1	3	3	3	-	-	-	-	-	-	-	3	3	3
CEBS231.2	3	3	3	-	-	-	-	-	-	-	3	3	3
CEBS231.3	3	3	3	-	-	-	-	-	-	-	3	3	3
CEBS231.4	3	3	3	-	-	-	-	-	-	-	3	3	3
CEBS231.5	3	3	3	-	-	-	-	-	-	-	3	3	3
CEBS231.6	3	3	3	-	-	-	-	-	-	-	3	3	3

6.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK1	A systematic, theory-based understanding of the nature sciences applicable to the discipline and awareness of relevant social sciences.	The subject Discrete structure and graph theory gives a foundational and core understanding of Computer Science and Engineering.
2	WK2	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	Use of Logical and Mathematical concepts in problem solving.
3	WK3	A systematic theory based formulation of engineering fundamentals in the engineering discipline.	A systematic formulation of Logical reasoning , Graphical theory , and other mathematical concepts in engineering discipline.
4	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	Knowledge of Logical reasoning , Graphical theory , and other mathematical concepts usage in various subjects and applications in computer engineering.
5	WK8	Engagement with selected knowledge in the current literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.	Engaging with current literature in Discrete Structures and Graph Theory requires moving beyond rote formula memorization. It involves active, logical deduction and graph modeling to solve dynamic computational problems. This process relies heavily on critical analysis, algorithmic reasoning, and creative problem-solving.

6.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Discrete Mathematics with Applications	5th	Susanna S. Epp	Cengage Publications	2020
T2	Discrete Mathematics	5th	Kenneth A. Ross	Pearson Publications	2019
T3	Discrete Mathematical Structures	6th	Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman	Pearson Education	2015
T4	Discrete mathematics with Graph Theory and Combinatorics	-	T. Veera Rajan	McGraw Hill Publications	2006

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Elements of Discrete Mathematics	2nd	C. L. Liu	McGraw-Hill Book Company	2008
R2	Textbook of Discrete Mathematics	9th	Swapan Kumar Sarkar	S. Chand Publications	2016
R3	Discrete and Combinatorial Mathematics	5th	Ralph P. Grimaldi	Pearson Publications	2019
R4	Discrete Mathematical structures with applications to computer science.	1st	J P Tremblay , R Manohar	McGraw-Hill International Edition	2017

Online Resources

SN	Title	Description
01	https://nptel.ac.in/courses/111104416	Logic
02	https://onlinecourses.nptel.ac.in/noc23_cs60/preview	Relations, Functions and Algebraic structures
03	https://onlinecourses.nptel.ac.in/noc25_ma26/preview	Posets and Lattice & Graph Theory
04	https://onlinecourses.nptel.ac.in/noc26_cs68/preview	Counting
05	https://nptel.ac.in/courses/111107127	Graph Theory
06	https://nptel.ac.in/courses/106108227	Discrete Mathematics
07	https://nptel.ac.in/courses/106106183	Introduction to Course Discrete Mathematics
08	https://nptel.ac.in/courses/106103205	Discrete Mathematics

Chapter 7:
Subject - Analysis of Algorithm (Sem III)

Overview			
Course code:	**CEPC231**	**Course Category:**	Program Core
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

7.1 Teaching & Learning Scheme

Components	Classroom Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	2	-	3	**8**
Hours/Sem	45	-	30	-	45	**120**
Credits	3	-	1	-	-	**4**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

7.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	50%	50%	**100%**	**1**

7.3 Course Objectives

Pre-requisite Course / Knowledge	C Programming, Data Structure
Course Overview: This course focuses on the study of computational efficiency and performance of algorithms. Through theoretical understanding and practical problem-solving, students learn to design efficient algorithms, evaluate trade-offs, and apply suitable approaches to real-world computational problems.	
Course Objective: 1. To provide a mathematical approach for analyzing the performance of algorithms. 2. To apply different algorithm design paradigms for solving problems. 3. Evaluate & compare various algorithm design strategies that can help in solving the real-world problem effectively.	

7.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC231.1	Evaluate algorithms based on their time and space complexity using asymptotic notation.	Apply (L3)
CEPC231.2	Analyze the time complexity of divide and conquer algorithm.	Analyze (L4)
CEPC231.3	Construct solutions to optimization problems using greedy algorithms.	Apply (L3)
CEPC231.4	Formulate and solve Dynamic Programming algorithms efficiently to solve optimization problems.	Apply (L3)
CEPC231.5	Apply backtracking and branch and bound techniques to solve real world problems.	Apply (L3)
CEPC231.6	Apply String Matching techniques for efficient patterns matching.	Apply (L3)

7.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Fundamentals of Algorithm**	**CO1**	**L3**	**T1,O1**	**7**
	1.1	Definition of Algorithms, Properties of Algorithms, Expressing Algorithms, Order of Growth, Asymptotic Notations, Substitution method, Master Theorem, Recurrence tree.				
	1.2	Sorting techniques: Insertion sort, Selection sort, Heap sort.				
	1.3	Complexity classes: P, NP, NP-Complete, NP Hard problems.				
2	**Title**	**Divide and Conquer**	**CO2**	**L4**	**T1,T2,R1,O1**	**6**
	2.1	General method, Merge sort, Quick sort, Randomized Quick Sort.				
	2.2	Finding Maximum and Minimum element, Binary search.				
3	**Title**	**Greedy algorithms**	**CO3**	**L3**	**T1,T2,R1,O2**	**7**
	3.1	General method, Fractional Knapsack problem.				
	3.2	Minimal Spanning Trees Prim and Kruskal algorithm, Single source shortest path: Dijkstra's algorithm.				
	3.3	Job sequencing with Deadline.				
4	**Title**	**Dynamic Programming**	**CO4**	**L3**	**T1,T2,O3**	**8**
	4.1	General method, Multistage graph, Bellman ford, All pair shortest path: Floyd warshall.				
	4.2	0/1Knapsack problem, Longest Common Subsequence, Travelling sales person problem.				
5	**Title**	**Backtracking and Branch & Bound**	**CO5**	**L3**	**T2,O3**	**6**
	5.1	Backtracking: General method, Queen's problem, Graph Coloring, Sum of Subset.				
	5.2	Branch and Bound: General method, 15 puzzle, job assignment and scheduling problems.				
6	**Title**	**String Matching**	**CO6**	**L4**	**T1,O4**	**5**
	6.1	General method, Naïve String Matching, Rabin Karp matching algorithm, Knuth Morris Pratt, Finite Automata Matcher.				
Self study	**SS.1**	Tight vs Loose bounds (Big-O, Ω, Θ in depth)				**3 hou**
	SS.2	Strassen's Matrix Multiplication				
	SS.3	Huffman Coding algorithm				

	SS.4	Matrix Chain Multiplication	**rs / we ek**
	SS.5	Sudoku solver using backtracking Hamiltonian Cycle problem	
	SS.6	Z-algorithm for pattern matching ,Boyer-Moore algorithm	

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Implement Selection sort and evaluate Time complexity in best, average and worst case.	CO1	2
2	Implement Insertion sort and evaluate Time complexity in best, average and worst case.	CO1	2
3	Implement Merge sort using divide and conquer strategy and evaluate Time complexity in best, average and worst case.	CO2	2
4	Implement Quick sort using divide and conquer strategy and evaluate Time complexity in best, average and worst case.	CO2	2
5	Implement Binary search using divide and conquer strategy and evaluate Time complexity in best, average and worst case.	CO2	2
6	Implement the Dijkstra algorithm using a greedy approach.	CO3	2
7	Implement Fractional knapsack using a greedy approach.	CO3	2
8	Implement Belman ford Algorithm using dynamic programming approach.	CO4	2
9	Implement Floyd warshall Algorithm using dynamic programming approach.	CO4	2
10	Implement Longest Common Subsequence (LCS) using dynamic programming approach.	CO4	2
11	Implement N queen problem using Backtracking approach.	CO5	2
12	Implement 15 puzzle problem using Branch and Bound approach.	CO5	2
13	Implement Naive string matching algorithm.	CO6	2
14	Implement Robin Karp string matching algorithm.	CO6	2

7.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA-1	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
2	IA-2	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	--
4	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5hrs

**IA = Internal Assessment; FA = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of next 3 modules
Assessment Instruments → **What Tools and instruments used for the assessment.*
Assessment Methods → **How Are assessments evaluated and/or executed.*
** Refer section 3.8*

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Lab Experiment	E-Parikshak	15	30	2 hrs
2	Attendance	-	CAT	Attendance	Record based	5	10	-
3	Presentation	1	CAT	Lab Presentation	Rubrics Based	5	10	15 min
4	ESE	-	ESE	Oral and Practical	E-Parikshak	25	50	2 hrs

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

7.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC231.1	3	3	2	-	3	-	-	-	2	2	3	3	3
CEPC231.2	3	3	2	-	3	-	-	-	2	2	3	3	3
CEPC231.3	3	3	2	-	3	-	-	-	2	2	3	3	3
CEPC231.4	3	3	2	-	3	-	-	-	2	2	3	3	3
CEPC231.5	3	3	2	-	3	-	-	-	2	2	3	3	3
CEPC231.6	3	3	2	-	3	-	-	-	2	2	3	3	3

7.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK2**	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modeling applicable to the discipline. engineering	Use of mathematical tools to analyze algorithm efficiency
2	**WK3**	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Design paradigms provide systematic, theory-based algorithm design methods.
3	**WK5**	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.	Designing efficient algorithms for real-world problems

7.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Introduction to Algorithms	3rd	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	MIT Press	2009
T2	Fundamentals of Algorithms	2nd	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran	Universities Press	2008
T3	Design and Analysis of Algorithms	2nd	Chandra Mohan	PHI	2015

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Introduction to design and analysis of algorithm	2nd	Anany Levitin	Pearson Education	2007
R2	The Art of Computer programming	3rd	Donald E Knuth	Addison-Wesley	1997
R3	Design and analysis of algorithm	2nd	S. Sridhar	Oxford University Press	2014
R4	Algorithm	4th	Robert Sedgewick and Kevin Wayne	Addison-Wesley	2011

Online Resources

SN	Title	Description
01	http://nptel.ac.in/courses/106105164	Asymptotic notation, Spanning Tree, Divide and conquer ,greedy , dynamic programming
02	https://www.w3schools.com/dsa/dsa_intro.php	Soring,0/1 knapsack, spanning tree
03	https://www.geeksforgeeks.org/dsa/dsa-tutorial-learn-data-structures-and-algorithms/	Sorting, Divide and conquer , dynamic programming, backtracking and branch and bound
04	https://www.tutorialspoint.com/data_structures_algorithms/dsa_pattern_searching.htm	String matching

Chapter 8:
Subject - Computer System Design (Sem III)

Overview			
Course code:	**CEPC232**	**Course Category:**	Program Core
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

8.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	2	-	2	-	2	6
Hours/Sem	30	-	30	-	30	**90**
Credits	2	-	1	-	-	**3**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

8.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**2**
Labs	100%	-	**100%**	**1**

8.3 Course Objectives

Pre-requisite Course / Knowledge	Digital system, computer fundamentals, introduction of 8086.

Course Overview:

This course is on Computer Architecture and Organization, designed for undergraduate students of CSE. This course introduces the principles of computer organization, processors and microcontroller concepts. This will serve as a foundation for studying fundamentals of processor, controller and interfacing devices for Advanced computer architecture, Multi-core architecture etc.

Course Objective:

1. To gain core knowledge of computer system structures.
2. To understand how components collaborate to execute tasks.
3. To build computing systems tailored for real-world use.
4. To learn to maximize computing efficiency and speed.
5. To prepare for complex processor and controller designs.
6. To build the skills needed for embedded technology.

8.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC232.1	Understand the organization of 8086 Processors.	Understand (L2)
CEPC232.2	Design 8086 based system using Memory devices	Apply (L3)
CEPC232.3	Explore different types of I/O peripheral devices, examine data transfer methods	Apply (L3)
CEPC232.4	Understand the organization of Pentium Processor and hyper threading technology	Understand (L2)
CEPC232.5	Understand different parallel organizations that include pipelining Hazards.	Understand (L2)
CEPC232.6	Understand the organization of 8051 Microcontroller	Understand (L2)

8.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	8086 Processor	**CO1**	**L2**	**T1, T2, R1**	**5**
	1.1	8086 : Programming Model				
	1.2	8086 Instructions : Instruction set-Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions				
	1.3	Control Unit: Micro-programmed and hardwired control unit design methods. Microinstruction sequencing and execution, Micro programs				
	1.4	8086 Interrupt Structure and its servicing				
2	**Title**	**Memory System Organization**	**CO2**	**L3**	**T1, T2, R1**	5
	2.1	8086: Memory Interfacing, RAM - ROM decoding Techniques				
	2.2	Segmentation				
	2.3	Paging				
3	**Title**	**I/O organization**	**CO3**	**L3**	**T1, T2, R1**	4
	3.1	I/O Interface, I/O channels, I/O modules and IO processor,				
	3.2	Types of data transfer techniques: Programmed I/O, Interrupt driven I/O.				
	3.3	PPI 8255: Block diagram, CWR, Interfacing with 8086				
	3.4	PIC 8259: Block diagram, CWR, Interfacing with 8086				

4	**Title**	**Pentium 4**	**CO4**	**L2**	**T3, T4, R1**	4
	4.1	Pentium 4: Net burst micro architecture. MESI Protocol				
	4.2	Integer & Floating-Point Pipeline Stages, Branch Prediction Logic.				
	4.3	Hyper threading Technology and its use in Pentium 4				
5	**Title**	**Parallel Processing**	**CO5**	**L2**	**T4, R2**	4
	5.1	Pipeline Architecture, Superscalar Architecture				
	5.2	Integer and floating point pipeline stages				
	5.3	Pipeline Hazards, Mitigation of Hazards with branch prediction and data forwarding techniques				
6	**Title**	**Microcontroller**	**CO6**	**L2**	**T5, R3**	4
	6.1	Architecture: 8051				
	6.2	Addressing Modes: Immediate, Register, Direct, Indirect.				
	6.3	Register Banks, Program Counter (PC), Stack Pointer (SP)				
	6.4	8051 Timer/Counters: Modes of operation, Timer programming (TMOD, TCON registers).				
Self - Study	SS.1	DMAC 8257				**2 hours/ week**
	SS.2	Comparative study of 8086, 80386, Pentium I, Pentium II, Pentium III				
	SS.3	32 Bit ARM Cortex				

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Installation and configure MASM	CO1	2
2	Data transfer using 8086: Byte/word transfer in different addressing modes, block move (with overlap), data swapping.	CO1	2
3	Array/Looping in 8086: Sorting ascending /descending), finding largest/smallest, Fibonacci series.	CO2	2
4	code conversion using 8086: Binary to BCD, BCD to ASCII, Hex to Decimal	CO2	2
5	String operations using 8086 : Move, reverse, compare, find length, search for characters/strings	CO2	2
6	Interfacing and programming stepper motor rotation with 8086	CO3	2
7	Interfacing Analog-to-Digital and Digital-to-Analog Converters to generate waveforms (ramp, triangular) using 8086	CO4	2
8	Drawing and studying the motherboard layout and chipset	CO4	2

9	Installing various operating systems, with reports of running Windows XP, Windows 7 x64, and various Linux distributions (like MX Linux or Q4OS).	CO5	2
10	Programs for AND, OR, XOR, and complement operations using 8051	CO6	2
11	Moving data blocks between internal/external memories. using 8051	CO6	2
12	Calculating the sum of a given series of numbers using 8051	CO6	2

8.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA-1	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
2	IA-2	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	--
5	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5 Hrs

**IA = Internal Assessment; FA = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of next 3 modules
Assessment Instruments → **What Tools and instruments used for the assessment.*
Assessment Methods → **How Are assessments evaluated and/or executed.*
** Refer section 3.8*

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical / Experiments	Journal (Rubrics Based)	15	60	2 hrs
2	Assignments	6	CAT	Assignments	Assignment (Rubrics Based)	5	20	-
3	Attendance	-	CAT	Attendance	Record	5	20	-

Note:
1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

8.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC232.1	3	2	-	-	2	-	-	-	-	-	-	2	2
CEPC232.2	2	2	3	-	2	-	-	-	-	-	-	2	2
CEPC232.3	3	3	3	-	2	-	-	-	-	-	-	2	2
CEPC232.4	3	3	-	-	2	-	-	-	-	-	-	2	2
CEPC232.5	2	3	-	-	2	-	-	-	-	-	-	2	2
CEPC232.6	2	-	-	-	2	-	-	-	-	-	-	2	2

8.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK3	Systematic, theory- based formulation of engineering fundamentals required in the engineering discipline.	Learning basic CPU blocks, registers, ALU, and control units forms the fundamental infrastructure (WK3) of computer engineering
2	WK3	Systematic, theory- based formulation of engineering fundamentals required in the engineering discipline.	Understanding how memory, busses, execution units, and assembly language interact is a core competency unique to computer engineering specialists. It transitions the student from raw hardware fundamentals (WK3) into specialized knowledge of processing mechanisms (WK4).
3	WK5	Knowledge that supports engineering design and development of solutions.	Designing a system requires executing structured engineering design methodologies (WK5) under strict resource parameters.
4	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas	Tweaking pipelines, balancing hazard mitigations, and analyzing cache structures are complex optimization problems native to advanced computing sciences
5	WK4	Engineering specialist knowledge that provides theoretical frameworks and	This objective builds the prerequisite theoretical scaffolding needed to study deep, professional architectures like multi-core CPUs or system-on-chips

		bodies of knowledge for the accepted practice areas	
6	WK6	Knowledge of engineering practice including technologies, techniques, tools and resources.	Developing embedded logic requires the execution of specialized, modern toolchains (compilers, debuggers, logic analyzers) and operational engineering practices

8.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	8086/8088 Family: Design Programming and Interfacing	2nd	John Uffenbeck	PHI	1996
T2	Computer Architecture and Organization	3rd	John P. Hayes Tata	McGraw-Hill	2012
T3	Pentium Processor System Architecture	2nd	Tom Shanley and Don Anderson	Addison - Wisley	1995
T4	The 80386, 80486, and Pentium Microprocessor: Hardware, Software, and Interfacing	3rd	Walter Triebel	Pearson	1997
T5	The 8051 Microcontroller and Embedded System	2nd	Mohammad Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay	Pearson	

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Computer Architecture and Organization: Design Principles and Application	3rd	B. Govindarajulu	Tata- McGraw Hil	2017
R2	Advance Computer Architecture: Parallelism, Scalability, Programmability	3rd	Kai Hwang	Tata- McGraw Hil	2017
R3	The 8051 Microcontroller	3rd	Ayala	Cengage	

Online Resources

SN	Title	Description
01	NEPTEL : https://nptel.ac.in/courses/106105163	This course will discuss the basic concepts of computer architecture and organization
02	YouTube : https://www.youtube.com/@computerarchitectureandorg2015	This channel will discuss the basic concepts of computer architecture and organization

Chapter 9:
Subject - Operating System (Sem III)

Overview			
Course code:	**CEPC233**	**Course Category:**	Program Core
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

9.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	2	-	3	8
Hours/Sem	45	-	30	-	45	**120**
Credits	3	-	1	-	-	**4**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

9.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	50%	50%	**100%**	**1**

9.3 Course Objectives

Pre-requisite Course / Knowledge	Data Structure, C-Programming, Digital System (Computer organization & Architecture Fundamentals)

Course Overview:

This course provides conceptual and practical knowledge of operating systems, focusing on the design and functioning of system software that manages resources, processes, memory, files, and I/O systems. It covers key topics such as process scheduling, synchronization, memory management, and file systems, while also emphasizing the implementation of OS algorithms using programming and Linux tools.

Course Objective:

1. To introduce the basic concepts, functions and services of Operating systems.
2. To introduce the concept of a process and its management like transition, scheduling, etc.
3. To understand the concepts related to process synchronization.
4. To understand the basic concept of Deadlock management.
5. To understand the various memory management techniques
6. To understand the File system & IO management techniques

9.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC233.1	Understand the basic concepts of the operating system, its operations, services and structures of OS.	Understand (L2)
CEPC233.2	Evaluate the performance of process scheduling algorithms.	Evaluate (L5)
CEPC233.3	Apply synchronization primitives to address process coordination	Apply (L3)
CEPC233.4	Apply the concept of deadlocks to solve the problems.	Apply (L3)
CEPC233.5	Analyze the concepts of memory management techniques.	Analyze (L4)
CEPC233.6	Analyze different techniques of file systems and I/O management.	Analyze (L4)

9.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction to Operating System:**	**CO1**	**L2**	**T1, T2, T3, R1**	**5**
	1.1	Objectives, functions and services of operating systems				
	1.2	Operations of operating system				
	1.3	Operating system Structure: Layered, Monolithic and Microkernel				
	1.4	Types of Operating Systems				
	1.5	Shell, System Calls				
2	**Title**	**Process Management**	**CO2**	**L5**	**T1, T2, T3, R1**	**7**
	2.1	Concept of a Process: Process State Transition Model, operations, Process Control Block, Context switching				
	2.2	Threads: Introduction, Types and Models, Concept of Multithreading				
	2.3	Types of Schedulers, Process Scheduling Criteria, Types of Process Scheduling: Preemptive and Non-Preemptive				
	2.4	FCFS, SJF, SRTF				
	2.5	Priority based, Round Robin				
3	**Title**	**Process Synchronization**	**CO3**	**L3**	**T1, T2, T3, R1**	**7**
	3.1	Concurrency: Principles of Concurrency, Inter-Process Communication, Process Synchronization				
	3.2	Mutual Exclusion: Requirements, Critical Section Problem				
	3.3	Peterson's Solution				
	3.4	Hardware Support (TSL), OS Support (Semaphores)				
	3.5	Classical synchronization problem: Producer and Consumer problem, Readers - Writers Problem, Dining philosophers' problem				
4	**Title**	**Deadlock Management**	**CO4**	**L3**	**T1, T2, T3, R1**	**6**
	4.1	Principles of deadlock, System Model, Deadlock Characterization, Resource Allocation Graph				
	4.2	Deadlock Prevention				
	4.3	Deadlock Avoidance: Banker's algorithm for Single & Multiple Resources				
	4.4	Deadlock Detection and Recovery				

5	**Title**	**Memory Management**	**CO5**	**L4**	**T1, T2, T3, R1**	**7**
	5.1	Memory Management Requirements, Memory Partitioning, Swapping, Memory Allocation Strategies (First Fit, Best Fit, Next Fit, Worst Fit)				
	5.2	Paging: Concept, Structure of Page Table, Address Translation, Translation Lookaside Buffer (TLB)				
	5.3	Segmentation: Concept and Comparison with Paging				
	5.4	Virtual Memory: Concept, Demand Paging, Copy-on-Write				
	5.5	Page Replacement Algorithms: FIFO, LRU, Optimal				
	5.6	Performance Issues: Thrashing				
6	**Title**	**File system and IO Management**	**CO6**	**L4**	**T1, T2, T3, R1**	**7**
	6.1	File System: Overview, Attributes, Operations, Types of file organization				
	6.2	File Access Methods: Sequential, Direct, Indexed				
	6.3	File Allocation Methods: Contiguous, Linked, Indexed				
	6.4	IO Management & Disk Scheduling: IO Devices, IO Buffering techniques				
	6.5	I/O System Organization, Disk Structure and Organization.				
	6.6	Disk Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK				
Self - Study	SS.1	Study of Advanced Operating System Architecture				**3 hours/ week**
	SS.2	Real-time Scheduling algorithms and applications.				
	SS.3	Lock-Free & Wait-Free Algorithms				
	SS.4	Study a real time case study for Deadlock detection and recovery				
	SS.5	Memory Management of IoT, Android Operating System				
	SS.6	Disk scheduling optimization				

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Explore the internal commands of Linux.	CO1	2
2	Write shell scripts to do the following: a. Display top 10 processes in descending order Display processes with highest memory usage. b. Display current logged in user and log name. c. Display current shell, home directory, operating system type, current path setting, current working directory.	CO1	2

	d. Display OS version, release number, kernel version. e. Illustrate the use of sort, grep, awk, etc.		
3	Demonstrate the use of system calls	CO1	2
4	Implementation of non-preemptive scheduling algorithms (any one)	CO2	2
5	Implementation of Preemptive scheduling algorithms (any one)	CO2	2
6	Implementation of Multithreading concept	CO2	2
7	Implement the solution of Producer and Consumer problem through Semaphore	CO3	2
8	Implement the solution of Readers - Writers Problem through Semaphore	CO3	2
9	Implementation of Peterson's Solution or algorithm	CO3	2
10	Implementation of deadlock avoidance concept through Banker's algorithm	CO4	2
11	Implementation of deadlock detection algorithm	CO4	2
12	Design the Resource Allocation Graph & Wait For Graph for your own problem statement	CO4	2
13	Implement the concept of MVT and MFT memory management techniques	CO5	2
14	Implementation of dynamic partitioning placement algorithms	CO5	2
15	Implementation of page replacement policies for handling page faults	CO5	2
16	Implementation of File Allocation methods	CO6	2
17	Implementation of disk scheduling algorithms	CO6	2
18	Implementation of IO Buffering techniques	CO6	2

9.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA-1	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
2	IA-2	1	CAT	Paper – Pen	Class Room Test	15	15	60 min
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	-
4	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5hrs

**IA = Internal Assessment; FA = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of next 3 modules
Assessment Instruments → **What Tools and instruments used for the assessment.*
Assessment Methods → **How Are assessments evaluated and/or executed.*
**Refer section 3.8*

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	12	CAT	Practical - Experiment	Journal (Rubrics Based)	20	40	2 hrs
2	Attendance	-	CAT	Attendance	Record based	5	10	-
3	ESE	-	ESE	Oral and Practical	-	25	50	2.5 hrs

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

9.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC233.1	3	3	-	-	3	-	-	-	-	-	-	3	3
CEPC233.2	3	3	-	3	3	-	-	-	-	-	-	3	3
CEPC233.3	3	3	3	3	3	-	-	-	-	-	-	3	3
CEPC233.4	3	3	2	3	3	-	-	-	-	-	-	3	3
CEPC233.5	3	3	-	3	3	-	-	-	-	-	-	3	3
CEPC233.6	3	3	-	3	3	-	-				-	3	3

9.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK2	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline. engineering	OS involves algorithm analysis, scheduling calculations, paging numerical, and performance metrics, requiring strong mathematical and analytical skills
2	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Core OS topics are fundamental engineering concepts in computer science
3	WK6	Knowledge of engineering practice (technology) in the practice area in the engineering discipline.	OS labs involve Linux, C programming, system calls, IPC, and real system tools, giving hands-on exposure to engineering practice and technologies.

9.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Operating System Concepts	10th	A. Silberschatz, P. Galvin, G. Gagne	Wiley	2018
T2	Operating Systems: Internal and Design Principles	9th	W. Stallings,	Pearson	2018
T3	Modern Operating Systems	4th	A. Tanenbaum	Pearson	2015

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Principles of Operating Systems	1st	N. Chauhan	Oxford University Press	2014
R2	Operating System Design and Implementation	3rd	A. Tanenbaum and A. Woodhull	Pearson	–
R3	Operating Systems	3rd	Achyut Godbole and Atul Kahate	McGraw Hill Education	-
R4	Operating Systems: Three Easy Pieces	1st	R. Arpaci-Dusseau and A. Arpaci-Dusseau	CreateSpace Independent Publishing Platform	2018

Online Resources

SN	Title	Description
O1	https://www.youtube.com/watch?v=2i2N_Qo_FyM&list=PLEbnTDJUr_If_BnzJkkN_J0Tl3iXTL8vq	GATE Computer Science
O2	https://www.youtube.com/watch?v=RozoeWzT7IM&list=PLdo5W4Nhv31a5ucW_S1K3-x6ztBRD-PNa	Computer Science & IT
O3	https://www.youtube.com/watch?v=bkSWJJZNgf8&list=PLxCzCOWd7aiGz9donHRrE9I3Mwn6XdP8p	GATE Smashers
O4	https://www.nptel.ac.in	-
O5	https://swayam.gov.in	-
O6	https://www.coursera.org/	-

Chapter 10:
Subject - Entrepreneurship and Business Model Development (Sem III)

Overview			
Course code:	IGEM231	**Course Category:**	Entrepreneurship /Eco / Mgmt.
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

10.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	2	2	-	**4**
Hours/Sem	-	-	30	30	-	**60**
Credits	-	-	2		-	**2**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

10.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	**-**	**-**
Labs	100%	-	**100%**	**2**

10.3 Course Objectives

Pre-requisite Course / Knowledge	Basic design thinking principles
Course Overview: A course on Business Model Development typically teaches how to design, analyze, and refine the way a company creates, delivers, and captures value.	
Course Objective: 1. To introduce a learner to entrepreneurship and its role in economic development . 2. To familiarize a learner with the start-up ecosystem and government initiatives in India. 3. To explain the process of starting a business. 4. To familiarize a learner with the building blocks of a business. 5. To teach a learner to plan their own business with the help of Business model canvas. 6. To teach a learner to have a financial plan for a business model.	

10.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGEM231.1	Discuss the role of entrepreneurship in the economic development of a nation and describe the process of starting a business.	Understand (L2)
IGEM231.2	Describe start-up ecosystem in Indian and global context.	Understand (L2)
IGEM231.3	Identify different types of business models.	Understand (L2)
IGEM231.4	Identify customer segments, channels and customer relationship components for a particular business.	Apply (L3)
IGEM231.5	Identify key activities, key partners and key resources for a particular business.	Apply (L3)
IGEM231.6	Develop a financial plan for a business with the help of cost structure and revenue model.	Create (L6)

10.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction Entrepreneurship**	**CO1**	**L2**	**T1,T2,R1,R2**	**4**
	1.1	Introduction, definition of entrepreneurship				
	1.2	The role of entrepreneurship in economic development				
	1.3	Women entrepreneurs, Corporate entrepreneurship				
	1.4	Entrepreneurial mindset, feasibility planning's (four stage growth model, feasibility plan)				
2	**Title**	Entrepreneurship Development	**CO2**	**L2**	**T1,T2,R1,R2**	**4**
	2.1	Types of business ownerships: Proprietorship ,success factor for entrepreneurs				
	2.2	Public and Private Companies,				
	2.3	Micro, Small and Medium Enterprises (MSME): Definition Role of MSMEs in economic development				
	2.4	Synopsis for learning and stating how MSME works				
3	**Title**	**Start-up financing**	**CO3**	**L2**	**T1,T2,R1,R2**	**5**
	3.1	Cost and revenue models,				
	3.2	Sources of start-up findings: Angel investors, Venture capitalists, Crowd funding,				
	3.3	Government schemes for start-up funding Self-learning Topics: Successful business pitching				
	3.4	Franchising, structuring of acquisition				
4	**Title**	**Intellectual Property Rights (IPR)**	**CO4**	**L3**	**T1,T2,R1,R2**	**4**
	4.1	Intellectual Property Rights (IPR):Types of IPR: Patents, trademarks and copyrights				
	4.2	Patent search and analysis, Strategies for IPR protection				
	4.3	Ethics in technology and innovation				
	4.4	Patents, type ,disclosure process				
5	**Title**	**Business Model Development**	**CO5**	**L3**	**T1,T2,R1,R2**	**5**
	5.1	Business Model Development: Types of business models, Value proposition				

	5.2	Customer segments, Customer relationships				
	5.3	Channels, Key partners, Key activities				
	5.4	Key resources, Prototyping and MVP				
	5.5	Perspective of marketing research , market research in pre-startup phase				
6	**Title**	**Digital Business Management**	**CO6**	**L6**	**T1,T2,R1,R2**	**4**
	6.1	Digital Business Management: Digital business models (Subscription, Fermium etc.)				
	6.2	Digital marketing: Search Engine Optimization (SEO)				
	6.3	Search Engine Marketing (SEM), Social media and influencer marketing,				
	6.4	Disruption and innovation in digital business				

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Problem identification (pain point, market survey)	CO1	**2**
2	Design a digital solution for the problem (ideation techniques)	CO1	**2**
3	Preparing a business model canvas value proposition , key patterns, key resources, key activities	CO2	**2**
4	Preparing a business model canvas : customer segment ,customer relationship and channels	CO2	**2**
5	Preparing a business model canvas :cost and revenue structure	CO3	**2**
6	Prototype development : low fidelity	CO3	**2**
7	Prototype development: customer feedback	CO4	**2**
8	Prototype development: HIGH Fidelity	CO4	**2**
9	Feasibility plan Of an idea	CO5	**2**
10	Franchisee plan of your company	CO6	**2**

Assignments (Suggested list of Assignments)

SN	Title of Assignments	CO
1	Presentation on case study of a failed business model	CO1
2	presentation on case study of a woman entrepreneur	CO2
3	Case study Angel investor and venture capitalist	CO3
4	Case study of trademarks and copyright	CO4
5	Business model prototyping	CO5
6	Innovation in digital business	CO6

10.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical-Experiment	Journal (Rubrics Based)	25	50	2Hrs
2	Assignments	6	CAT	Written	Assignment (Rubrics Based)	10	20	-
3	Report	1	CAT	Presentation	Rubrics based	10	20	-
4	Attendance	1	CAT	Attendance	Record Based	5	10	-

Note:

1 *CAT Activity will be part of Term Work.*

2 *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*

3 *Learners will perform minimum 10 experiment at least 1 experiment from each module.*

4 *Each practical will be assessed considering* ***50% work of lab +20% Assignment+20% Report +10% attendances.***

10.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
IGEM231.1	2	2	2	-	-	3	2	-	2	2	2	2	3
IGEM231.2	2	2	-	-	-	3	2	-	2	2	2	2	3
IGEM231.3	2	2	3	-	-	2	-	-	2	2	2	2	3
IGEM231.4	-	2	3	-	-	2	-	2	3	2	2	2	3
IGEM231.5	2	2	3	-	-	2	-	3	2	3	2	2	3
IGEM231.6	3	3	3	2	2	2	-	2	2	3	2	2	3

10.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK2**	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modeling applicable to the discipline. engineering	The subject involves financial planning, cost structure analysis, and revenue modeling, which require strong analytical and quantitative decision-making skills.
2	**WK4**	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted	Focuses on business model development, startup ecosystems, and strategic frameworks,

		practice areas in the engineering discipline; much is at the forefront of the discipline.	requiring domain-specific knowledge of business and entrepreneurship.
3	**WK5**	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.	Emphasizes efficient use of resources, cost optimization, and long-term sustainability in business planning and value creation.
4	**WK7**	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.	Highlights the impact of entrepreneurship and startups on economic development, employment generation, and societal growth.

10.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Entrepreneurship – David A	1st	Kirby	McGraw Hill	2002
T2	Harvard Business Review: Entrepreneurs Handbook	2nd	HBR Press	HBR Press	2018
T3	Business model generation	1st	Yves pigneur	strategyzer	2010
T4	E-business and e- commerce management : strategy & implementiation	1st	Practice – Dave chaffey	Pearson education	-

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Entrepreneurship: New venture creation – David Holt, Prentice Hall of India Pvt. Ltd.	2nd	David Holt	Prentice Hall of India Pvt. Ltd.	2005
R2	E-Business & E-Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education	3rd	Implementation	Pearson Education	2018
R3	Business model generation; Alexander ostlewalder and YVES pigneur	1st	Strategyzer	Pearson Education	2010

Online Resources

SN	Title	Description
01	Entrepreneurship by Prof. C Bhaktavatsala Rao http://onlinecourses.nptel.ac.in/noc20_mg35/preview	Online resources include digital learning materials and platforms that support teaching, learning and self-study. These resources provide students with access to e-books, video lectures, research papers,

		tutorials, simulation, case studies, quizzes and practical demonstration relatec to the subject
02	Innovation, business models and entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview	They help learners enhance conceptual understanding, improve problem-solving skills and stay updated with recent developments in the field.

Chapter 11:
Subject - Advanced Java (Sem III)

Overview			
Course code:	**CEVS232**	**Course Category:**	Vocational and Skill Enhancement Course
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

11.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	2	2	-	**4**
Hours/Sem	-	-	30	30	-	**60**
Credits	-	-	2		-	**2**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

11.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	-	-
Labs	50%	50%	100%	2

11.3 Course Objectives

Pre-requisite Course / Knowledge	Dig Basics of Java Programming, OOP Concepts, Basic HTML and SQL.

Course Overview:

This course covers advanced features of Java programming including multithreading, collection framework, GUI development using AWT and Swing, database connectivity using JDBC, and web application development using Servlets and JSP. It also introduces enterprise application development concepts using MVC architecture, Spring, Hibernate, and REST APIs.

Course Objective:

1. To understand advanced Java concepts such as packages, exception handling, multithreading, and file handling.
2. To apply Collection Framework and Generics for efficient data management.
3. To develop GUI applications using AWT and Swing with event handling.
4. To implement database connectivity using JDBC and perform CRUD operations.
5. To build dynamic web applications using Servlets and JSP.

6. To introduce enterprise application development concepts using MVC, Spring, Hibernate, and REST APIs.

11.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEVS232.1	Apply advanced Java concepts such as packages, interfaces, exception handling, multithreading, and file handling	Apply (L3)
CEVS232.2	Use Collection Framework and Generics for efficient data processing	Apply (L3)
CEVS232.3	Develop GUI applications using AWT and Swing with event handling	Create (L6)
CEVS232.4	Design and implement database-driven applications using JDBC	Apply (L3)
CEVS232.5	Build dynamic web applications using Servlets and JSP with session management	Create (L6)
CEVS232.6	Apply basic enterprise application development concepts using MVC, Spring, Hibernate, and REST APIs	Apply (L3)

11.5 Modules / Syllabus Content

Theory Component

Module	**Unit**	**Topic**	**CO**	**Blooms Level**	**Reference**	**Hrs**
1	**Title**	**Object-Oriented Programming and Advanced Core Java Concepts**	**CO1**	**L3**	**T1**	**5**
	1.1	Object-Oriented Programming Concepts: Class, Object, Encapsulation, Inheritance, Polymorphism, and Abstraction				
	1.2	Packages and Access Modifiers				
	1.3	Interfaces and Abstract Classes				
	1.4	Exception Handling (try-catch-finally, throw/throws, custom exceptions)				
	1.5	Multithreading (Lifecycle, Creating Threads, Synchronization),Java I/O Streams and File Handling				
2	**Title**	**Collection Framework & Generics**	**CO2**	**L3**	**T1,T3**	**5**
	2.1	Introduction to Collection Framework				
	2.2	List Interface: ArrayList, LinkedList				
	2.3	Set Interface: HashSet, TreeSet				
	2.4	Map Interface: HashMap, Hashtable				

	2.5	Iterators, Comparable, Comparator, and Generics basics				
3	**Title**	**GUI Programming using AWT & Swing**	**CO3**	**L6**	**T1**	**5**
	3.1	Introduction to GUI programming				
	3.2	AWT components (Label, Button, TextField, Checkbox)				
	3.3	Layout managers and event handling				
	3.4	Swing components: JFrame, JButton, JTable, JComboBox				
	3.5	Dialog boxes and menu creation				
4	**Title**	**JDBC**	**CO4**	**L3**	**T1,T3**	**4**
	4.1	Introduction to JDBC, architecture, and types of drivers				
	4.2	Establishing database connection; Statement, Prepared Statement, Callable Statement				
	4.3	Result Set and CRUD operations				
	4.4	Transaction handling				
5	**Title**	**Servlets**	**CO5**	**L6**	**T2**	**4**
	5.1	Introduction to web applications; Servlet architecture and lifecycle				
	5.2	Generic Servlet and HTTP Servlet; handling client requests				
	5.3	Session tracking: Cookies, URL rewriting				
	5.4	Filters and listeners				
6	**Title**	**JSP & Introduction to Frameworks**	**CO6**	**L3**	**T2, T4**	**3**
	6.1	JSP lifecycle, JSP tags,				
	6.2	implicit objects Session management in JSP , MVC architecture				
	6.3	Introduction to Spring Framework and Hibernate ORM REST API basics				
Self - Study	SS.1	Packages, interfaces, exceptions, threads, I/O				**1hour/week**
	SS.2	Collections, Generics, List/Set/Map				
	SS.3	AWT, Swing, event handling				
	SS.4	JDBC basics, CRUD				
	SS.5	Servlets, session tracking				
	SS.6	JSP, MVC, Spring, REST				

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Write a Program on Packages and Custom Exception Handling	CO1	2
2	Write a Program on Multithreading with Synchronization	CO1	2
3	Write a Program on Collection Framework using ArrayList and Iterator	CO2	2
4	Write a Program on Set and Map Interface (HashSet, HashMap)	CO2	2
5	Write a Program on GUI Form using AWT Components	CO3	2
6	Write a Program on AWT components (Label, Button, TextField, Checkbox)	CO3	2
7	Write a program on JDBC connectivity to establish a connection with a database using Driver Manager and execute SQL queries using Statements and Prepared Statement..	CO4	2
8	Write a Program on JDBC CRUD Operations using Prepared Statement	CO4	2
9	Write a Program on Servlet for Form Handling and Session Management	CO5	2
10	Write a Program on Servlet Filters and Listeners to log user requests and responses	CO5	2
11	Write a program on session management in JSP to implement a login system using session tracking.	CO6	2
12	Write a program on JSP form handling to accept user input and display the result dynamically.	CO6	2

11.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical / Experiments/Tutorials	Journal (Rubrics Based)	10	20	2hr
2	Classroom Participation	-	CAT	Attendance	Record and Rubrics	5	10	-
3	Mini project	1	CAT	Mini project	Rubrics Based	10	20	-
4	ESE	1	ESE	Oral and Practical	Rubrics based	25	50	2hr

Note:

1 *CAT Activity will be part of Term Work.*

2 *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*

3 *Learners will perform minimum 10 experiment at least 1 experiment from each module.*

4 *Each practical will be assessed considering **50% work of lab +20% Assignment+20% Report +10% attendances.***

11.7 Suggested CO-PO/PSO/PEO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEVS232.1	3	2	2	2	2	-	-	-	-	-	-	3	2
CEVS232.2	2	2	3	3	3	-	-	-	-	-	-	3	3
CEVS232.3	3	3	3	3	3	2	-	-	-	-	-	3	3
CEVS232.4	2	3	3	3	2	2	-	-	-	-	-	3	3
CEVS232.5	2	3	3	3	3	2	-	-	-	-	-	3	3
CEVS232.6	2	3	2	2	-	-	-	-	-	-	-	3	2

11.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK1**	Basic knowledge of mathematics, science, and engineering fundamentals	Required to understand programming logic, multithreading concepts, and system-level execution
2	**WK2**	Problem analysis	Used in debugging Java programs, handling exceptions, and analyzing application requirements
3	**WK3**	Design/development of solutions	Applied in developing GUI applications, JDBC-based systems, and web applications using Servlets & JSP
4	**WK4**	Modern tool usage	Use of Java frameworks, JDBC drivers, IDEs, and libraries for application development

11.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Java: The Complete Reference	11	Herbert Schildt	McGraw Hill	2018
T2	Core Java Volume I – Fundamentals	11	Cay S. Horstmann	Pearson	2018
T3	Core Java Volume II – Advanced Features	11	Cay S. Horstmann	Pearson	2019
T4	Head First Servlets and JSP	2	Bryan Basham, Kathy Sierra, Bert Bates	O'Reilly	2008

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Effective Java	3rd	Joshua Bloch	Addison-Wesley	2018
R2	Java Concurrency in Practice	1st	Brian Goetz	Addison-Wesley	2006
R3	Thinking in Java	4th	Bruce Eckel	Prentice Hall	2006

R4	Head First Java	2nd	Kathy Sierra, Bert Bates	O'Reilly	2005

Online Resources

SN	Title	Description
O1	Oracle Java Documentation	Official documentation for Java, covering core concepts, APIs, JDBC, multithreading, and advanced features
O2	Java Tutorials by Oracle	Beginner to advanced tutorials on Java programming, including GUI, collections, and networking
O3	GeeksforGeeks – Java	Comprehensive articles, examples, and practice problems on Java, JDBC, Servlets, JSP, and frameworks
O4	W3Schools Java Tutorial	Simple and easy-to-understand tutorials on Java basics, advanced topics, and web technologies
O5	TutorialsPoint Java	Step-by-step tutorials covering core and advanced Java concepts including Servlets and JSP
O6	Baeldung	In-depth articles on Java, Spring, JDBC, and enterprise application development
O7	Javatpoint	Detailed tutorials on Java, AWT, Swing, JDBC, Servlets, JSP, and frameworks
O8	Udemy Java Courses	Paid online courses covering Java programming, GUI, JDBC, and web development

Chapter 12:
Subject - Comprehensive Soft Skills & professional Development (Sem III)

Overview			
Course code:	**IGAE231**	**Course Category:**	Vocational and Skill Enhancement Course
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

12.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	2		-	2
Hours/Sem	-	-	30		-	**30**
Credits	-	-	1		-	**1**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

12.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	**-**	**-**
Labs	100%	-	**100%**	**1**

12.3 Course Objectives

Pre-requisite Course / Knowledge	Knowledge of Principles of Communication and Ethics (PCE)

Course Overview:

This course is designed to develop students' communication, interpersonal, presentation, and professional skills required for academic and career success. It focuses on personality development, verbal and written communication, group discussions, resume writing, interview preparation, workplace etiquette, aptitude training, and career planning. The course helps students build confidence, teamwork, leadership qualities, and professional readiness for modern corporate and engineering environments.

Course Objective:

1. To develop effective verbal, non-verbal, written, and digital communication skills among students.
2. To enhance personality development, self-confidence, interpersonal skills, and professional behavior.

3. To train students in group discussions, teamwork, leadership, and collaborative problem-solving techniques.
4. To prepare students for professional recruitment processes through resume writing, interview preparation, and mock interview practice.
5. To build awareness of workplace etiquette, corporate communication, time management, and professional ethics in modern work environments.
6. To strengthen aptitude, reasoning, career planning, and personal branding skills for improving employability and career growth.

12.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGAE231.1	Demonstrate effective verbal and non-verbal communication using the 7Cs and self-awareness tools to enhance personality and confidence.	Apply (L3)
IGAE231.2	Develop professional written communication including formal emails and LinkedIn profiles while practicing digital etiquette.	Create (L6)
IGAE231.3	Participate actively and confidently in group discussions by applying group behaviour techniques and teamwork skills.	Apply (L3)
IGAE231.4	Create structured and ATS-compliant resumes and prepare for interviews using the STAR method and professional etiquette.	Create (L6)
IGAE231.5	Exhibit professional behaviour at the workplace through appropriate time management, ethical conduct, and corporate communication.	Apply (L3)
IGAE231.6	Solve aptitude problems and outline a career plan using test strategies and personal branding tools.	Analyze (L4)

12.5 Modules / Syllabus Content

Demonstration Component

Module	**Unit**	**Topic**	**CO**	**Blooms Level**	**Reference**	**Hrs**
1	**Title**	Fundamentals of Communication & Personality	**CO1**	Apply	**T1, R1**	**5**
	1.1	Importance of Soft Skills in Engineering & Career, Verbal & Non-verbal Communication, 7Cs of Effective Communication				
	1.2	Body Language, Facial Expressions & Grooming Etiquette				
	1.3	Self-awareness, Personality Types & SWOT Analysis, Activities: Icebreakers, Self-introduction Video & Confidence-building Exercises				
	1.4	**Activity**: Conduct self-introduction video recording to evaluate verbal and non-verbal communication skills including body language and confidence.				
	1.5	**Activity**: Perform SWOT analysis and personality type assessment to understand self-awareness and personality development				
2	**Title**	**Verbal, Written & Digital Communication Skills**	**CO2**	Create (L6)	**T2, R2**	**5**
	2.1	Public Speaking, JAM & Storytelling Techniques, Professional Email Writing: Structure, Tone & Etiquette				
	2.2	Grammar Improvement & Vocabulary Enhancement				

	2.3	LinkedIn Profile Creation, Digital Behavior & Personal Branding, Activities: Draft Emails, LinkedIn Review & Mock JAM Rounds				
	2.4	**Activity**: Draft and submit professional emails based on given workplace scenarios focusing on tone, structure, and etiquette				
	2.5	**Activity**: Create and optimize LinkedIn profile to practice digital branding and professional online presence				
3	Title	**Group Discussion & Team Dynamics**	**CO3**	Apply (L3)	**T3, R3**	**4**
	3.1	Introduction to Group Discussion & Types of GDs, GD Techniques: Entry, Lead, Counter & Conclude				
	3.2	Group Behavior, Leadership Roles & Team Dynamics, Teamwork, Cooperation & Collaborative Problem-solving, Activities: Mock GDs, Peer Feedback & Role Rotation				
	3.3	**Activity**: Conduct mock group discussions with assigned topics focusing on entry, lead, counter, and conclusion techniques				
	3.4	**Activity**: Perform role rotation activity in team tasks to understand leadership, cooperation, and teamwork dynamics				
4	Title	**Resume Building & Interview Readiness**	**CO4**	Create (L6)	**T4, R4**	**4**
	4.1	Resume Format, Keywords & Achievement Writing, ATS-friendly Resume Preparation for Engineers				
	4.2	HR & Technical Interview Questions, STAR Method, Interview Etiquette & Virtual Interview Activities: Resume Clinic, Mock Interviews & Peer Reviews				
	4.3	**Activity**: Prepare ATS-friendly resume using proper keywords, achievements, and structured formatting.				
	4.4	**Activity**: Conduct mock interview sessions using STAR method with peer evaluation and feedback				
5	Title	**Workplace & Corporate Etiquette**	**CO5**	Apply (L3)	**T5, R5**	**4**
	5.1	Work Ethics & Professionalism, Time Management Tools: Pomodoro & Eisenhower Matrix				
	5.2	Email, Meeting & Call Etiquette, Work-from-home/Hybrid Professionalism & Accountability, Activities: Etiquette Checklist, Planner Setup & Roleplay				
	5.3	**Activity**: Perform workplace roleplay activities focusing on email, meetings, and communication etiquette scenarios.				
	5.4	**Activity**: Create personal time management planner using Pomodoro and Eisenhower matrix techniques				
6	Title	**Aptitude Test Strategies & Career Planning**	**CO6**	Analyze (L4)	**T6, R6**	**4**
	6.1	Overview of Quantitative, Reasoning & Verbal Aptitude, Aptitude Test Strategies & Speed Improvement Techniques				
	6.2	Previous Year Placement Aptitude Questions (TCS, Infosys, etc.), Career Goal Setting, Personal Branding & Self-pitch, Activities: Mini Aptitude Quiz, Pitch Presentation & Career Map Submission				
	6.3	**Activity**: Attempt mini aptitude tests covering quantitative, reasoning, and verbal sections with timed evaluation				
	6.4	**Activity**: Prepare and present personal career roadmap and self-pitch presentation for placement readiness				

12.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	12	CAT	Practical / Experiments/Tutorial	Journal (Rubrics Based)	20	80	1 Hr
2	Class Room Participation	-	CAT	Attendance/ Teachers Observation	Record and Rubrics	5	20	-

Note:

CAT Activity will be part of Term Work.

12.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
IGAE231.1	2		-	-	-	2	-	2	3	3	-	-	-
IGAE231.2	2	2	-	-	2	-	-	-	-	3	-	2	2
IGAE231.3	-	-	3	2	-	2	-	2	-	-	2	-	2
IGAE231.4	2	-	-		2	-	-	-	3	3	-	3	2
IGAE231.5	-	2	-	-	2	3	-	3	3	-	2	2	2
IGAE231.6	2	3	2	-	2	2	-	2	2	3	2	3	2

12.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK1**	A systematic, theory-based understanding of the natural sciences applicable to engineering fundamentals.	Students develop foundational understanding of communication principles, personality development, and professional behavior that is essential for engineering environments.
2	**WK6**	Knowledge of engineering practice includes technologies, processes, and standards in practical situations.	Workplace etiquette, virtual meeting behavior, email etiquette, and hybrid work professionalism expose students to modern corporate practices.
3	**WK7**	Comprehension of the role of engineering in society and identified issues in engineering practice.	Group discussions, leadership exercises, and teamwork activities develop collaboration, ethical awareness, and social interaction skills.
4	**WK8**	Engagement with selected knowledge in the research literature of the discipline.	Students explore placement trends, aptitude patterns, and professional communication strategies through self-learning and practical assignments.

12.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	*Soft Skills: Know Yourself and Know the World*	3rd	Dr. K. Alex	S. Chand Publishing	2019
T2	*Personality Development and Soft Skills*	2nd	Barun K. Mitra	Oxford University Press	2016
T3	*Business Communication and Personality Development*	1st	Biswajit Das & Ipseeta Satpathy	Excel Books	2009
T4	*Interview and Group Discussion*	1st	T. Sudha	Tata McGraw Hill	2010
T5	*English and Soft Skills*	1st	S.P. Dhanavel	Orient BlackSwan	2010
T6	*Campus to Corporate: Your Roadmap to Employability*	1st	Gangadhar Joshi	Cengage Learning India	2021

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	*Business Communication*	2nd	Meenakshi Raman & Prakash Singh	Oxford University Press	2012
R2	*The 7 Cs of Communication: A Skills Workbook*	1st	Lucas Burns	Independently Published	2020
R3	*Body Language: How to Read Others' Thoughts by Their Gestures*	Revised	Allan Pease	Manjul Publishing	2017
R4	*Group Discussion and Interview Skills*	1st	Priyadarshi Patnaik & Barun K. Mitra	Cambridge University Press India	2011
R5	*Workplace Etiquette: A Guide to Career Success*	1st	Barbara Pachter	Career Press	2014
R6	*Quantitative Aptitude for Competitive Examinations*	2024	R.S. Aggarwal	S. Chand Publishing	2024

Online Resources

SN	Title	Description
O1	https://www.coursera.org/courses?query=communication%20skills	Offers professional courses on communication skills, public speaking, teamwork, and workplace communication from leading universities.
O2	https://www.linkedin.com/learning	Provides industry-oriented learning modules on professional communication, LinkedIn profile building, leadership, interview preparation, and career development.

O3	https://www.toastmasters.org	A global platform for improving public speaking, confidence, leadership, and presentation skills through practical activities.
O4	https://learning.tcsionhub.in/career-edge	Free employability enhancement program covering communication skills, resume writing, interview preparation, aptitude, and workplace etiquette.
O5	https://www.geeksforgeeks.org/aptitude-gq	Provides quantitative aptitude, logical reasoning, verbal ability practice questions, and placement preparation resources.
O6	https://www.yoodli.ai	AI-powered platform for practicing speeches, interviews, group discussions, and improving communication confidence with feedback.

Chapter 13:
Subject - Mathematics for Computer Engineering (Sem IV)

Overview			
Course code:	**CEBS241**	**Course Category:**	Basic Science
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

13.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	2	1	-	-	3	6
Hours/Sem	30	15	-	-	45	**90**
Credits	2	1	-	-	-	**3**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

13.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**2**
Tutorial & Term Work	100%	-	**100%**	**1**

13.3 Course Objectives

Pre-requisite Course / Knowledge	Knowledge of Applied Mathematics I and II
Course Overview: This course provides a comprehensive foundation in mathematical concepts and analytical techniques essential for engineering and applied sciences. It integrates topics from linear algebra, Fourier analysis, number theory, optimization, and statistics to develop strong problem-solving and modelling skills.	
Course Objective: 1. To introduce concepts and fundamentals Matrix algebra for engineering problems. 2. To enhance the skills to expand Fourier series for periodic functions with various periods. 3. To introduce the concept of modular arithmetic 4. To introduce the concepts of Linear and Non-Linear Programming Problems for optimization and their applications. 5. To develop proficiency in statistical techniques arising in engineering applications.	

6. To familiarize students with the concepts of probability distributions and their applications in engineering and data science.

13.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEBS241.1	Apply the concepts of eigenvalues and eigenvectors in engineering problems.	Apply (L3)
CEBS241.2	Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.	Apply (L3)
CEBS241.3	Analyse modular arithmetic for security applications.	Analyze (L4)
CEBS241.4	Solve Linear and Non-Linear programming problems for optimisation of engineering problems	Evaluate (L5)
CEBS241.5	Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.	Apply (L3)
CEBS241.6	Apply probability distributions to analyse and solve engineering problems involving uncertainty and data analysis.	Apply (L3)

13.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Linear Algebra (Theory of Matrices)**	**CO1**	**L3**	**T1, R4**	**4**
	1.1	Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof)				
	1.2	Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials				
	1.3	Similarity of matrices, Diagonalizable and non-diagonalizable matrices				
2	**Title**	**Fourier Series**	**CO2**	**L3**	**T2, R2**	**4**
	2.1	Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).				
	2.2	Fourier series of periodic function with period 2π and 2l.				
	2.3	Fourier series of even and odd functions				
3	**Title**	**Modular Arithmetic**	**CO3**	**L4**	**T3, R3**	**4**
	3.1	Introduction to Congruence, Linear congruence, Chinese Remainder theorem (CRT), solving polynomials, system of linear congruence				
	3.2	Euler's Totient theorem, Fermat's Little theorem				
	3.3	Application of congruence-RSA algorithm				
4	**Title**	**Linear and Non-Linear Programming Problems**	**CO4**	**L5**	**T1, R1**	**5**
	4.1	Types of Solutions, Standard and Canonical form of LPP, Basic and Feasible Solution				
	4.2	Simplex Method				
	4.3	NLPP with one and two equality constraint (two or three variables) using the method of Lagrange's multipliers				
5	**Title**	**Statistical Techniques**	**CO5**	**L3**	**T1, R1**	**4**
	5.1	Karl Pearson's coefficient of correlation (r)				

	5.2	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)				
	5.3	Fitting of first-degree and second-degree curve.				
6	**Title**	**Probability Theory**	**CO6**	**L3**	**T1, R1**	**5**
	6.1	Basics of probability, Random variables (Discrete & Continuous), Probability Density Function (PDF)				
	6.2	Expectation, Variance, and Standard deviation.				
	6.3	Probability distributions: Binomial, Poisson, and Normal distributions				
Self-Study	SS.1	Derogatory and non-derogatory matrices, Functions of Square Matrix, Linear Transformations, Quadratic forms.				**3 hours/ week**
	SS.2	Half range sine and cosine series, Orthogonal and orthonormal set of functions, Complex form of Fourier Series, Fourier Transforms				
	SS.3	Divisibility, GCD, properties of prime numbers, fundamental theorem of arithmetic.				
	SS.4	Sensitivity Analysis, Big-M method, NLPP with inequality constraints (Kuhn-Tucker conditions)				
	SS.5	Covariance, Line of Regressions, Fitting of exponential curve				
	SS.6	Moments and moment generating function, Skewness and Kurtosis of distribution.				

Tutorials

SN	Topics to be covered	CO	Hrs
1	Module 1 – **Linear Algebra (Theory of Matrices)**	CO1	3
2	Module 2 – **Fourier Series**	CO2	2
3	Module 3 – **Modular Arithmetic**	CO3	2
4	Module 4 – **Linear and Non-Linear Programming Problems**	CO4	3
5	Module 5 – **Statistical Techniques**	CO5	2
6	Module 6 – **Probability Theory**	CO6	3

13.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1.	IA-1	1	CAT	Paper – Pen	Class Room Test	15	20	1 Hr
2.	IA-2	1	CAT	Paper – Pen	Class Room Test	15	20	1 Hr
	FA	2	CAT	Teacher's choice*	Teacher's choice*	10	10	-
3.	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5 hrs

IA = Internal Assessment; **FA** = Formative Assessment;
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of 3 modules
*Assessment Instruments → **What** Tools and instruments used for the assessment.

Assessment Methods → **How Are assessments evaluated and/or executed.*

Term Work

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Tutorial	6	CAT	Tutorial	Journal (Rubrics Based)	10	40	1 Hr
2	Mini Project	1	CAT	Mini Project Presentation	Rubrics based	10	40	-
3	Attendance	1	CAT	Attendance	-	5	20	-

13.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEBS241.1	3	3	-	-	2	-	-	-	-	-	-	2	-
CEBS241.2	3	3	-	2	-	-	-	-	-	-	-	2	-
CEBS241.3	3	3	-	-	2	-	-	-	-	-	-	-	3
CEBS241.4	3	3	2	-	-	-	-	-	-	-	-	2	-
CEBS241.5	3	3	2	-	-	-	-	-	-	-	-	2	-
CEBS241.6	3	3	-	2	3	-	-	-	-	-	-	2	3

13.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	The syllabus directly includes matrices, numerical methods, statistics, differential equations, and mathematical modelling required in computer engineering.
2	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Engineering mathematics provides the theoretical and analytical foundation for core computer engineering subjects.

3	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for accepted practice areas in the engineering discipline.	Mathematical concepts support specialized computing domains such as AI, machine learning, graphics, and data analytics.
4	WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.	The subject develops logical reasoning, analytical thinking, and problem-solving abilities required for research and innovation in computing.

13.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Engineering Mathematics-III (NEP)	1st	G.V. Kumbhojkar	P. Jamnadas LLP	2025
T2	Engineering mathematics	44th	Dr. B.S Grewal	Khanna Publications	2017
T3	Number Theory	1st	M. G. Nadkarni & J. S. Dani	Tata McGraw Hill Education	1992

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Advance Engg. Mathematics	4th	R.K. Jain & S.R.K Iyengar	Narosha Publication	2014
R2	Advance Engg. Mathematics	10th	Erwin Kreyszig	Wiley	2011
R3	Elementary Number Theory	7th	David M. Burton	McGraw Hill	2010
R4	Text Book of Matrices	6th	Shanti Narayan & P.K. Mittal	S. Chand Publication	2010

Online Resources

SN	Title	Description
01	https://nptel.ac.in/courses/122107037	Online course covering Linear Algebra, Fourier Series
02	https://www.youtube.com/@NesoAcademy	Video lectures for Modular Arithmetic
03	https://nptel.ac.in/courses/111105090	Online Course for Probability and Statistics in detail
04	https://www.youtube.com/@pradeepgiriacademy	Video lectures for LPP and NLPP
05	https://ocw.mit.edu/	MIT OpenCourseWare – Mathematics lecture, notes and videos

Chapter 14:
Subject - Computational Theory (Sem IV)

Overview			
Course code:	**CEPC241**	**Course Category:**	Program Core
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

14.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	-	-	3	3
Hours/Sem	45	-	-	-	45	**90**
Credits	3	-	-	-	3	**3**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

14.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	-	-	**-**	**-**

14.3 Course Objectives

Pre-requisite Course / Knowledge	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions, Discrete Structures.

Course Overview:

The study of Computational Theory enables students to develop strong understanding in Automata theory, Formal languages, decidability and undecidability. It enables to design automata models for computing problems. Analysing various automata models in its power, limitations, and applications.

Course Objective:

1. To acquire conceptual knowledge of grammar and languages.
2. To understand the relation between Regular Language and Finite Automata.
3. To understand the language hierarchy, CFG and CFL.
4. To design a PDA equivalent to a given context-free grammar/language.
5. To learn the principles of computation by designing a Turing Machine and understand the concept of decidability and undecidability.

14.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC241.1	To design regular expressions that represent regular languages and understand the properties of regular language.	Apply (L3)
CEPC241.2	To design and minimise and optimise Finite Automata for regular language recognition.	Apply (L3)
CEPC241.3	To design Context Free Grammars, simplify the CFG and understand the properties of CFL.	Apply (L3)
CEPC241.4	To design PDA for a given context-free grammar or language and enumerate its applications.	Apply (L3)
CEPC241.5	Design Turing machines as generators, deciders, and acceptors for various computational tasks.	Apply (L3)
CEPC241.6	Understand decidability and undecidability and apply it to learn the properties and problems of Recursive and Recursively enumerable languages.	Apply (L3)

14.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**BASIC CONCEPTS AND REGULAR LANGUAGES**	**CO1**	**L3**	**T1, T2 , T3 , R1, R2**	**6**
	1.1	Importance of TCS, Alphabets, Strings, Grammar , Chomsky Hierarchy , Languages				
	1.2	Regular Expression, Arden's theorem, Regular Grammar, Regular Language, Closure properties. Decision properties of RL, Pumping lemma for RL				
2	**Title**	**FINITE AUTOMATA**	**CO2**	**L3**	**T1, T3, R1, R2**	**8**
	2.1	Finite State machine (FSM) , Finite Automata (FA) : Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA).				
	2.2	NFA with ε- transitions , NFA to DFA Conversion				
	2.3	FSM with output: Moore and Mealy machines, Applications and limitations of FA.				
	2.2	Equivalence of Left and Right linear grammar, Equivalence of RG and FA				
3	**Title**	**CONTEXT FREE GRAMMAR**	**CO3**	**L3**	**T1, T2 , T3 , R1, R2**	**8**

	3.1	Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity, **Normal Forms:** Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)				
	3.2	**Simplification of CFG:** Eliminating unit productions, useless production, useless symbols, and Є-productions				
	3.3	**Normal Forms:** Chomsky Normal Form (CNF) and Greibach Normal Form (GNF)				
	3.4	Pumping Lemma of CFL , Closure properties of CFL , Applications of CFL				
4	**Title**	**PUSHDOWN AUTOMATA**	**CO4**	**L3**	**T1, T3, R1, R2**	**6**
	4.1	Definition, Language of PDA, PDA as generator, decider and acceptor of CFG				
	4.2	Deterministic PDA , Non- Deterministic PDA, Applications of PDA.				
	4.3	Equivalence of PDA and CFG.				
5	**Title**	**TURING MACHINE**	**CO5**	**L3**	**T1, T3, R1, R2**	**7**
	5.1	Definition, Design of TM as generator, decider and acceptor				
	5.2	Variants of TM: Multitrack, Multitape, Universal TM, Applications of TM, Power and Limitations of TMs.				
6	**Title**	**Decidability and Computability**	**CO6**	**L3**	**T1, T3, R1, R2**	**4**
	6.1	Decidability and Undecidability, Recursive and Recursively Enumerable Language , Properties of Re cursive and Recursively Enumerable language.				
	6.2	Halting Problem, Rice's Theorem, Post Correspondence Problem				
Self Study Topics	SS.1	RE in text search and replace, Application of Regular Languages in Compiler Design, Text Processing, and Natural Language Processing (NLP)				**3 hours/ week**
	SS.2	Minimization of DFA , Conversion of Moore to Mealy & Mealy to Moore machine.				
	SS.3	Applications of CFL : Parser, Markup languages				

	SS.4	Parsing & PDA: Top-Down Parsing, Bottom-up Parsing, Closure properties and Deterministic PDA.	
	SS.5	Algorithms using Turing Machine, The Model of Linear Bounded Automata	
	SS.6	NP Completeness of the SAT Problem, A Restricted Satisfiability Problem	

14.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA-1	1	CAT	Paper – Pen Pencil	Class Room Test	15	15	1 Hr
2	IA-2	2	CAT	Paper – Pen Pencil	Class Room Test	15	15	1 Hr
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	--
4	ESE	1	ESE	Paper- Pen, Pencil	Class Room Test	60	60	2.5 Hr

IA = Internal Assessment; **FA** = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of 3 modules
Assessment Instruments* → **What Tools and instruments used for the assessment.*
Assessment Methods* → **How Are assessments evaluated and/or executed.*
**refer section 3.8*

14.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC241.1	3	3	3	-	-	-	-	-	-	-	3	3	3
CEPC241.2	3	3	3	-	-	-	-	-	-	-	3	3	3
CEPC241.3	3	3	3	-	-	-	-	-	-	-	3	3	3
CEPC241.4	3	3	3	-	-	-	-	-	-	-	3	3	3
CEPC241.5	3	3	3	-	-	-	-	-	-	-	3	3	3
CEPC241.6	3	3	3	-	-	-	-	-	-	-	3	3	3

14.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK1	A systematic, theory based understanding of the nature sciences applicable to the discipline and awareness of relevant social sciences.	Computational theory provides a common language—algorithms and information structure—that allows scientists to formalize their theories and simulate complex systems, leading to more profound insights, higher predictability, and a greater awareness of the underlying mechanisms in both natural and social worlds.
2	WK2	Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	Computational theory provides the foundational mathematical framework that enables the transition from abstract concepts to practical computer-based solutions. By classifying problems based on their inherent difficulty, it supports detailed analysis and modeling across numerical methods, data analysis, statistics, and formal computer science.
3	WK3	A systematic theory based formulation of engineering fundamentals in the engineering discipline.	Computational theory acts as a systematic translator, converting abstract engineering mathematics into efficient, computable algorithms, thus providing a sound foundation for advanced engineering fields like robotics, AI, and complex simulations.
4	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.	Computational theory (or the Theory of Computation) serves as the foundational, theoretical framework for modern engineering, providing the mathematical models, algorithms, and logical structures that enable advanced, software-driven, and simulation-based engineering practices. It bridges abstract mathematics with practical engineering applications, driving innovation in areas such as AI, autonomous systems, and computational design.
5	WK8	Engagement with selected knowledge in the current literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.	Computational theory provides the vocabulary necessary to understand and analyse contemporary, fast-paced literature in computer science and data science. Computational theory fosters critical thinking by forcing a shift from simply using tools to understanding the underlying mechanics, capabilities, and limitations of machines. Computational theory

			encourages creative problem-solving by emphasising abstraction ; the ability to identify recurring patterns and ignore irrelevant details to focus on the core issue.

14.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Introduction to Automata Theory Language and Computation	3rd	**J**ohn E. Hopcroft, Rajeev Motwani, Jeffery D. Ullma**n**	Pearson Education	2008
T2	Theory of Computation	3rd	Michael Sipser	Cengage learning	2013
T3	Theory of Computation	Illustrated Edition	Vivek Kulkarni	Oxford University Press	2013

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Introduction to Languages and the Theory of Computation	6th	J. C. Martin	Tata McGraw Hill Publication	2013
R2	Theory of Computation: A Problem-Solving Approach	Kindle Edition	Kavi Mahesh	Wiley-India	2011

Online Resources

SN	Title	Description
01	YouTube : https://youtube.com/playlist?list=PLyqSpQzTE6M9-v4V62bCygAVYGluaijyo&si=PJazlO1atch-HQnR	NPTEL -NOC IITM COURSE

Chapter 15:
Subject - Data Base Management System (Sem IV)

Overview			
Course code:	**CEPC242**	**Course Category:**	Program Core
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

15.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	2	-	3	**8**
Hours/Sem	45	-	30	-	45	**120**
Credits	3	-	1	-		4

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

15.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	50%	50%	**100%**	**1**

15.3 Course Objectives

Pre-requisite Course / Knowledge	Data Structures

Course Overview:

The Database Management System course is intended to deliver the basic concepts of a database management system to students. In today's data-driven world, DBMS are essential for efficiently storing, managing, and analyzing the data. This course equips students with foundational concepts and practical skills to design and implement robust data-driven solutions across diverse domains.

Course Objective:

1. To learn the basics and understand the need of a database management system.
2. To construct ER/EER data model for real world applications
3. To develop a Relational Model from ER/EER.
4. To elaborate the concept of SQL to store and retrieve data efficiently.
5. To demonstrate notions of normalization for database design.
6. To understand the concepts of transaction, concurrency control recovery procedures.

15.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC242.1	Learn fundamentals and understand need of DBMS, data models, and architecture	Understand (L2)
CEPC242.2	Articulate ER/EER models for real-world applications	Apply (L3)
CEPC242.3	Transform ER/EER models into relational schemas	Apply (L3)
CEPC242.4	Apply SQL queries for data creation and retrieval	Apply (L3)
CEPC242.5	Analyze and apply normalization techniques	Analyze (L4)
CEPC242.6	Discuss transaction, concurrency, and recovery concepts	Understand (L2)

15.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction to Database Systems**	**CO1**	**L2**	**T1,T4, R1,R4**	**5**
	1.1	Introduction, Characteristics of databases				
	1.2	Filesystem V/s Database system, Users of a Database system				
	1.3	DBMS system architecture				
	1.4	Data Models, Data Independence				
	1.5	Database Administrator (DBA), Role of a DBA & database languages.				
2	**Title**	**The Entity- Relationship Model**	**CO2**	**L3**	**T1,R2,R3**	**8**
	2.1	Types of data Models, The Entity-Relationship (ER) Model				
	2.2	Entity Sets, Entity Types, Attributes and Keys				
	2.3	Relationship Sets, Relationship Types, Weak Entity Types,				
	2.4	Mapping Cardinality & Participation. Extended Entity-Relationship (EER) Model, Generalization, Specialization and Aggregation.				
3	**Title**	**Relational Model & Relational Algebra**	**CO3**	**L3**	**T2, R2,R4**	**10**
	3.1	Introduction to Relational Model, Relational Model and Relational Algebra				
	3.2	Relational Model Constraints and Relational Database Schemas				
	3.3	Concept and types of Keys, Mapping the ER and EER to relational model.				
	3.4	Introduction to Relational Algebra: Selection, Projection, Union, Cartesian Product, Joins, Intersection, Rename				

	3.5	Relational Algebra Queries.				
4	**Title**	**Structured Query Language (SQL)**	**CO4**	**L3**	**T2, T3, R1,R3**	**5**
	4.1	Overview of SQL, Data Definition Commands, Set operations, Aggregate function, Null values				
	4.2	Data Manipulation commands, Data Control commands, Views in SQL				
	4.3	Complex Queries using Group By, Joins , Nested queries, Integrity constraints in SQL				
	4.4	Security and authorization: Grant & Revoke in SQL, Aggregate functions, Hierarchical retrieval of data Functions and Procedures in SQL				
	4.5	Cursors, Trigger and its types, Recursive Queries, Nested Queries , Referential integrity in SQL.				
5	**Title**	**Relational Database Design**	**CO5**	**L4**	**T1,T4, R2,R3**	**8**
	5.1	Design guidelines for relational schema, Decomposition, Functional Dependencies & types				
	5.2	Database tables and normalization. Introduction to multi valued dependency				
	5.3	Need for normalization. Definition of Normal Forms- 1NF, 2NF, 3NF & BCNF.				
	5.4	Converting Relational Schema to higher normal forms				
6	**Title**	**Transaction Management, Concurrency & Recovery**	**CO6**	**L4**	**T2, T4, R2,R4**	**3**
	6.1	Transaction concepts, State Diagram, ACID Properties, Transaction Control Commands, Concurrent Executions.				
	6.2	Serializability – Conflict and View. Concurrency Control: Lock-based-protocols and Timestamp based protocols.				
	6.3	Deadlock handling, Recovery Concepts and Recovery System				
Self-Study	SS.1	Need & Applications of databases (banking, e-commerce, airlines, education etc)				**3 hours/ week**
	SS.2	Common ER Modeling Mistakes & Best Practices				
	SS.3	Common ER Modeling Mistakes & Best Practices				
	SS.4	Introduction to Relational Calculus				

	SS.5	Anomalies in Database Design	
	SS.6	Log based recovery methods.	

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Study of Database Fundamentals and DBMS Architecture	**CO1**	2
2	Identify the case study and detailed statement of the problem. Design an Entity Relationship (ER) / Extended Entity-Relationship (EER) Model.	**CO2**	2
3	Mapping ER/EER to Relational schema model.	**CO3**	2
4	Create a database using DDL and apply integrity constraints .	**CO4**	2
5	Perform data manipulations (DML) operations on populated databases.	**CO4**	2
6	Perform Simple, Nested queries and Complex queries using Join operation.	**CO4**	2
7	Perform DCL commands (Grant & Revoke)	**CO4**	2
8	Perform TCL command (Start, commit, rollback & save point)	**CO4**	2
9	Implementation of procedure and functions in SQL.	**CO4**	2
10	Implementation of Views and Triggers.	**CO4**	2
11	Study of Database Normalization and Normal Forms (1NF, 2NF, 3NF, BCNF)	**CO5**	2
12	Demonstration & implementation of Transaction and Concurrency control techniques using locks.	**CO6**	2
13	Mini project (Design simple GUI and Backend Connectivity)	**CO6**	2

Sr. No.	Guidelines for Mini proj / Case Study takeaway (Suggested)	Hours
Part A	Identify a real-world application (e.g., hospital management, online shopping, college admission, banking system or any similar applications) and perform the following: 1. Formulate a clear problem statement. 2. Design the ER / EER diagram showing entities, attributes, relationships, and constraints. 3. Convert the ER/EER model into a relational schema with primary keys, foreign keys, and cardinality constraints. Expected Output: 1. ER/EER diagram 2. Relational schema 3. Entity descriptions	2 Hours

Part B	Using the relational schema created in Part A: 1. Create all tables using DDL commands with appropriate integrity constraints (PK, FK, CHECK, UNIQUE, NOT NULL). 2. Populate tables with sample data (minimum 10–15 records per table). 3. Perform DML operations (INSERT, UPDATE, DELETE). 4. Execute basic and complex SQL queries, including: a) JOINs b) Subqueries c) Aggregate functions d) Group By / Having e) Set operations Expected Output: 1. DDL scripts 2. DML scripts 3. SQL query results (screenshots or printouts)	2 Hours

15.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA-1	1	CAT	Paper – Pen	Class Room Test	15	15	1 Hr
2	IA-2	1	CAT	Paper – Pen	Class Room Test	15	15	1 Hr
3	FA	2	CAT	Teachers Choice*	Teachers Choice*	10	10	-
4	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5 Hrs

IA = Internal Assessment; **FA** = Formative Assessment;*
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of 3 modules
Assessment Instruments → **What Tools and instruments used for the assessment.*
Assessment Methods → **How Are assessments evaluated and/or executed.*
**refer section 3.8*

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical	Journal (Rubrics Based)	10	20	2 Hrs
2	Classroom Participation	-	CAT	Attendance	Record and Rubrics	5	10	-
3	Mini Project	1	CAT	Mini Project /Online Certification (MOOCs)	Rubrics Based	10	20	-
4	ESE	1	ESE	Oral and Practical	-	25	50	-

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

15.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC242.1	3	2	-	-	-	-	-	3	2	-	3	3	-
CEPC242.2	3	3	3	-	2	-	-	3	2	-	3	3	-
CEPC242.3	3	3	3	-	3	-	-	3	3	-	3	3	-
CEPC242.4	3	3	-	-	3	-	-	3	3	-	3	3	-
CEPC242.5	3	3	-	-	3	-	-	3	3	-	3	3	3
CEPC242.6	3	2	2	-	-	-	-	3	2	-	3	3	-

15.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK1**	Apply knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Students begin with fundamental knowledge (definitions, architecture) and develop basic understanding. This builds awareness and interest in database systems.
2	**WK2**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Requires understanding of concepts and applying them to design models. Often done in groups, encouraging teamwork and structured problem-solving.
3	**WK3**	Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health, safety, cultural, societal, and environmental factors.	Focuses on practical implementation and solving real database queries, promoting logical thinking and problem-solving attitude.
4	**WK4**	It provides theoretical frameworks and bodies of knowledge for the	Focus on understanding & usage of tools

		accepted practice areas in the engineering discipline.;	
5	**WK5**	Knowledge, including efficient resource use, to support engineering design and operations in a practice area	Students create solutions for engineering problems and design/develop outcome to meet identified needs.
6	**WK6**	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve engineering problems.
7	**WK8**	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.	Conduct investigations of engineering problems including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.student will be able to recognize the need and ability for independent and life-long learning, adaptability to new and emerging technologies and critical thinking .

15.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Database System Concepts	7th	Korth & Slberchatz, Sudarshan	McGraw Hill	2023
T2	Fundamentals of Database Systems	7th	Elmasri and Navathe	Pearson education	2017
T3	SQL and PL/SQL for Oracle 10g Black Book	1st	Dr. P.S. Deshpande	Dreamtech Press	2011
T4	Database Management systems	1st	G.K gupta	McGraw Hill	2011

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Database Management Systems	3rd	R.Ramakrishnan, Johannes Gehrke	McGraw Hill	2014
R2	An Introduction to Database Systems	8th	C.J. Date	Pearson education	2006
R3	Database Systems: A practical Approach to Design ,Implementation and Management.	5th	Thomas Connolly, Carlyn Begg	Pearson/ Addison-Wesley	2014

Online Resources

SN	Title	Description
O1	Introduction to Database Systems	**NPTEL link**
O2	https://www.postgresql.org/	Advanced Open source relational database
O3	Draw.io	**Software:** ER Diagram & Data Modeling Tool

Chapter 16:
Subject - Computer Networks (Sem IV)

Overview			
Course code:	**CEPC243**	**Course Category:**	Program Core
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

16.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	3	-	2	-	2	**7**
Hours/Sem	45	-	30	-	45	**120**
Credits	3	-	1	-	-	**4**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

16.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	**100%**	**3**
Labs	50%	50%	**100%**	**1**

16.3 Course Objectives

Pre-requisite Course / Knowledge	Knowledge of any programming or algorithms is desirable

Course Overview:

This course provides a comprehensive overview of how digital devices communicate, covering the fundamentals of network architectures, protocols, and technologies. Knowledge of Computer networking is required to understand communication between browsers, webservers, routers, Hubs, Layer 2, 3 switches. This is going to help to understand cloud computing, machine learning, and AI engineering.

Course Objective:

1. To introduce basic concepts of computer networking and layered architecture.
2. To investigate the complexities and challenges in Data Link Layer.
3. To understand IP primitives and routing algorithms.
4. To elaborate connection oriented and connection-less protocols.
5. To demonstrate notions of application layers protocols.
6. To create and simulate practical network based applications.

16.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPC243.1	Explain the basics of computer network components.	Understand (L2)
CEPC243.2	Explore the different services and design challenges of the data link layer.	Understand (L2)
CEPC243.3	Classify IP addressing with subnetting and super netting techniques.	Understand (L2)
CEPC243.4	To learn and apply concepts of connection management and flow control.	Apply (L3)
CEPC243.5	To learn and apply protocols concepts at the application layer.	Apply (L3)
CEPC243.6	To design and develop network applications using simulation tools and socket programming.	Create (L6)

16.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction to Networking**	**CO1**	**L3**	**T1, R1,R5**	**6**
	1.1	Introduction to computer network, Network Devices				
	1.2	Network topology				
	1.3	Switching: Circuit-Switched Networks, Packet Switching				
	1.4	Network Types: LAN, MAN, WAN, Layered architecture				
	1.5	TCP/IP model, Difference between OSI and TCP/IP.				
2	**Title**	**Physical and Data Link Layer**	**CO2**	**L4**	**T1,T2,R2,R5**	**9**
	2.1	Physical Layer: Communication mechanisms and Electromagnetic Spectrum,				
	2.2	Guided Transmission Media: Twisted pair, Coaxial, Fiber optics				
	2.3	DLL Design Issues (Services, Framing, Error Control, Flow Control),				
	2.4	Error Detection and Correction (Hamming Code, CRC, Checksum)				
	2.5	Elementary Data Link protocols, Stop and Wait,				
	2.6	Sliding Window (Go-Back-N, Selective Repeat),				
	2.7	Medium Access Control Sublayer Channel Allocation problem, Multiple Access Protocol (ALOHA)				
	2.8	Carrier Sense Multiple Access, (CSMA/CD)				
3	**Title**	**Network Layer**	**CO3**	**L2**	**T1,R1,R2**	**8**
	3.1	Network Layer: Communication Primitives, IPv4 Addressing: classful and classless				
	3.2	Subnetting, Introduction to IPv4 Protocol,				
	3.3	IPv4 Header format, Network Address Translation (NAT)				
	3.4	IPv6 addressing, IPv4 vs IPv6 addressing				
	3.5	Routed vs Routing protocols, Classification of Routing algorithms.				

	3.6	Shortest Path algorithms (Dijkastra's), Link State Routing				
	3.7	Distance Vector Routing, ICMP.				
4	**Title**	**Transport Layer**	**CO4**	**L3**	**T3, R2,R3**	**8**
	4.1	Transport Layer: Service primitives				
	4.2	Sockets				
	4.3	Connection management (Handshake), UDP				
	4.4	TCP, TCP state transition,				
	4.5	TCP timers, TCP Flow control (sliding Window),				
	4.6	TCP congestion control.				
5	**Title**	**Application Layer**	**CO5**	**L3**	**T1,R1,R2**	**6**
	5.1	HTTP, HTTPS				
	5.2	SMTP, Telnet,				
	5.3	FTP, DHCP				
	5.4	DNS types, DNS name server				
6	**Title**	**Socket Programming and Simulation**	**CO6**	**L6**	**T2,R4,R5**	**8**
	6.1	Introduction to Socket Programming				
	6.2	Types of Sockets, Socket API basics				
	6.3	Socket Life Cycle				
	6.4	TCP client server, UDP client server,				
	6.5	Introduction to Wireshark Packet capturing tool,				
	6.6	Simulation using ns3.				
Self - Study	SS.1	OSI Model, Basic Networking Commands.				2 hours/week
	SS.2	Modulation Techniques, Byte stuffing vs Bit stuffing, ARQ Mechanism, CISCO Packet tracer.				
	SS.3	Advanced IP Addressing and Subnetting, Packet Structure and Analysis. ICMP in real life, IP spoofing (basic idea),Firewalls				
	SS.4	UDP vs TCP (Real Applications),TCP Congestion control algorithms, Performance Metrics, Network troubleshooting tools(Netstat, Telnet)				
	SS.5	Cookies and sessions, Digital Certificates, SSH, Telnet Vs SSH, Command Line tools				
	SS.6	Advanced socket concepts,Real applications using Sockets.Open ports and vulnerabilities Basic idea of: Port scanning ,Denial of Service (DoS)				

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Identify computer networking like Switches, Hub, Router, Cables. Design Straight and Cross connection UTP cable using crimping tool and test wiring of connection using Network tester	CO1	2
2	Execute Networking related commands on Windows platform a)ping www.google.com b)netstat -r c)ipconfig d)arp	CO1	2
3	Implement GO-BACK-N Algorithm using C.	CO2	2

4	Run wireshark packet capturing software and run in promiscuous mode, check header details of MAC header to find the 48 bit address of ethernet .	CO2	2
5	Design a Implement Stop and Wait Algorithm.	CO2	2
6	Implement Dijstra's Algorithm for routing.	CO3	2
7	Design a small computer network using 5 client server switches of 8 ports. Check speed transmission from client to server using Cisco Packet tracer.	CO3	2
8	Implement UDP client Server application. Use suitable port number and IP address as per requirement.	CO4	2
9	Run Wireshark packet capturing software and capture UDP, TCP,HTTP, DNS, ethernet packet and analyse its header.	CO4	2
10	Capture and analyse SMTP packets. (On the background of the system you should open your email to capture details of these packets. Find out source email ID, Source IP address, destination IP address.	CO5	2
11	Implement Telnet/FTP protocol for file transfer.	CO5	2
12	Implement TCP layer Sliding window protocol in C language.	CO6	2
13	Implement TCP Client -Server application. two windows on the same computer while implementing this experiment.	CO6	2

16.6 Assessment Methodologies and Tools

Theory Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA 1	1	CAT	Paper – Pen	Class Room Test	15	15	1 Hr
2	IA2	1	CAT	Paper-Pen	Class Room Test	15	15	1 Hr
3	FA	2	CAT	Teacher Choice*	Teacher Choice*	10	10	-
4	ESE	1	ESE	Paper- Pen	Class Room Test	60	60	2.5 Hrs

IA = Internal Assessment; **FA** = Formative Assessment;
IA 1 will be conducted after completion of 3 Modules; IA 2 will be conducted after completion of 3 modules
*Assessment Instruments → **What** Tools and instruments used for the assessment.
*Assessment Methods → **How** Are assessments evaluated and/or executed.
*refer section 3.8

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical	Journal (Rubrics Based)	20	40	2Hr
2	Class Participation	-	CAT	Attendance	Record and Observation	05	10	-
3	ESE	1	ESE	Oral and Practical	Rubrics	25	50	1Hr

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

16.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPC243.1	3	2	2	-	-	-	-	-	-	-	-	3	-
CEPC243.2	2	3	2	-	-	-	-	-	-	-	-	3	-
CEPC243.3	3	2	2	-	-	-	-	-	-	-	-	3	-
CEPC243.4	3	2	-	-	-	-	-	-	-	-	-	3	-
CEPC243.5	3	2	-	-	-	-	-	-	-	2	-	3	-
CEPC243.6	2	2	3	2	3	-	-	3	2	2	2	3	-

16.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK1**	Apply knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	Course covers fundamental concepts such as network components, IP addressing, protocols, and flow control.
2	**WK 2**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Students analyze networking problems, such as data link layer challenges, subnetting logic, and protocol behavior.
3	**WK3**	Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health, safety, cultural, societal, and environmental factors.	Involves designing network applications and understanding protocol design aspects.
4	**WK4**	Use research-based knowledge and research methods including design of experiments, analysis and	Students perform testing, debugging, simulation, and result analysis using tools.

		interpretation of data, and synthesis of information to provide valid conclusions.	
5	**WK5**	Create, select, and apply appropriate modern computing tools and technologies (e.g., simulators, programming languages, networking tools, packet analyzers) with an understanding of their limitations.	Use of simulation tools (NS2/NS3), socket programming, packet analyzers

16.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	*Computer Networking: A Top-Down Approach*	8th	Kurose, J. F., & Ross, K. W.	Pearson	2021
T2	*Data Communications and Networking*	5 th	Behrouz A. Forouzan	Mc Graw Hill education	2013
T3	Illustrated TCP/IP	Volume 1, 2	W. Richard Stevens	Prentice Hall	2015

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Computer Networks: Principles, Technologies & Protocols for Network Design.	1 st	Natalia Olifer & Victor Olifer	Wiley India	2011
R2	Computer Networks: A Systems Approach	2 nd	Larry L.Peterson, Bruce S.Davie	Morgan Kaufmann (an imprint of Elsevier)	2000
R3	An Engineering Approach to Computer Networking: ATM Networks, the Internet, and the Telephone Network	1 st	Srinivasan Keshav	Pearson Education (India)	2002
R4	ns-3 Tutorial Release ns-3-dev	-		ns-3 Project	2025
R5	Computer networking for beginners	-	Bansod, Dr Patil	Shroff Publisher	2024

Online Resources

SN	Title	Description
01	NEPTEL : https://nptel.ac.in/courses/106105163	This course will discuss the basic concepts of computer architecture and organization
02	YouTube : https://www.youtube.com/@computerarchitectureandorg2015	This channel will discuss the basic concepts of computer architecture and organization

Chapter 17:
Subject - Design Thinking (Sem IV)

Overview			
Course code:	**IGEM241**	**Course Category:**	Humanities Social Sciences
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

17.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	2	2	-	**4**
Hours/Sem	-	-	30	30	-	**60**
Credits	-	-	2		-	**2**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

17.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	**-**	**-**
Tutorial	100%	-	**100%**	**2**

17.3 Course Objectives

Pre-requisite Course / Knowledge	Digital system, computer fundamentals, introduction of 8086.

Course Overview:

This course introduces students to the principles, process, and practical application of design thinking as a human-cantered approach to problem-solving. It focuses on understanding user needs, redefining problems, and creating innovative solutions through iterative design.

Course Objective:

1. To introduce learners to the fundamental concepts of Design Thinking.
2. To make learners understand the different stages involved in the Design Thinking process.
3. To acquaint learners with various tools used in Design Thinking.
4. To study techniques used for generating solutions to problems.
5. To provide exposure to different case studies related to Design Thinking.
6. To design, develop, and evaluate a prototype.

17.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGEM241.1	Differentiate between traditional problem-solving methods and the Design Thinking approach, and explain its core principles.	Analyze (L4)
IGEM241.2	Develop a user persona by applying empathy-based techniques.	Apply (L3)
IGEM241.3	Formulate a clear problem statement using appropriate Design Thinking tools.	Apply (L3)
IGEM241.4	Apply ideation methods to generate multiple solution options for a problem.	Apply (L3)
IGEM241.5	Build prototypes using a variety of techniques.	Create (L6)
IGEM241.6	Evaluate prototypes and collect feedback to improve and refine them.	Evaluate (L5)

17.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction to Design Thinking**	**CO1**	**L4**	**T1, R1**	**5**
	1.1	Definition, History and need of Design Thinking				
	1.2	Difference between Traditional Problem Solving and Design Thinking approach				
	1.3	Key tenets of Design Thinking				
2	**Title**	**Empathize**	**CO2**	**L3**	**T1, T2, R1**	**5**
	2.1	Foundation of Empathy and its purpose				
	2.2	Methods for understanding user needs: Interviews, observation and immersion				
	2.3	Empathy Mapping and persona development				
3	**Title**	**Define – Problem Definition and Analysis**	**CO3**	**L3**	**T2, T3, R1**	**5**
	3.1	Significance of defining a problem				
	3.2	Analyse research data to identify core problem				
	3.2	Crafting actionable Problem Statements (Point of View -POV)				
4	**Title**	**Ideate – Generating solution**	**CO4**	**L3**	**T1, T2, R2**	**5**
	4.1	Divergent vs Convergent thinking				
	4.2	Brainstorming techniques: Mind mapping, SCAMPER				
	4.3	Concept selection and feasibility assessment				
5	**Title**	**Prototype - Making ideas tangible**	**CO5**	**L6**	**T1, T3, R1**	**3**
	5.1	Low Fidelity to High Fidelity Prototype				
	5.2	Rapid Prototyping technique				
6	**Title**	**Test – Iteration and Feedback**	**CO6**	**L5**	**T1, T2, R1**	**3**
	6.1	Guidelines for conducting test				
	6.2	User validation and usability testing				

	6.3	Developing Feedback loops to refine the prototype based on testing	
Self-Study	SS.1	Case Studies from various domains	**2 hours/week**
	SS.2	Empathy and User Research	
	SS.3	Creating a Persona – A Step by step guide with tips and examples	
	SS.4	How to run an effective ideation workshop: A step by step guide	
	SS.5	Various case studies related to prototyping	
	SS.6	To find End Goals of test: Desirability, Feasibility and Viability	

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Customer Journey Mapping – Visualize user interaction from discovery to usage and identify pain points	CO2	2
2	Stakeholder Mapping – Identify stakeholders and categorize them by influence and interest	CO2	2
3	How Might We Problem Framing – Convert insights into actionable problem statements	CO3	2
4	Brainstorming Session – Generate creative ideas using mind mapping and brainwriting techniques	CO4	2
5	Affinity Diagramming – Group ideas into themes to identify patterns and insights	CO3	2
6	Rapid Prototyping – Create quick, low-fidelity prototypes focusing on functionality	CO5	2
7	Wireframing – Design basic layouts for mobile/web interfaces	CO5	2
8	Role-Playing – Simulate user interactions with prototypes to gather feedback	CO6	2
9	Usability Testing – Test prototypes with users to identify issues and improvements	CO6	2
10	Feedback Loop and Iteration – Refine solutions based on user feedback and document improvements	CO6	2

Assignments (Suggested list of Assignments)

SN	List of Assignments
1	Create an empathy map for a specific target user group. Divide it into four sections: *Says, Thinks, Feels, and Does*. Gather insights by interviewing users or researching their experiences.
2	Based on research, develop user personas that include demographics, motivations, pain points, and goals. Present the persona to the class.
3	Select three real-life products with both good and bad design aspects. Analyse them and explain why you consider their design effective or ineffective.
4	Explore any open-source design thinking tool and write a short report about it. You may also conduct a user survey to support your findings.

17.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiment	10	CAT	Practical Experiments	Journal (Rubrics Based)	**25**	50	2 Hr
2	Assignment	4	CAT	Teacher Choice	Teacher Choice	**10**	20	-
3	Report	1	CAT	Report Writing	Rubrics based	**10**	20	-
4	Attendance	1	CAT	Attendance	Record based	**5**	10	-

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

17.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
IGEM241.1	3	3	-	-	2	-	-	2	2	-	-	2	2
IGEM241.2	2	3	3	2	2	-	-	2	2	-	-	3	2
IGEM241.3	3	3	3	2	2	--	-	2	2	-	-	3	2
IGEM241.4	2	2	2	2	2	-	-	2	2	-	-	3	2
IGEM241.5	2	2	2	2	2	-	-	2	2	-	-	3	2
IGEM241.6	2	2	2	3	2	-	-	2	2	-	-	3	2

17.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	Design Thinking involves analytical and data-driven approaches for understanding user needs and evaluating solutions.

2	WK5	Knowledge including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts.	The subject promotes sustainable and resource-efficient solution development for real-world problems.
3	WK7	Knowledge of the role of engineering in society and identified issues in engineering practice including public safety and sustainable development.	Design Thinking focuses on solving societal problems with user-centric and socially responsible approaches.
4	WK8	Engagement with current research literature, critical thinking, and creative approaches to evaluate emerging issues.	The subject develops innovation, creativity, critical thinking, and problem-solving abilities.

17.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-Solving	1st	Pavan Soni	Penguin Random House India Pvt. Ltd.	2022
T2	Design Thinking: Methodology Book	1st	Emrah Yayici	CRC Press	2016
T3	Handbook of Design Thinking	1st	Christian Mueller-Roterberg	Independently Published	2018

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School	2nd	Idris Mootee	Wiley	2013
R2	Change by Design	Revised Edition	Tim Brown	Harper Business	2009

Online Resources

SN	Title	Description
01	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview	SWAYAM course covering fundamentals of Design Thinking, innovation processes, user-centered design, ideation techniques, and real-world applications.
02	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr. Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview	SWAYAM course introducing Design Thinking concepts, problem-solving

		methodologies, empathy, ideation, prototyping, and testing techniques.
03	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing	Online resource explaining usability testing principles, user evaluation methods, feedback collection techniques, and best practices for improving user experience and product design.

Chapter 18:
Subject - Engineering Fundamentals & Technical Skills (Sem IV)

Overview			
Course code:	**IGVS241**	**Course Category:**	Vocational and Skill Enhancement Course
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

18.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	-	2	-	2
Hours/Sem	-	-	-	30	-	**30**
Credits	-	-	-	1	-	**1**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

18.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Labs	50%	50%	**100%**	**1**

18.3 Course Objectives

Pre-requisite Course / Knowledge	Programming for Problem Solving, Engineering Mathematics.

Course Overview:

The course series provides comprehensive training in programming, problem solving, database management, and competitive coding skills required for academic excellence and industry readiness. It covers Python and Java programming fundamentals, object-oriented programming, data structures, algorithms, SQL query writing, debugging techniques, and optimization methods. The courses also focus on logical reasoning, competitive programming strategies, advanced problem-solving techniques, graph and string algorithms, and number theory concepts. Through hands-on coding practice, placement-oriented challenges, mock tests, and real-world case studies, students develop strong analytical, technical, and interview preparation skills essential for software development, coding competitions, and career opportunities in the IT industry.

Course Objective:

1. To develop programming and logical problem-solving skills using Python fundamentals, data structures, object-oriented concepts, and placement-oriented coding techniques.

2. To apply Java programming concepts, object-oriented principles, and data structures for developing efficient solutions to coding and real-world programming problems.
3. To understand and implement SQL queries, joins, subqueries, indexing, and aggregate functions for effective database management and data retrieval.
4. To enhance algorithmic thinking and coding efficiency through optimization techniques, modular arithmetic, and competitive programming strategies.
5. To strengthen analytical reasoning, debugging abilities, and optimization skills for solving computational and logical problems efficiently.
6. To apply advanced algorithms, graph techniques, string algorithms, and number theory concepts in solving complex programming and real-world competitive coding challenges.

18.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGVS241.1	Apply Python programming concepts, data structures, object-oriented programming principles, and competitive coding techniques to solve logical and placement-oriented programming problems efficiently.	Apply (L3)
IGVS241.2	Develop Java-based solutions using programming fundamentals, object-oriented concepts, data structures, algorithms, and debugging techniques for software development and coding challenges.	Apply (L3)
IGVS241.3	Design and execute SQL queries using joins, subqueries, aggregate functions, indexing, and views for efficient database management and data retrieval applications.	Understand (L2)
IGVS241.4	Analyze and solve competitive programming problems using algorithmic techniques such as greedy methods, divide-and-conquer strategies, sliding window, prefix sums, and modular arithmetic.	Analyze (L4)
IGVS241.5	Demonstrate effective problem-solving abilities through optimization techniques, debugging strategies, test case validation, and analytical reasoning for computational problems.	Analyze (L4)
IGVS241.6	Apply advanced algorithms including graph algorithms, weighted pathfinding, string matching algorithms, and number theory concepts to solve complex real-world and competitive programming challenges.	Evaluate (L5)

18.5 Modules / Syllabus Content

Demo Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Python Programming and Problem Solving**	**CO1**	Apply (L3)	**T1, R1**	**5**
	1.1	**Python Programming Fundamentals** 1. Variables, Data Types, and Operators 2. Conditional Statements and Loops 3. Functions, Lists, and String Handling				
	1.2	**Data Structures using Python** 1. Lists, Tuples, and Dictionaries 2. Stack and Queue Implementation 3. Searching and Sorting Techniques, Time Complexity and Optimization Techniques 2. Pattern Programming and Logical Problem Solving 3. Placement-Oriented Coding Challenges				
	1.3	**Object-Oriented Programming in Python** 1. Classes and Objects 2. Inheritance and Polymorphism 3. Constructors and Encapsulation				
	1.4	**Activity**: Develop Python programs to perform searching and sorting techniques such as Linear Search, Binary Search, Bubble Sort, and Selection Sort.				
	1.5	**Activity**: Analyze the time complexity of different algorithms and implement optimized coding solutions for placement-oriented problems.				
2	**Title**	**Core Java Programming and Problem Solving**	**CO2**	Apply (L3)	T2, R2	5
	2.1	**Java Programming Fundamentals** 1. Variables, Data Types, Operators, and Input/Output 2. Conditional Statements and Looping Constructs 3. Methods, Arrays, and String Handling				
	2.2	**Data Structures using Java** 1. Arrays, Array List, and LinkedList 2. Stack, Queue, and HashMap Implementation 3. Searching and Sorting Algorithms, **Competitive Coding using Java** 1. Time Complexity and Optimization Techniques 2. Pattern Programming and Logical Coding Problems 3. Placement-Oriented Coding Challenges				
	2.3	**Object-Oriented Programming in Java** 1. Classes, Objects, and Constructors 2. Inheritance, Polymorphism, and Abstraction 3. Encapsulation and Interface Concepts				
	2.4	**Activity**: Develop Java programs to perform searching and sorting algorithms such as Linear Search, Binary Search, Bubble Sort, and Merge Sort.				
	2.5	**Activity**: Create Java classes and objects to model real-world applications using constructors and methods.				
3	Title	**SQL Basics and Intermediate**	**CO3**	Apply (L3)	T3, r3	4
	3.1	Understanding SQL Syntax, Writing Complex Queries, Advanced Joins (INNER OUTER, CROSS)				
	3.2	Nested Subqueries, Indexing Techniques, Aggregate Functions (GROUP BY, HAVING) Using Views for Query Simplification				
	3.3	**Activity**: Develop SQL queries using nested subqueries for data analysis and conditional retrieval.				
	3.4	**Activity**: Develop a database application using views to generate summarized reports from multiple tables.				
4	Title	**Competitive Programming Basics**	**CO4**	Apply (L3)	T4, R4	4
	4.1	Greedy Algorithms in Practice, Divide and Conquer Techniques, Sliding Window and Two Pointers, Prefix Sums				
	4.2	Dynamic Array Usage in Problem Solving, Applying Modular Arithmetic in Coding Challenges				
	4.3	**Activity**: Implement prefix sum algorithms to perform efficient range sum and cumulative data analysis operations.				

	4.4	**Activity**: Solve competitive programming challenges involving modular arithmetic and large number computations efficiently.				
5	Title	**Problem Solving Techniques**	**CO5**	Apply (L3)	T5, R5	4
	5.1	Understanding Problem Statements, Optimizing Solutions (Time and Space Complexity)				
	5.2	Test Case Generation and Validation, Debugging Advanced Logical Errors				
	5.3	**Activity**: Analyze different programming problem statements and identify inputs, outputs, constraints, and expected solutions.				
	5.4	**Activity**: Develop automated test scenarios to verify the accuracy and reliability of coding solutions.				
6	Title	**Advanced Problem Solving**	**CO6**	Analyze (L4)	T6, r6	4
	6.1	Advanced Graph Problems (Dynamic Graph Queries), Pathfinding in Weighted Graphs), String Algorithms (KMP, Z Algorithm, Rabin- Karp)				
	6.2	Number Theory (Primality Testing, GCD, LCM, Chinese Remainder Theorem), Real- world Case Studies in Competitive Programming				
	6.3	**Activity**: Develop programs for dynamic graph queries and real-time pathfinding applications using graph data structures.				
	6.4	**Activity**: Design optimized coding solutions for industry-level problem statements using advanced algorithms and data structures.				

18.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Activities	12	CAT	Practical	Journal (Rubrics Based)	20	80	2 Hr
2	Class Participation	-	CAT	Class Participation	Record and Rubrics Based	5	20	-

Note:

1. *CAT Activity will be part of Term Work.*

18.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
IGVS241.1	-	-	-	-	-	2	-	2	3	3	-	2	-
IGVS241.2	2	2	-	-	2	-	-	-	3	3	-	-	2
IGVS241.3	-	-	2	2	-	-	-	-	-	-	-	-	2
IGVS241.4	2	2	-	-	-	2	-	2	3	-	-	3	-
IGVS241.5	-	2	-	-	2	-	-	3	-	3	2	-	-
IGVS241.6	2	3	2	-	2	2	-	-	2	3	2	3	2

18.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK1	A systematic, theory-based understanding of the natural sciences applicable to engineering fundamentals.	Students develop foundational knowledge of Python programming, Java programming, SQL, algorithms, and computational problem-solving concepts essential for engineering and software applications.
2	WK2	Conceptually based mathematics, numerical analysis, statistics, and formal aspects of computer and information science to support engineering analysis and modeling.	Competitive programming, time complexity analysis, modular arithmetic, graph algorithms, and optimization techniques strengthen analytical, mathematical, and logical reasoning abilities.
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in engineering specialization.	The course develops core understanding of data structures, object-oriented programming, database systems, searching and sorting techniques, and advanced computational methods required for computer engineering specialization.
4	WK5	Engineering practice is supported by techniques, resources, and modern engineering and IT tools necessary for engineering activities.	Practical implementation using Python, Java, SQL platforms, coding environments, debugging tools, GitHub, and online coding platforms enhances modern software engineering practices.
5	WK6	Engineering practice is informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues relevant to professional engineering practice.	Real-world case studies, debugging practices, and placement-oriented coding activities improve professional decision-making and responsible software development skills.

18.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Python Programming: An Introduction to Computer Science	3rd	John Zelle	Franklin, Beedle & Associates	2016
T2	Java: The Complete Reference	11th	Herbert Schildt	McGraw Hill	2019
T3	Learning SQL	3rd	Alan Beaulieu	O'Reilly Media	2020
T4	Database System Concepts	7th	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	2019

T5	*Problem Solving with Algorithms and Data Structures using Python*	3rd	Bradley N. Miller, David L. Ranum	Franklin, Beedle & Associates	2011
T6	*Algorithm Design*	1st	Jon Kleinberg, Éva Tardos	Pearson	2005

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Automate the Boring Stuff with Python	2nd	Al Sweigart	No Starch Press	2019
R2	Introduction to Programming in Java	2nd	Robert Sedgewick, Kevin Wayne	Addison-Wesley	2017
R3	SQL Practice Problems	1st	Sylvia Moestl Vasilik	Manning Publications	2017
R4	Database Management Systems	3rd	Raghu Ramakrishnan,	McGraw Hill	2002
R5	Guide to Competitive Programming	1st	Antti Laaksonen	Springer	2017
R6	Algorithms Unlocked	1st	Thomas H. Cormen	MIT Press	2013

Online Resources

SN	Title	Description
O1	https://leetcode.com	A student-friendly platform to practice coding problems, data structures, and algorithms for improving programming skills and preparing for placements.
O2	https://docs.oracle.com/en/java/javase/26/	Official Java learning resource for students to understand core Java concepts, syntax, libraries, and programming fundamentals.
O3	https://sqlzoo.net/wiki/SQL_Tutorial	Interactive SQL practice website designed for students to learn and apply database queries step-by-step.
O4	https://codeforces.com/	Competitive programming platform for students to practice coding challenges and improve problem-solving speed and accuracy.
O5	https://www.interviewbit.com/	Structured learning platform for students to prepare for technical interviews through coding practice and conceptual learning.

Chapter 19:
Subject - AI Tools (SEM IV)

Overview			
Course code:	**CEVS241**	**Course Category:**	Vocational and Skill Enhancement Course
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

19.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	2	-	-	2	-	**4**
Hours/Sem	30	-	-	30	-	**60**
Credits	-	-	2		-	**2**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

19.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	-	-
Labs	50%	50%	**100%**	**2**

19.3 Course Objectives

Pre-requisite Course / Knowledge	Knowledge of any programming or algorithms is desirable

Course Overview:

This course provides hands-on exposure to modern AI-powered tools across writing, image generation, coding, research, and workflow automation. Students will learn to effectively integrate these tools into real-world academic, research, and industrial applications.

Course Objective:

1. To introduce students to the landscape and capabilities of modern AI tools used in various domains.
2. To familiarize students with the use of AI tools for enhancing productivity in writing, coding, research, and design tasks.
3. To provide exposure to AI-based systems for generating and processing text, images, and code.
4. To impart knowledge of integrating multiple AI tools for building automated workflows.

5	To create awareness about ethical considerations, limitations, and responsible use of AI technologies.

19.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEVS242.1	Use AI tools effectively for content creation and communication	Apply (L3)
CEVS242.2	Generate and evaluate AI-based visual outputs	Evaluate (L5)
CEVS242.3	Apply AI-assisted coding in software development	Apply (L3)
CEVS242.4	Conduct efficient AI-supported research	Analyze (L4)
CEVS242.5	Design automated workflows integrating multiple AI tools	Create (L6)

19.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**AI for Writing & Content Creation**	**CO1**	**L3**	**T1, R2**	**7**
	1.1	AI-assisted writing fundamentals				
	1.2	Prompt engineering for content generation				
	1.3	Blog writing, reports, technical documentation				
	1.4	Summarization and paraphrasing techniques				
	1.5	Tone adaptation and multilingual writing				
2	**Title**	**Image Generation Tools**	**CO2**	**L5**	**T3**	**5**
	2.1	Basics of generative AI in image synthesis				
	2.2	Prompt design for image creation				
	2.3	Style transfer and artistic rendering				
3	**Title**	**AI Code Assistants**	**CO3**	**L3**	**T3, T5, R3**	**5**
	3.1	AI-assisted programming concepts				
	3.2	Code generation, debugging, and optimization				
	3.3	Auto-completion and documentation generation				
	3.4	Limitations and risks in AI-generated code				
4	**Title**	**Research & Knowledge Tools**	**CO4**	**L4**	**T4, R2**	**4**
	4.1	AI in academic research				
	4.2	Literature review automation				
	4.3	Citation generation and validation				
	4.4	Knowledge extraction and summarization				
5	**Title**	**Workflow Automation**	**CO5**	**L6**	**T4, T2, R4**	**5**
	5.1	Introduction to no-code/low-code automation				
	5.2	Integrating AI tools into workflows				
	5.3	Event-based automation and triggers				
	5.4	Building intelligent pipelines				

Self - Study	SS.1	Explore AI tools for grammar correction and plagiarism detection such as Grammarly and Turnitin.	**2 hours/ week**
	SS.2	Explore AI video generation tools like Runway ML and Synthesia.	
	SS.3	Study AI testing/debugging tools and DevOps assistants such as Tabnine and Replit.	
	SS.4	Explore academic reference management tools such as Mendeley and Zotero.	
	SS.5	Explore AI agent platforms and autonomous workflow systems such as AutoGPT and LangChain.	

Laboratory Component (Suggested List of Experiments)

SN	Title of the experiment	CO	Hrs
1	Generate blog/article using Claude, ChatGPT, and Jasper; compare quality and accuracy; create technical documentation using Copy.ai	CO1	2
2	Design zero-shot, few-shot, and chain-of-thought prompts; generate summaries and paraphrased outputs; experiment with tone adaptation and multilingual writing	CO1	2
3	Generate images using Midjourney, DALL·E, and Stable Diffusion; compare realism vs creativity; apply negative prompts and style keywords	CO2	2
4	Define a poster theme; generate visual elements using AI image tools; assemble poster using Canva; present final poster with prompt explanation	CO2	2
5	Set up GitHub Copilot/Cursor; build a simple app (to-do list, calculator, or API app); use AI for code generation; validate and test	CO3	2
6	Load buggy code into AI-assisted IDE; fix errors using AI suggestions; request optimization; generate inline comments and docstrings automatically	CO3	2
7	Use Perplexity AI for topic exploration; use Elicit to discover research papers; use NotebookLM to extract insights;	CO4	2
8	Perform manual literature review (30 min); repeat using AI tools; compare time, sources, depth, and accuracy; identify hallucinations; prepare comparison report	CO4	2
9	Generate Citation and annotated bibliography and cross-check citations	CO4	2
10	Build an automated workflow to generate AI-based content from form submissions.	CO5	2
11	Design an end-to-end workflow for AI-generated content delivery through email.	CO5	2
12	Create a complete automation pipeline	CO5	2

19.6 Assessment Methodologies and Tools

Lab Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Experiments	10	CAT	Practical / Experiments/Tutorials	Journal (Rubrics Based)	15	30	2 hours
2	Presentation	1	CAT	Presentation	Rubrics Based	5	10	-
3	Attendance		CAT	Attendance	Record Based	5	10	-
4	ESE	1	ESE	Oral and Practical	Rubrics based	25	50	2 hours

Note:

1. *CAT Activity will be part of Term Work.*
2. *The final certification and acceptance of Term Work (TW) shall be granted only if the student has demonstrated satisfactory performance in laboratory work and has secured the minimum passing marks in the Term Work.*
3. *Learners will perform minimum 10 experiment at least 1 experiment from each module.*
4. *Presentation topics strictly based on Application of Analysis of Algorithms in various domains.*

19.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEVS242.1	3	2	2	3	2	-	3	-	-	-	-	3	3
CEVS242.2	2	2	3	3	3	2	2	-	-	-	-	3	3
CEVS242.3	3	3	3	3	2	-	3	-	-	-	-	3	3
CEVS242.4	3	3	2	3	2	2	3	-	-	-	-	3	3
CEVS242.5	2	3	3	3	3	3	3	-	-	-	-	3	3

19.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	**WK1**	Theory based understanding of the natural science applicable to the discipline	Applies scientific principles of data processing and computational intelligence that form the basis of modern AI tools.
2	**WK3**	Theory based formulation of engineering fundamentals	The course develops engineering fundamentals through prompt design and automation workflows.
3	**WK4**	Engineering specialist Knowledge	AI-assisted development, research automation, and intelligent workflow systems.

4	**WK6**	Knowledge of engineering practice	Practical implementation of AI tools for solving real-world engineering and productivity challenges.
5	**Wk9**	Professional ethics and responsibilities	ethical awareness regarding responsible AI usage, privacy, plagiarism

19.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Prompt Engineering for Generative AI	-	James Phoenix, Mike Taylor	O'Reilly Media,	2024
T2	Generative AI for Software Developers	-	Saurabh Shrivastava et al.	Packt Publishing,	2025
T3	Generative AI: Techniques, Models and Applications	-	Rajan Gupta, Sanju Tiwari, Poonam Chaudhary	Springer	2025
T4	AI Tools for Everyone: Your Guide to Artificial Intelligence	-	Aditya Basu		2025
T5	AI Prompt Engineering Absolute Beginner's Guide	-	Michael Miller	Pearson	2025

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Co-Intelligence: Living and Working with AI	-	Ethan Mollick	Portfolio/Penguin	2024
R2	Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business	-	Tom Taulli	Apress(ISBN: 978-1-484-29922-3)	2023
R3	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play	2nd	David Foster	O'Reilly MediaISBN: 978-1-098-13418-1	2019
R4	Modern Generative AI with ChatGPT and OpenAI Models	-	Valentina Alto	Packt Publishing ISBN: 978-1-805-12366-0	2023

Online Resources

SN	Title	Description
01	https://docs.anthropic.com	Anthropic Claude documentation and prompt engineering guides
02	https://www.promptingguide.ai	Comprehensive prompt engineering techniques guide
03	https://platform.openai.com/docs	OpenAI API documentation for ChatGPT and DALL·E

04	https://huggingface.co	Open-source AI models, datasets, and image generation spaces
05	https://zapier.com/learn	Zapier learning hub for workflow automation tutorials
06	https://docs.n8n.io	n8n workflow automation platform documentation
07	https://elicit.com	AI research assistant for literature discovery and synthesis
08	https://learnprompting.org	Free open-source course on prompt engineering

Chapter 20:
Subject- Mini Project (Sem IV)

Overview			
Course code:	**CEPR241**	**Course Category:**	PROJECT (PR)
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

20.1 Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions		Team work/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	2	-	-	2
Hours/Sem	-	-	15	-	15	**30**
Credits	-	-	1	-	-	**1**

** L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning*

20.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Mini Project	50%	50%	**100%**	**2**

20.3 Course Objectives

Pre-requisites.	Students should possess fundamental knowledge of engineering sciences, discipline-specific core subjects, problem-solving techniques, programming/tools relevant to the domain, and basic communication and teamwork skills to undertake a mini project successfully.
Course Overview: The Mini Project course provides students with hands-on experience in solving real-world engineering problems by applying technical knowledge and engineering principles. It promotes innovation, teamwork, problem-solving, project planning, and communication skills. Students design, develop, test, and present solutions while gaining practical exposure to modern engineering tools and practices.	
Course Objective: 1. To familiarize oneself with the process of recognizing demands and transforming them into a problem. 2. To acclimate to the process of collaboratively resolving the issue. 3. To familiarize oneself with the use of fundamental engineering principles in addressing challenges. 4. To instill the practice of self-directed learning and inquiry	

20.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
CEPR241.1	Recognize issues stemming from social or research demands and utilize knowledge and skills to address these difficulties together.	Understand (L2)
CEPR241.2	Build interpersonal skills to function effectively as a group member or leader, and derive appropriate conclusions from available data using theoretical, experimental, or simulation methods.	Apply (L3)
CEPR241.3	Evaluate the effects of solutions within the societal and environmental frameworks for sustainable development.	Evaluate (L5)
CEPR241.4	Employ established engineering standards and excel in both written and verbal communication.	Analyze (L4)
CEPR241.5	Demonstrate self-directed learning ability within a group, fostering lifelong education.	Apply (L3)
CEPR241.6	Present exemplary project management concepts during project execution.	Apply (L3)

20.5 Course Outcomes

Laboratory Component (Suggested List of Experiments)

SN	Title of the Activity	CO	Hrs
1	Conduct surveys and identify needs. These needs will be transformed into a problem statement for mini projects. comprehend problems, propose multiple solutions, and select the most suitable solution in consultation with their guide or supervisor.	CO1	5
2	Submission Short Description of Mini project and implementation plan in the form of a Gantt/PERT/CPM chart that outlines the weekly activities of the mini project	CO2	5
3	Transform the optimal solution into a functional model by utilizing a variety of components from their respective domains and presenting it. Acquiring components/systems, creating a functioning prototype, and validating outcomes and Mid-term review	CO3	5
4	Evaluation /Troubleshooting /testing of the readiness of a functional prototype	CO4	5
5	Validation of the solution with appropriate justification and compilation of a Project report	CO5	5
6	Final review and presentation of the prototype implemented and submission of Project report and logbook	CO6	5

20.6 Assessment Methodologies and Tools

Lab Component

SN	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
01	Activities	6	CAT	Group Discussion/ Presentation/ Project	Synopsis / Project Report (Rubrics Based)	15	30	-
02	Logbook	1	CAT	Rubrics based	Rubrics based	5	10	-
03	Attendance	-	CAT	Attendance	Attendance	5	10	-
04	Oral/ Viva	1	ESE	Oral/ Presentation	Rubrics based	25	50	-

20.7 Suggested CO-PO/PSO Correlation Matrix

CO-PO Correlation (3-Strong, 2-Moderate, 1-Weak Correlation)

CO #	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CEPR241.1	-	-	-	-	2	-	-	-	2	2	2	2	-
CEPR241.2	-	-	2	2	3	-	-	2	2	2	2	2	-
CEPR241.3	-	-	2	2	3	-	-	2	2	2	2	2	2
CEPR241.4	-	-	2	-	2	-	-	3	2	2	3	2	3
CEPR241.5	-	-	2	3	3	-	-	2	3	3	3	2	3
CEPR241.6	-	-	2	2	2	-	-	2	2	3	3	2	3

20.8 Course to Knowledge and Attitude Profile (WK) Mapping

WK	WK Statement	Justification of Mapping
WK5	Engineering design practice for solving complex engineering problems.	Students design and develop systems, software, models, prototypes, or processes to meet specified requirements
WK6	Engineering practice is supported by technology, techniques, resources, and modern engineering tools.	Students utilize software tools, programming platforms, simulation packages, laboratory equipment, and project management tools.
WK8	Research literature, investigation methods, experimentation, data analysis, and interpretation.	Students conduct experiments, surveys, simulations, testing, validation, and performance evaluation of developed solutions

WK9	Ethics, professionalism, communication, teamwork, project management, and lifelong learning.	Students work effectively as individuals and team members, sharing responsibilities and achieving project objectives

20.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Project Management for Engineering, Business and Technology	6th Edition	John M. Nicholas, Herman Steyn	Routledge	2020
T2	Engineering Design: A Project-Based Introduction	5th Edition	Clive L. Dym, Patrick Little, Elizabeth J. Orwin, R. E. Spjut	Wiley	2019

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	The Design of Everyday Things	Revised & Expanded Edition	Don Norman	Basic Books	2013
R2	Successful Project Management	7th Edition	Jack Gido, Joseph Clements, James Cogswell	Cengage Learning	2021

Online Resources

SN	Title	Description
O1	NPTEL – Project Management for Engineers	Comprehensive online courses covering project planning, scheduling, resource allocation, risk management, teamwork, and project execution in engineering applications.
O2	IEEE Xplore Digital Library	Online repository of research papers, technical articles, standards, and project ideas that help students conduct literature surveys and develop innovative engineering project

20.10 General Guidelines for Mini Project

1. Students are required to create a group of three to four students. It is prohibited to form a group with fewer than three or more than four students, as this is a group activity.
2. In consultation with the faculty supervisor, Head of department, or internal committee of faculties, students should conduct surveys and identify needs. These needs will be transformed into a problem statement for micro projects.
3. Students are required to submit an implementation plan in the form of a Gantt/PERT/CPM chart that outlines the weekly activities of the micro project.
4. Each group is required to create a logbook in which they can document their weekly work progress, and the guide/supervisor can corroborate and record any notes or comments.
5. While faculty supervisors may provide students with feedback during the micro project activity, the primary objective is to encourage self-directed learning.
6. Students in a group should be able to effectively comprehend problems, propose multiple solutions, and select the most suitable solution in consultation with their guide or supervisor.
7. Students are required to transform the optimal solution into a functional model by utilizing a variety of components from their respective domains and presenting it.
8. Validation of the solution with appropriate justification and compilation of a report in the standard format provided by Dept.
9. Given the emphasis on self-learning, innovation, addressing societal issues, and the development of entrepreneurship quality within the students through the Mini Projects, it is advisable for all student groups to implement a single project of a suitable quality over the course of two semesters. i.e. Mini Project 1 in semesters III/IV and Mini Project 2 in semesters V/VI.
10. Nevertheless, providing that the proposed Mini Project adheres to the qualitative aspects mentioned above and is completed in the odd semester, the group may be permitted to work on the extension of the Mini Project with appropriate improvements/modifications or a completely new project idea in the even semester, based on the individual students or group capability and the mentor's recommendations. This policy may be implemented on an individual basis.

20.11 Mini Project Assessment Criteria

Mini Project will be evaluated based on the following criteria:

a. Survey quality and need identification.
b. Clearly define the problem based on necessity.
c. Innovative solutions.
d. Assessing the feasibility of offered issue solutions and selecting the best answer.
e. Cost effectiveness.
f. Social effects.
g. Innovativeness.
h. Cost-effectiveness and social impact.
i. The functional model fully meets the given requirements.
j. Effectively applying skill sets.
k. Effective use of engineering standards.
l. Individual contributions as members or leaders.
m. Clear written and verbal communication.

20.12 Recommended Self Learning Resources for IoT Mini Project

SN	Resource	Description
1	Kaggle Learn	Hands-on tutorials, datasets, notebooks, and competitions for AI, ML, and Data Science projects.
2	Google Colab	Cloud-based Python environment for developing and testing AI and ML models without local installation.
3	TensorFlow Documentation	Official tutorials and guides for building deep learning applications.
4	Scikit-Learn Documentation	Comprehensive resource for implementing machine learning algorithms and evaluation techniques.
5	GitHub Open-Source Projects	Repository of AI and Data Science projects for learning implementation and best practices.

20.13 Recommended Courses for Mini Project

1. Python for Data Science
2. Machine Learning
3. Data Analytics with Python
4. Deep Learning
5. Natural Language Processing
6. Design Thinking and Innovation