



**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 ELECTRICAL ENGINEERING



Department of Electrical Engineering

CURRICULUM AND SYLLABI

EXIT DEGREE B.TECH (Electrical Engineering)	
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DETAILED SYLLABI:	For SEM III, SEM IV
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Prof. M. K. Alam
HOD (Electrical Engg)

Dr. V. P. Patil
Dean (Academics)

Dr. Sunil Chavan
Principal

Document Control

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Dr. Sunil Chavan
Member Secretary
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Chapter 1: Preamble

To uphold excellence in engineering education and align with the vision of NEP 2020, it is essential to systematically address and deliberate on the issue of quality. Accreditation serves as the key mechanism for ensuring quality assurance in higher education, with its primary focus on evaluating the outcomes of academic programs. In this context, the Faculty of Science and Technology (particularly Engineering) at the SIGCE has taken the initiative to integrate the principles of NEP 2020 into the curriculum development process.

The Second-Year Engineering program focuses on developing scientific and logical thinking while offering flexibility through core courses, multidisciplinary minors, and vocational skill-enhancement options. In line with NEP 2020, the curriculum builds strong fundamentals in Electrical Engineering and provides exposure to modern practices and emerging technologies. Choice-based pools, including open electives and minors in the third and fourth semesters, encourage stress-free, learner-centric education. Vocational and skill-based courses further nurture creativity and practical competence, giving learners opportunities to pursue courses aligned with their interests across disciplines.

The Program Core Courses include essential Electrical Engineering subjects, along with Open Electives (OE) and Multidisciplinary Minors (MDM), offered through a pool of choices. In the current context, providing diverse options is necessary to meet learners' aspirations for careers in emerging technologies and interdisciplinary research. Ability enhancement at the undergraduate level is achieved by promoting objective and creative learning, moving beyond rote methods. To support this, *Design Thinking* is introduced in the first semester to guide learners toward becoming skilled professionals. In line with the NEP 2020 framework, vocational skill pools are also included to provide industry exposure and to support multiple exit options with Certificate and Diploma awards.

Under NEP 2020, the grading system brings a significant shift from teacher-centric to learner-centric education, where workload is measured by the learner's investment of time rather than teaching hours. The system emphasizes continuous evaluation, thereby improving the overall quality of education. Course credits are assigned based on a 15-week teaching-learning framework, with 12–13 weeks dedicated to classroom instruction and the remaining 2–3 weeks utilized for revision, tutorials, guest lectures, and content beyond the syllabus.

It was emphasized that the Second-Year syllabus should not be overloaded, as it is essential to ease the transition of learners entering engineering education. Reducing the burden of syllabus and credits will help students adapt to the new college environment and foster a healthy bond between teachers and learners. The curriculum will be implemented for Second Year Engineering from the academic year 2026–27, followed by Third Year in 2027–28, and Final Year in 2028–29.

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 Electrical Engineering Department

Vision of the Department

To mould socially committed, ethical and competent electrical engineers.

Mission of the Department

- 1 To provide a conducive environment for teaching & learning.
- 2 To provide educational programs for improvement in academics and ethics.
- 3 To motivate students for participation in social & industrial activities.

2.3 Program Education Outcomes

- 1 PEO 1: - To train students to identify, comprehend and solve the problems with creative and critical reasoning skills.
- 2 PEO 2: - Be a practicing engineer in design, research, testing and manufacturing areas of electrical engineering.
- 3 PEO 3:- To demonstrate leadership skill at workplace and act professionally in competitive world

2.4 Program Outcomes

- 1 **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.
- 2 **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- 3 **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)
- 4 **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).
- 5 **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)
- 6 **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).
- 7 **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- 8 **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- 9 **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, make effective presentations considering cultural, language, and learning differences
- 10 **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.
- 11 **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)

2.5 Program Specific Outcomes

- 1 PSO 1: - Understand concept and application of electrical machines, power systems and control systems.
- 2 PSO 2: - Assess performance of electrical system to maintain its functioning.
- 3 PSO 3: - Aspire to work in a team to execute engineering activities in society.

2.6 Knowledge and Attitude Profile (WK)

1. **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
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. engineering
3. **WK3:** A systematic, theory-based formulation of fundamentals required in the 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.
5. **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.
6. **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
7. **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.
8. **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.
9. **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 Project							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 Enhancement 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

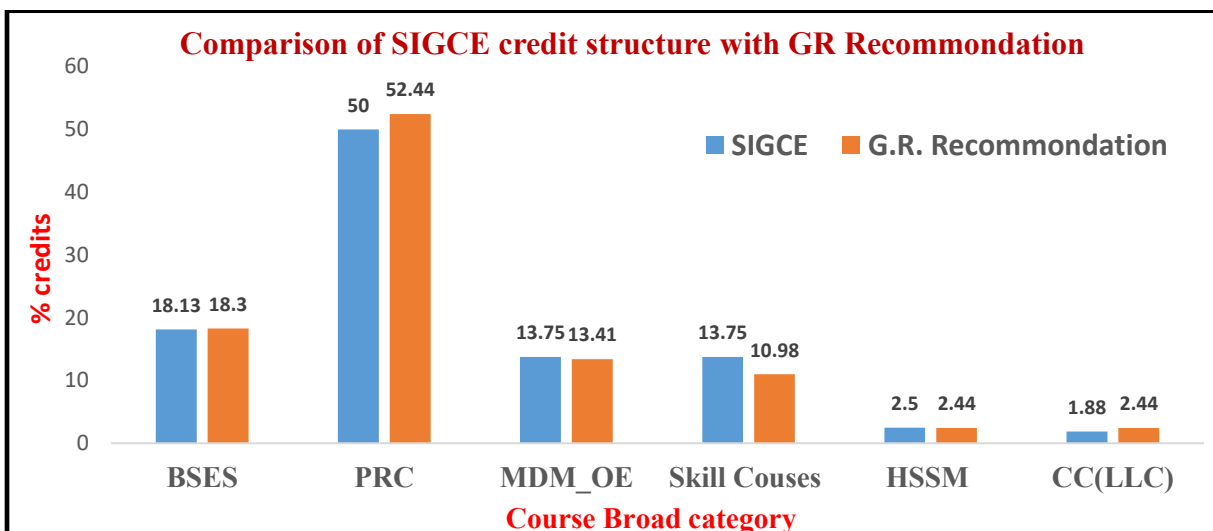
3.4 Course Codes – Letter Placement and Meaning

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		SL	TE	L	T	P/D	TC
				L	T	P	D						
EEBS231	BS	Applied Mathematics for Electrical Engineering	Compulsory	2	1	0	0	3	6	2	1	-	3
EEPC231	PC	Electrical Machines - I	Compulsory	3	0	2	0	3	8	3		1	4
EEPC232	PC	Electrical Power System -I	Compulsory	3	0	2	0	3	8	3		1	4
EEPC233	PC	Electrical and Electronics Measurement	Compulsory	2	0	2	0	2	6	2		1	3
IGOE23X	OE	Open Elective	Choice Based*	2	-	-	-	2	4	2	-	-	2
EEVS231	VS	Skill Enhancement Course- MATLAB	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				12	1	12	6	13	44	12	1	9	22

*CR=Classroom Teaching; L = Lectures; T = Tutorials; P = Practical; D= Demo; SL=Self Learning; TE = Total Engagement Hours; TC = Total Credit

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

Semester IV

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme (Hrs)						Credit Assigned			
				CR		Lab		SL	TE	L	T	P/D	TC
				L	T	P	D						
EEBS241	BS	Applied Engineering Mathematics for Circuit Theory and Signal Processing	Compulsory	2	0	2	0	2	6	2		1	3
EEPC241	PC	Electrical Machines -II	Compulsory	3	0	2	0	3	8	3		1	4
EEPC242	PC	Electrical Power Systems -II	Compulsory	3	0	2	0	3	8	3		1	4
EEPC243	PC	Electromagnetic Field and Waves	Compulsory	3	0	0	0	3	6	3		0	3
IGOE24x	OE	Open Elective	Choice Based*	2	-	-	-	2	4	2	-	-	2
EEVS242	VS	AI TOOLS	Compulsory	-	-	2	2	-	4	-	-	2	2
EEVS241	VS	Engineering Fundamentals and Technical Skills	Compulsory	-	-	-	2	-	2	-	-	1	1
IGEM241	EM	Design Thinking	Compulsory	-	-	2	2	-	4	-	-	2	2
EEPR241	PR	Mini Project-I	Compulsory			2			2			1	1
TOTAL				13	-	12	6	11	44	13	-	9	22

3.7 Program Examination Scheme

Semester III

Course Code	Broad Catg.	Course Name	Course choice	TC	Evaluation Scheme (Marks)								Evaluation Scheme (%)								
					Theory					LAB			TH+LAB	Theory					LAB		
					IA1	IA2	FA	ESE	Tot	CIE	ESE	Tot	GT	IA1	IA2	FA	ESE	Total	CIE	ESE	Total
EEBS231	BS	Applied Mathematics for Electrical Engineering	Compulsory	3	15	15	10	60	100	25	0	25	125	15	15	10	60	100	100	0	100
EEPC231	PC	Electrical Machines - I	Compulsory	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
EEPC232	PC	Electrical Power System -I	Compulsory	4	15	15	10	60	100	25		25	125	15	15	10	60	100	100		100
EEPC233	PC	Electrical and Electronics Measurement	Compulsory	3	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
IGOE23x	OE	Open Elective-01	Any one from this bucket	2	15	15	10	60	100	0	0	0	100	15	15	10	60	100	0	0	0
IGVE231	VE	Skill Enhancement Course	Compulsory						0	25	25	50	50						50	50	100
IGAE231	AE	Comprehensive Soft Skill and Professional Development	Compulsory						0	25	0	25	25						100		100
IGEM231	EM	Entrepreneurship and Business Model Development	Compulsory						0	50	0	50	50						100		100
IGCC231x	CC	Cocurricular Course-2 A	Any one from this bucket						0	25	0	25	25						100		100
TOTAL					75	75	50	300	500	200	100	300	800								100

Semester IV

Course Code	Broad Catg.	Course Name	TC	Evaluation Scheme (Marks)									Evaluation Scheme (%)								
				Theory					LAB			TH+LAB	Theory					LAB			
				IA1	IA2	FA	ESE	Tot	CIE	ESE	Tot	GT	IA1	IA2	FA	ESE	Total	CIE	ESE	Total	
EEBS241	BS	Applied Engineering Mathematics for Circuit Theory and Signal Processing	3	15	15	10	60	100	25	0	25	125	15	15	10	60	100	100	0	100	
EEPC241	PC	Electrical Machines -II	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100	
EEPC242	PC	Electrical Power Systems -II	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100	
EEPC243	PC	Electromagnetic Field and Waves	3	15	15	10	60	100	0	0	0	100	15	15	10	60	100	0	0	100	
IGOE241	OE	OPEN ELECTIVE-2A	2	15	15	10	60	100	0	0	0	100	15	15	10	60	100	0	0	0	
EEVS242	VS	AI TOOLS	2	0	0	0	0	0	25	25	50	50	0	0	0	0	0	50	50	100	
EEVS241	VS	Basic Technical Training	1	0	0	0	0	0	25	0	25	25	0	0	0	0	0	100	0	100	
IGEM241	EM	Design Thinking	2	0	0	0	0	0	50	0	50	50	0	0	0	0	0	100	0	100	
EEPR245	PR	Mini Project-I	1	0	0	0	0	0	25	25	50	50	0	0	0	0	0	50	50	100	
TOTAL				75	75	50	300	500	225	100	325	800								100	

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 should be multi-dimensional and should measure Knowledge, Skills, Application, Innovation, Ethics, Communication, Teamwork, Lifelong learning, Social responsibility.

Assessment Instruments

These are the tools and techniques used for assessment. Following is the indicative list of Assessment Instruments. However, teachers are encouraged to be creative in using different assessment instruments to evaluate learners

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 analyse 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 organisation, 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 analysing student performance through digital platforms for programming (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

Assessment Methods are methods which are used for execution and evaluation of the assessment.

SN	ASSESSMENT METHODS / MODE	DESCRIPTION
1	Supervised In-Class Mode	Assessment is conducted physically during scheduled academic time under faculty or authorised supervision.
2	Open book Mode	Students are permitted to consult specified books, notes, standards, or approved resources during the assessment. Tasks should emphasise 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.

Chapter 4:

Indicative List of Courses

4.1 BSE Courses

SN	LIST OF SUGGESTED OPEN ELECTIVES	COURSE CODE	Semester
1	Mathematics for Computer Engineering	CABS231	III
5	Statistical Methodes in Data Science	CABS241	IV

4.2 Humanities Courses

SN	LIST OF SUGGESTED OPEN ELECTIVES	COURSE CODE	Semester
1	Entrepreneurship and Business Model development	IGEM231	III
2	Design Thinking	IGEM241	IV

4.3 Co-Curricular Courses

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

Link for Co-curricular Course [syllabus](#)

4.4 Open Elective

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

Link for Open Elective Course [syllabus](#)

Chapter 5:

Mapping and Justification

5.1 Indicative Mapping of Courses to PO

Semester III

Course Name	Sem.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Applied Mathematics for Electrical Engineering	III	3	3									3		2	3
Electrical Machines - I	III	3	3		3								3	3	
Electrical Power System - I	III	3	3	2	2	1	2		3		1	2	3	3	
Electrical and Electronics Measurement	III	3	3	3	2	1	1		3			2	3	2	
Skill Enhancement Course- Matlab	III	2	3	1	2	3	1	1	1	2	1	1	2	2	1
Comprehensive Soft Skill and Professional Development	III	2	2	2	2	2	2		2	3	3	2	3	2	1
Entrepreneurship and Business Model Development	III														

Semester IV

Course Name	Sem.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
Applied Engineering Mathematics for Circuit Theory and Signal Processing	IV	3	3	3	2	3			3				3	2	
Electrical Machines -II	IV	3	2	2	3	3	1		3	2		2	3	3	2
Electrical Power Systems -II	IV	3	3	1	2	2	2				3	2	3	3	2
Electromagnetic Field and Waves	IV	3	3	3	3	3	2							3	3

Open Elective –II (Leadership Management)	IV	1	2	1	1		1	2	2	2	1	2	1	1	1
Open Elective –II (Principles and Practices of Management)	2	2	2	1	1	1	1	1	2	2	2	2			
Design Thinking	IV														
Basic Technical Training	IV	2	2	2	2	2	2		2	3	3	2	2	2	2
AI Tools	IV														
MINI PROJECT-1	IV	3	3	3	3	3	3	3	3	3	3	3	3	3	3

5.2 Indicative Mapping of Courses to WK

Sem III

Course Name	Semester	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
Applied Mathematics for Electrical Engineering	III	X	X	X					X	
Electrical Machines - I	III	X	X	X	X				X	
Electrical Power System -I	III		X	X	X	X	X			
Electrical and Electronics Measurement	III	X	X	X	X		X			
Skill Enhancement Course- Matlab	III	X	X	X	X	X	X	X	X	
Comprehensive Soft Skill and Professional Development	III	X	X	X	X	X	X	X	X	
Entrepreneurship and Business Model Development	III									

Semester IV

Course Name	Semester	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
Applied Engineering Mathematics for Circuit Theory and Signal Processing	IV	X	X	X	X				X	
Electrical Machines -II	IV		X	X	X	X	X			
Electrical Power Systems -II	IV	X	X	X	X		X	X		
Electromagnetic Field and Waves	IV		X	X	X		X			
Design Thinking	IV									
Basic Technical Training	IV	X	X	X	X	X	X	X	X	
AI Tools	IV									
MINI PROJECT-1	IV	X	X	X	X	X	X	X	X	X

5.3 Indicative Mapping of Courses to WK

Courses	WK	Justification w.r.t Wks
Applied Mathematics for Electrical Engineering	WK1	It builds strong theoretical foundations from natural sciences and applies them to solve real-world and complex engineering problems.
	WK2	It integrates conceptual mathematics, statistical analysis, and computational thinking to support accurate modeling and problem-solving in electrical engineering.
	WK3	It aligns with a theory-based foundation of engineering fundamentals, as they involve applying advanced mathematical concepts to analyze and solve real-world engineering problems.
	WK8	The mathematical tools connect theory with modern engineering and AI applications while developing critical thinking and creative problem-solving skills.
Electrical Machines - I	WK1	Gain basic Engineering knowledge in Electrical engineering.
	WK2	Analyze principle of magnetism, Electromechanical energy conversion devices , DC Machine& special purpose machine.
	WK3	Acquire systematic, theory-based formulation of engineering fundamentals of Electromechanical energy conversion devices , DC Machine & special purpose machine.
	WK4	Specific Engineering knowledge of DC Machine, Special purpose machine & Electrical engineering materials.

	WK8	Evaluate the performance of the DC machine.
Electrical Power System -I	WK2	Covers fundamental electrical parameters (R, L, C) and specialized transmission line concepts like corona, skin effect, and proximity effect.
	WK3	Involves analysis of transmission line performance using engineering fundamentals and investigative approaches such as regulation, efficiency, and Ferranti effect.
	WK4	Deals with specialized knowledge of cables and earthing along with practical implementation and safety considerations in power systems.
	WK5	Includes application of advanced fault analysis techniques, use of computational methods (Z-bus), and practical engineering tools.
	WK6	Focuses on analytical evaluation of unsymmetrical faults using symmetrical component theory requiring deep technical knowledge.
Electrical and Electronics Measurement	WK1	Classification of analog instruments used in electrical systems like voltmeter, ammeter ,power factor meter
	WK2	Modeling and analysis of different sensors and digital techniques widely used in electronic and electrical measurements
	WK3	Learning analog and digital measuring instruments is a systematic approach of engineering
	WK4	Measurement of various parameters helps in electrical and electronics measurements
	WK6	Electrical and electronic measurements ,analog and digital circuits gains the knowledge of technology
Skill Enhancement Course- Matlab	WK1	MATLAB programming and numerical computation require mathematical and scientific concepts for solving electrical engineering problems and simulations.
	WK2	The course emphasizes MATLAB-based numerical methods, matrix operations, programming, and engineering analysis for electrical systems.
	WK3	Students apply MATLAB tools for circuit analysis, power systems, control systems, and signal processing applications based on electrical engineering fundamentals.
	WK4	MATLAB and Simulink are used for modeling, simulation, and analysis of specialized electrical engineering systems and industrial applications.
	WK5	MATLAB simulation and visualization techniques help students design and analyze engineering systems and technical solutions.

	WK6	Industry-oriented MATLAB applications, technical documentation, and simulation practices prepare students for professional engineering environments.
	WK7	MATLAB-based problem solving and engineering analysis support efficient and reliable solutions for modern industrial and societal electrical engineering applications.
	WK8	Students use MATLAB tools and documentation to explore advanced engineering applications, simulation methods, and technical resources.
Comprehensive Soft Skill and Professional Development	WK1	Students develop foundational understanding of communication principles, personality development, and professional behavior essential for engineering environments.
	WK2	Aptitude preparation, reasoning ability, and analytical problem-solving activities enhance logical and quantitative thinking skills.
	WK3	The course supports engineering professionalism through structured communication, teamwork, and workplace readiness practices.
	WK4	Resume building, interview readiness, and corporate communication practices align students with industry expectations and professional engineering standards.
	WK5	Activities such as LinkedIn profile creation, self-pitch design, and digital branding help students present professional profiles effectively.
	WK6	Workplace etiquette, virtual meeting behavior, email etiquette, and hybrid work professionalism expose students to modern corporate practices.
	WK7	Group discussions, leadership exercises, and teamwork activities develop collaboration, ethical awareness, and social interaction skills.
	WK8	Students explore placement trends, aptitude patterns, and professional communication strategies through self-learning and practical assignments.
Applied Engineering Mathematics for Circuit Theory and Signal Processing	WK1	It develops theory-based understanding of mathematical and scientific principles in electrical engineering to analyze electrical circuits using linear algebra and network theory.
	WK2	Improve mathematical and analytical skills through Fourier Series and Fourier Transform for analyzing signals in time and frequency domains to model and analyze engineering systems used in communication, control, and signal processing applications.
	WK3	Develops a theory-based understanding of engineering fundamentals through Laplace Transform for analyzing signals, transient responses, and dynamic circuit behavior using solution of differential equations and

		enhance analytical problem-solving and system analysis skills in electrical engineering.
	WK4	Elaborate application of Laplace Transform for analyzing time-domain signals, transient responses, and system models in circuit, control, communication, and power system applications to strengthen analytical and problem-solving skills.
	WK8	Engagement with selected knowledge in the research literature of the discipline and Discrete & Fast Fourier Transform
Electrical Machines - II	WK2	Performance analysis of induction motors and the design of transformers involve mathematical calculations such as efficiency, losses, regulation, and design parameters, which require numerical and analytical methods.
	WK3	learn engineering fundamentals such as transformer principles, EMF equation, losses, and efficiency.
	WK4	acquire knowledge related to transformer construction, operation, and applications in electrical systems.
	WK5	Transformer design requires consideration of efficiency, material utilization, insulation, and cost-effective operation, which aligns with engineering design principles and efficient resource usage.
	WK6	practical exposure such as transformer testing, motor operation, and design procedures, which reflect real-world engineering practices and technological applications.
Electrical Power Systems -II	WK1	Analysis of power system transients and stability requires understanding of fundamental physical principles such as electrical circuits, electromagnetic energy, and system dynamics derived from natural science.
	WK2	Power system operation, load flow studies, and stability analysis involve mathematical modelling, numerical methods, and computational techniques such as Gauss–Seidel and Newton–Raphson methods.
	WK3	All course objectives depend on core electrical engineering fundamentals including power system analysis, network theory, and system operation principles.
	WK4	The course provides specialized knowledge in power system stability, economic operation, load flow analysis, and power system control, which are key practice areas in electrical power engineering.
	WK6	The course includes practical applications such as system modelling, simulation, and operational control of power systems, reflecting real-world engineering practice.

	WK7	Power interchange and system control involve coordination between utilities and reliable supply of electricity, which directly impacts public safety, reliability, and societal infrastructure.
Electromagnetic Field and Waves	WK2	It justifies a curriculum focused on practical problem-solving. It enables students to apply numerical analysis, statistics, and modelling, transforming theoretical engineering concepts into actionable computer-based solutions and supporting advanced studies.
	WK3	Electromagnetic Field Theory serves as the core, mathematical, and physical bedrock that allows engineers to move beyond simple circuit analysis (lumped elements) into high-frequency, wave-based systems (distributed systems).
	WK3	Electromagnetic Field Theory serves as the core, mathematical, and physical bedrock that allows engineers to move beyond simple circuit analysis (lumped elements) into high-frequency, wave-based systems (distributed systems).
	WK4	The knowledge of time-varying fields provides the theoretical basis for several core engineering specializations: Antenna Design and Wave Propagation, Instrumentation and Medical Imaging
	WK6	Engineers must identify where interference originates to determine the appropriate mitigation technology
Basic Technical Training	WK1	Students develop foundational knowledge of Python programming, Java programming, SQL, algorithms, and computational problem-solving concepts essential for engineering and software applications.
	WK2	Competitive programming, time complexity analysis, modular arithmetic, graph algorithms, and optimization techniques strengthen analytical, mathematical, and logical reasoning abilities.
	WK3	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.
	WK4	Students design efficient coding solutions, database applications, and optimized algorithms to solve real-world computational and software engineering challenges.
	WK5	Practical implementation using Python, Java, SQL platforms, coding environments, debugging tools, GitHub, and online coding platforms enhances modern software engineering practices.

	WK6	Real-world case studies, debugging practices, and placement-oriented coding activities improve professional decision-making and responsible software development skills.
	WK7	Optimized algorithms, efficient database management, and resource-aware programming techniques encourage sustainable and high-performance computing solutions.
	WK8	Resume building, collaborative coding activities, professional interview preparation, and ethical programming practices promote professional conduct and teamwork in engineering environments.
Mini Project-I	WK1	By critical thinking and creative approach to sort out the emerging issues with social science to find out valid solution
	WK2	Implement the design solution by modelling different Projects, the circuit tracing, PCB designing and component mounting
	WK3	Design project with a systematic approach and applying engineering fundamentals
	WK4	Design of different Projects, the circuit tracing, PCB designing, mounting of components, testing of components
	WK5	While building project its environmental impact, recyclable components with optimum cost is considered
	WK6	Throughout technical knowledge of the project , its components and applications are incurred
	WK7	Design of project and its implementation based on safety and sustainability maintained considering social responsibility
	WK8	The design of project as per current research related with the topic and evaluate the emerging issues
	WK9	Execution of project with group members with all professional ethical practices, responsibilities and awareness about diversity

Chapter 6

Subject : Applied Mathematics for Electrical Engineering (Sem: III)

Overview			
Course code:	EEBS231	Course Category:	Basics Science
Sem:	III	Syllabus &Version:	SIGCE-NEP-R25-Y2

6.1 Teaching & Learning Scheme

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

Tutorial to be conducted batchwise

6.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	100%	2
Term work	100%	-	100%	1

6.3 Course Objectives

Pre-requisite Course Codes, if any.	Applied Mathematics-I (ASBS111), Applied Mathematics-II (ASBS121), Scalar and Vector Product: Scalar and vector product of three and four vectors.
Course Overview: Course provides the foundation for solving practical engineering problems efficiently and accurately and also focuses on using mathematical tools to analyze and design in the field of control system engineering, network and signal processing.	
Course Objective: The course is aimed	
1. To familiarize with Laplace Transform, Inverse Laplace Transform of various functions, and its applications.	

2. To acquaint myself with the concept of Fourier Series and enhance the problem solving skills and to introduce the concept of Fourier Transform and its application.
3. To understand the basics of Linear Algebra and its applications.
4. Apply the concepts of vector calculus in real life problems.
5. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
6. To learn the concepts of Calculus of Variations.

6.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEBS231.01	Apply the concept of Laplace transform and inverse Laplace transform to solve the real integrals in engineering problems.	Apply
EEBS231.02	Analyze electrical signal using Fourier series and Fourier transform	Analyze
EEBS231.03	Illustrate the use of matrix algebra to solve the engineering problems	Apply
EEBS231.04	Apply the concepts of vector calculus in the field of Electrical Engineering.	Apply
EEBS231.05	Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.	Apply
EEBS231.06	Find the extremals of the functional using the concept of Calculus of variation.	Apply

6.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Laplace Transform	CO1	L3	T1, R1	5
	1.1	Definition of Laplace transform and Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and tn , $n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property				
	1.2	Multiplication by t , Division by t ,				
	1.3	Laplace Transform of derivatives				

	1.4	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform				
	1.5	Inverse Laplace transform by Partial fraction.				
2	Title	Fourier Series & Fourier Transform	CO2	L3	T2,R5	5
	2.1	Definition of Fourier series, Dirichlet's conditions				
	2.2	Fourier series of even and odd functions				
	2.3	Definition of Fourier Transform, single sided and Double sided Fourier Transform				
	2.4	Fourier Transform of unit step signal, ramp signal, exponential signal, sinusoidal signal, gate function, sigma function & impulse function, pulse function.				
3	Title	Matrix Theory	CO3	L3	T3,R4	4
	3.1	Characteristic equation, Definition of Eigen values and Eigen vectors and its properties				
	3.2	Examples based on properties of Eigen values and Eigen vectors				
	3.3	Cayley-Hamilton theorem (Without proof) and examples				
4	Title	Vector Differentiation and Integral	CO4	L3	T4,R3	4
	4.1	Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof)				
	4.2	Properties of vector field: Solenoidal vector fields				
	4.3	Irrotational (conservative) vector fields				
	4.4	Vector integral: Line Integral				
5	Title	Statistical Techniques	CO5	L3	T1,R1,R2	4
	5.1	Karl Pearson's Coefficient of correlation (r)				
	5.2	Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks)				
	5.3	Lines of regression, Fitting of the first degree curve				
6	Title	Calculus of Variations	CO6	L3	T2,R3	4
	6.1	Euler-Lagrange equation (Without Proof), When F does not contain y				
	6.2	Euler-Lagrange equation (Without Proof), When F does not contain x				
	6.3	Euler-Lagrange equation (Without Proof), When F contains x, y, y'				
	6.4	Isoperimetric problems-Lagrange Method.				

Self - Study	SS	1.Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function. 2.Complex form of Fourier Series, Orthogonal and orthonormal set of functions. 3.Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices. 4.Gauss' divergence theorem and applications of Vector calculus. 5.Covariance, fitting of an exponential curve. 6.Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action, Several dependent variables.	3 Hrs
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Tutorial Component

SN	Title of the Tutorial	CO	Hrs
1	Tutorial -1(Laplace Transform)	CO1	1
2	Tutorial-2(Fourier Series & Fourier Transform)	CO2	1
3	Tutorial-3(Matrix Theory)	CO3	1
4	Tutorial-4(Vector Differentiation and Integration)	CO4	1
5	Tutorial-5(Statistical Techniques)	CO5	1
6	Tutorial-6(Calculus of Variations)	CO6	1

Live Assignments

SN	Title of the Assignment	CO	Hrs
1	Assignment -1(Laplace Transform)	CO1	1
2	Assignment-2(Fourier Series & Fourier Transform)	CO2	1
3	Assignment-3(Matrix Theory)	CO3	1
4	Assignment-4(Vector Differentiation and Integration)	CO4	1
5	Assignment-5(Statistical Techniques)	CO5	1
6	Assignment-6(Calculus of Variations)	CO6	1

6.6 Assessment Methodologies and Tools

Theory Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA1	1	CAT	Paper – Pen	Class Room Test	15	15	1 hr
IA2	1	CAT	Paper – Pen	Class Room Test	15	15	1 hr
FA1	1	CAT	Quiz	Online	5	5	10 min
FA2	1	CAT	Open Book Test	Class Room Test	5	5	10 min
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 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Tutorial Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Tutorial	6	CAT	In class Tutorial	Journal (Rubrics Based)	15	50%	1
Assignments	6	CAT	Take Home Assignment	Rubrics Based	5	40%	1
Class Participation	32	CAT	Attendance	Record and Observation	5	10%	1

Batchwise Tutorial to be conducted.

6.7 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	PSO 2	PSO 3
EEBSC231.1	3	3									3		2	
EEBSC231.2	3	3									3			
EEBSC231.3	3	3									3		2	
EEBSC231.4	3	3									3			
EEBSC231.5	3	3									3		3	
EEBSC231.6	3	3									3		2	

6.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
	WK1	A Systematic, theory-based understanding of the natural science applicable to the discipline and awareness of relevant social sciences.	It builds strong theoretical foundations from natural sciences and applies them to solve real-world and complex engineering problems.
	WK2	Conceptual-based mathematics, numerical data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.	It integrates conceptual mathematics, statistical analysis, and computational thinking to support accurate modeling and problem-solving in electrical engineering.
	WK3	A Systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	It aligns with a theory-based foundation of engineering fundamentals, as they involve applying advanced mathematical concepts to analyze and solve real-world engineering problems.
	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 mathematical tools connect theory with modern engineering and AI applications while developing critical thinking and creative problem-solving skills.

6.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Probability, Statistics and Random Processes	3rd	T. Veerarajan	McGraw-Hill education	2008
T2	Advanced engineering Mathematics	5th	R.K.Jain and R.K.Iyengar	Narosa Publication	2019
T3	Beginning Linear Algebra (Schaum's outline series)	1st	Seymour Lipschutz	McGraw Hill Publication	1996
T4	Vector Analysis	2nd	Murray R.Spiegel, Seymour Lipschutz	McGraw-Hill education	2009
T5	Engineering Mathematics- III	2016	C.B.Gupta,S.R.Singh	McGraw-Hill education	2016

T6	Engineering Circuit Analysis	7th	W H Hayt, S M Durbin, J E Kemmerly	Tata McGraw-Hill Education	2007
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Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Higher Engineering Mathematics	45th	Dr. B. S. Grewal	Khanna	2024
R2	Advanced engineering Mathematics	10th	Erwin Kreyszig	John Wiley and Sons Eastern Limited	2011
R3	Higher Engineering Mathematics,	1st	B. V. Ramana	Tata Mc-Graw Hill	2007
R4	Advanced Engineering Mathematics	22nd	H.K. Das	S.Chand	2024
R5	Advanced Engineering Mathematics	6th	Wylie and Barret	Tata Mc-Graw Hill	1995

Online Resources

SN	Title	Description
O1	https://www.youtube.com/watch?v=ma1QmE1SH3I	Vector Analysis
O2	https://www.youtube.com/watch?v=urflCPQYYY&list=PLyG0oabETl8uu8u7JSd2rYgE0p61phhqK	Calculus of
O3	https://www.youtube.com/watch?v=k7rjICzxJ24	Matrix Theory
O4	https://www.youtube.com/watch?v=lkAvgVUvYvY	Fourier Transform
O5	Lec 29: Linear regression using R - YouTube	Regression
O6	Lecture 01: Introduction to Integral Transform and Laplace Transform	Laplace Transform

Chapter 7

Subject : Electrical Machines - I (Sem: III)

Overview			
Course code:	EEPC232	Course Category:	Program Core Course-1
Sem:	III	Syllabus & Version:	SIGCE-NEP-R25-Y2

7.1 Teaching & Learning Scheme

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

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 Codes, if any.	Knowledge of Basic Electrical Engineering (ASES112) is desirable.
Course Overview: This course is very important to learn the basic concept of Magnetism, Electromechanical Energy Conversion, Construction & working principle of DC Machine, Starting, Braking, Speed control& testing of DC Motor, Special Machines & Electrical Engineering material.	
Course Objective: 1. Understand the concepts of magnetism and Electromechanical Energy Conversion. 2. Understand construction, working principle & operational characteristics of DC machines and their applications. 3. Examine different starting methods, braking methods, speed control techniques& testing of DC motors. 4. Identify and classify electrical engineering materials based on their conductivity, resistivity & insulation property. 5 Explain the concept and significance of special purpose electrical machines and their differences from conventional electrical machines.	

7.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPC232.1	Analyze basic laws of magnetism & magnetic circuit.	Analyze
EEPC232.2	Analyze the principle of energy conversion in singly excited magnetic circuits.	Analyze
EEPC232.3	Examine construction & working principle of DC machine & its application.	Analyze
EEPC232.4	Evaluate the performance of DC machines by conduction of various tests.	Evaluate
EEPC232.5	Identify and classify electrical engineering materials based on their conductivity, resistivity & insulation property.	Apply
EEPC232.6	Examine construction & working principle of special purpose machines.	Analyze

7.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Basics of Magnetism	CO1	L4	T1, R3	5
	1.1	Basic laws of magnetism				
	1.2	Magnetic field and circuit				
	1.3	Compare electrical & magnetic circuit				
	1.4	Series & parallel magnetic circuit				
	1.5	Flux linkage & leakage flux				
2	Title	Electromechanical Energy Conversion	CO2	L4	T2, R2	7
	2.1	Electromechanical Energy Conversion principle				
	2.2	Energy stored in magnetic field				
	2.3	Field and co energy				
	2.4	Force and torque equations				
	2.5	Torque in singly excited systems				
	2.6	MMF in distributed windings				
	2.7	Magnetic field in rotating machines, Rotating MMF				

3	Title	DC Machines	CO3	L4	T1, T2, T 5, R4	8
	3.1	Construction and working principle of DC machine				
	3.2	Types of DC machines				
	3.3	Armature reaction				
	3.4	concept of back EMF				
	3.5	Torque equations				
	3.6	Characteristics of DC generators and motors (speed – torque and performance)				
	3.7	Losses and efficiency				
	3.8	Application of DC Motor				
4	Title	Starting, Braking, Speed control & testing of DC Motor	CO4	L5	T3, R1,R2	8
	4.1	Necessity of starter and it's types				
	4.2	3-point & 4- point Starter				
	4.3	Factors Controlling motor speed,				
	4.4	Speed control (Flux Control method & Armature control method),				
	4.5	Braking methods (Rheostatic braking & Plugging)				
	4.6	Swinburne's test				
	4.7	Hopkinson's test				
	4.8	Retardation test				
5	Title	Electrical Engineering material	CO5	L3	T4	7
	5.1	Electrical conducting material, High conductivity materials				
	5.2	Material of high resistivity				
	5.3	Electrical carbon materials				
	5.4	Magnetic Materials, Types of magnetic materials,				
	5.5	Insulating Materials				
	5.6	Electrical properties of insulating material				
	5.7	Classification of insulating material.				

	Title	Special Machines		L4	T3,R1	
6	6.1	Introduction of special machine,				
	6.2	Stepper motor, Types of stepper motor,				
	6.3	Variable reluctance stepper motor, Permanent magnet stepper motor				
	6.4	Construction & Working Principle of BLDC Motor.				
Self - Study	SS	1) B-H Curve, Hysteresis loop & hysteresis loss, Magnetic saturation, Retentivity & coercivity, Magnetic circuits of Transformers, DC machines & Induction motor 2) Doubly excited systems, Study of Reluctance torque, Electromagnetic torque, Alignment torque, Harmonics in MMF due to winding distribution 3) Derivation of EMF equation of DC Generator, Commutation process, Interpoles (commutating poles), Compensating windings, Temperature rise and insulation limits. 4) Comparison of 3-point vs 4-point starter, Ward-Leonard method, Regenerative braking, Losses During Control and Braking, Protection of DC Motors 5) Temperature effect on resistance (positive/negative temperature coefficient), Resistivity variation with impurities and alloying, Applications in heating elements, Core losses (hysteresis + eddy current), Permanent magnet materials (Alnico, rare-earth magnets), Aging and Failure of Insulation, Material Selection for Electrical Applications 6) Holding torque, detent torque, pull-in and pull-out torque, Pulse generation and driver circuits, Protection in BLDC drives				3 HRS

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	Study basic law's of magnetism.	CO1	2
2	Study of B-H curve.	CO1	2
3	Study of flux in series & parallel Magnetic circuit	CO1	2
4	Study of rotating magnetic field.	CO2	2
5	Demonstration of Electromechanical Energy Conversion device.	CO2	2
6	Study of construction & working principle of DC motor.	CO3	2
7	Plot speed – torque characteristics of DC Motor	CO3	2
8	Study application of DC Motor.	CO3	2
9	Study of three point starter.	CO4	2
10	Study of four point starter.	CO4	2

11	Speed control of DC shunt motor.	CO4	2
12	Rheostatic braking of DC shunt motor.	CO4	2
13	Plugging of DC motor.	CO4	2
14	Load test on DC shunt motor.	CO4	2
15	Load test on DC series motor.	CO4	2
16	Retardation test of DC motor.	CO4	2
17	Swinburne's test on DC motor.	CO4	2
18	Hopkinson's test on DC motor.	CO4	2
19	Study of Conducting material, Magnetic Material & insulating material.	CO5	2
20	Study classification of insulating material.	CO5	2
21	Measurement of resistance of conducting & insulating material.	CO5	2
22	Stepper motor control.	CO6	2
23	Speed Control of BLDC motor.	CO6	2

Any other experiments based on syllabus which will help students to understand the topic/ concept.

7.6 Assessment Methodologies and Tools

Theory Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA 1	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
FA-I	6	CAT	Quiz	Online Assessment	5	5	20 min
FA-II	6	CAT	Assignment	Take Home Assignment	5	5	-
ESE	1	ESE	Paper- Pencil	Class Room Test	60	60	2.5 Hours

*IA = Internal Assessment; FA = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 10	10	CAT	Practical Evaluation	Journal (Rubrics Based)	10	20	2
Seminar/ Presentation	1	CAT	Seminar	Rubrics Based	10	20	2
Class Participation	49	CAT	Attendance	Record and Observation	5	10	2
ESE	1	ESE	Oral and Practical	Rubrics Based	25	50	---

7.7 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	PSO3
EEPC232.1	3	3										3		
EEPC232.2	3	3										3		
EEPC232.3	3	3										3		
EEPC232.4	3			3								3	3	
EEPC232.5	3											3		
EEPC232.6	3	3										3		
EEPC232	3	3		3								3	3	

7.8 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 the discipline and awareness of relevant social sciences.	Gain basic Engineering knowledge in Electrical engineering.
2	WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science	Analyze principle of magnetism, Electromechanical energy conversion devices , DC Machine& special purpose machine.

		to support detailed analysis and modelling applicable to the discipline.	
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Acquire systematic, theory-based formulation of engineering fundamentals of Electromechanical energy conversion devices , DC Machine & special purpose machine.
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.	Specific Engineering knowledge of DC Machine, Special purpose machine & Electrical engineering materials.
5	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.	Evaluate the performance of the DC machine.

7.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Electric Machinery	First Edition	Bimbhra P. S.	Khanna Publisher,	2023
T2	Electric Machines	Third Edition	Ashfaq Husain	Dhanpat Rai and Co. Publications	2024
T3	A first course on Electrical Drives,	Fourth Edition	S. K. Pillai	New Age International	2022
T4	Electrical Machine Design	Sixth Edition	A.K.Sawhney	Dhanpat Rai & Co	2014
T5	Principles of Electrical Machines,	First Edition	V. K. Mehta	S Chand Publications	2006

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Direct current machines,	Second Edition	M. G. Say and E. O. Taylor,	Pitman publication	1986
R2	A text book of Electrical technology, Volume II,	24 th Edition	B.L.Theraja& A.K. Theraja,	S. Chand & Company PVT LTD.	2024

R3	Generalized Machine Theory,	Seventh Edition	Bimbhra P. S.,	Khanna Publisher,	2021
R4	Electric Machinery	Sixth Edition	Fitzgerald, Kingsley & Uman	McGraw Hill India	2020

Online Resources

SN	Title	Description
O1	Course: Electrical Machines – I By Prof. Tapas Kumar Bhattacharya (IIT Kharagpur) https://swayam.gov.in/nd1_noc20_ee60/preview	Concept of DC machine
O2	Virtual Lab Website Reference 1. http://vlab.co.in/broad-area-electrical-engineering	Virtual Lab for Electrical Engineering

Chapter 8

Subject : Electrical Power System -I (Sem: III)

Overview			
Course code:	EEPC232	Course Category:	Program Core Course-4
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	SL	
Hours/Week	3	-	2	2	6
Hours/Sem	45	-	30	45	120
Credits	3	-	1	-	4

8.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	100%	2
Labs	50%	50%	100%	1

8.3 Course Objectives

Pre-requisite Course Codes, if any.	Basic knowledge of electrical circuits, network analysis, and fundamental concepts of power generation and transmission (ASES112).
Course Overview: This course focuses on the fundamental and advanced concepts of electrical power systems, including transmission and distribution line parameters, performance analysis, cable design, earthing systems, and fault analysis. It covers both symmetrical and unsymmetrical fault studies using modern analytical methods such as Z-bus formulation and symmetrical components. Additionally, the course introduces lightning phenomena and insulation coordination to ensure system protection and reliability. The subject equips students with analytical, design, and problem-solving skills required for real-world power system engineering applications.	
Course Objective: Understand the electrical and physical parameters affecting transmission and distribution lines.	

Analyze the performance of short, medium, and long transmission lines under different operating conditions.

Gain knowledge of cable construction, insulation, and earthing practices for safe power system operation.

Apply methods for symmetrical fault analysis using modern computational techniques.

Evaluate unsymmetrical faults using symmetrical component theory.

Understand lightning effects and implement insulation coordination for system protection.

8.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPC232.1	Calculate transmission line parameters to study corona, skin, and proximity effects.	Apply
EEPC232.2	Evaluate performance parameters of short, medium and long transmission lines.	Evaluate
EEPC232.3	Analyze the cable characteristics and various types of earthing system for effective grounding.	Analyze
EEPC232.4	Interpret symmetrical fault using short circuit MVA method, Z-bus formulation and sequence networks.	Evaluate
EEPC232.5	Analyze unsymmetrical faults (SLG, L-L, LLG) using symmetrical components.	Analyze
EEPC232.6	Assess lightning phenomena, surge protection methods and insulation coordination techniques in power systems.	Evaluate

8.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Transmission / Distribution Line Parameters	CO1		T1, R1	6
	1.1	Resistance of transmission line, skin effect, proximity effect, corona effect .				
	1.2	Inductance of three phase three wire line with symmetrical and unsymmetrical spacing				

	1.3	Capacitance of transmission line, capacitance of three phase line with symmetrical and unsymmetrical spacing,				
	1.4	Per Unit (PU) system- Introduction and advantage of PU system				
	1.5	Insulators: Type of insulators, string efficiency				
2	Title	Performance of Transmission Line	CO2			4
	2.1	Classification and modelling of short, medium and long lines				
	2.2	regulation and efficiency of short and medium lines				
	2.3	Ferranti effect, evaluation and estimation of generalized circuit constant (ABCD) for short and medium lines				
	2.4	surge impedance loading.				
3	Title	Electric Cable and Earthing	CO3			4
	3.1	Electric Cable: Classification and construction of cable, insulation resistance of cable				
	3.2	capacitance of single core and three core cable, grading of cable.				
	3.3	Earthing: Earthing definition, soil resistivity, step and touch potentials				
	3.4	measurement of earth resistance, soil resistivity, neutral grounding and its methods.				
4	Title	Symmetrical Fault Analysis and Component	CO4			6
	4.1	Introduction, transient on a transmission line, selection of Circuit breaker				
	4.2	short circuit MVA. Algorithm for SC studies,				
	4.3	Z Bus formulation. Symmetrical component transformation				
	4.4	phase shift in star-delta transformers				
	4.5	sequence impedances and sequence network of transmission line				
	4.6	synchronous machine and transformer, power invariance				
5	Title	Unsymmetrical Fault Analysis	CO5			4
	5.1	Types of unsymmetrical faults, Analysis of shunt type unsymmetrical faults:				
	5.2	single line to ground (SLG) fault				
	5.3	line to line (L-L) fault				

	5.4	double line to ground (LLG) fault.				
6	Title	Lightning and Insulation Coordination	CO6			3
	6.1	Lightning phenomenon, mechanism of Lightning stroke, over voltages due to Lightning				
	6.2	protection against surges, surge arresters, surge capacitor, surge reactor and surge absorber .				
	6.3	Insulation Coordination:- Volt time curve, Basic Insulation Level, Insulation coordination between Line and substation				
Self - Study	SS.1	Study the concept of bundled conductors, their impact on corona loss, inductance, and transmission efficiency in high voltage lines.				3 hrs
	SS.2	Understand the need for transposition, its effect on inductance and capacitance balancing in three-phase systems.				
	SS.3	Learn about mechanical design aspects such as sag, tension, and factors affecting conductor spacing and safety.				
	SS.4	Explore techniques such as tap-changing transformers, voltage regulators, and reactive power compensation for maintaining voltage profile.				
	SS.5	Study different earthing system configurations used in power distribution and their advantages in safety and fault protection.				
	SS.6	Understand shielding techniques using earth wires, shielding angle, and their role in protecting transmission lines from lightning strokes.				

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	Calculation of Inductance of 3-Phase Transmission Line	CO1	2
2	Calculation of Capacitance of 3-Phase Transmission Line	CO1	2
3	Performance Analysis of Short Transmission Line	CO2	2
4	Determination of ABCD Constants of Medium Transmission Line	CO2	2
5	Measurement of Insulation Resistance of Cable using Megger	CO3	2
6	Measurement of Earth Resistance using Earth Tester	CO3	2
7	Calculation of Short Circuit MVA for a Given Power System	CO4	2
8	Formation of Z-Bus Matrix using Building Algorithm	CO4	2
9	Analysis of Single Line-to-Ground (SLG) Fault using Symmetrical Components	CO5	2

10	Analysis of Line-to-Line (L-L) and Double Line-to-Ground (LLG) Faults	CO5	2
11	Study of Surge Protection Devices (Surge Arrester, Surge Capacitor, Reactor)	CO6	2
12	Plotting Volt-Time Characteristics for Insulation Coordination	CO6	2

Any other experiments based on syllabus which will help students to understand the topic/ concept.

8.6 Assessment Methodologies and Tools

Theory Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA 1	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
FA 1	6	CAT	Quiz	Online Assessment	5	5	20 min
FA 2	6	CAT	Assignments	Take Home Assignment	5	5	-
ESE	1	ESE	Paper- Pencil	Class Room Test	60	100	2.5 hrs

*IA = Internal Assessment; FA = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2 hrs
Industry Visit	1	CAT	Presentation	Rubrics based	10	20	-
Class Participation	-	CAT	Attendance	Record and Observation	5	10	2
ESE	1	ESE	Oral and Practical	Rubrics Based	25	50	---

8.7 Suggested CO-PO/PSO/PEO Correlation Matrix

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

CO #	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
EEPC232.1	3	2	1					3				3	3	
EEPC232.2	3	3	2	1				3				3	3	
EEPC232.3	3	2	2	1	1	2		3		1	2	3	3	
EEPC232.4	3	3	2	2	1			3			1	3	3	
EEPC232.5	3	3	2	2	1			3			1	3	3	
EEPC232.6	3	2	3	2	1	2		3		1	2	3	3	

8.8 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.	Covers fundamental electrical parameters (R, L, C) and specialized transmission line concepts like corona, skin effect, and proximity effect.
2	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Involves analysis of transmission line performance using engineering fundamentals and investigative approaches such as regulation, efficiency, and Ferranti effect.
3	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.	Deals with specialized knowledge of cables and earthing along with practical implementation and safety considerations in power systems.
4	WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts,	Includes application of advanced fault analysis techniques, use of computational methods (Z-bus), and practical engineering tools.

		that supports engineering design and operations in a practice area.	
5	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	Focuses on analytical evaluation of unsymmetrical faults using symmetrical component theory requiring deep technical knowledge.

8.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Power Plant Engineering	3rd Edition	Fredrick T Morse	East-West Press Pvt Ltd	1964
T2	Power Plant Engineering	2 nd Edition	Mahesh Verma	Metrolitan Book Co Pvt Ltd	1969
T3	A Text Book of Power System engineering	Revised Edition	RK Rajput	Laxmi Publication	2010
T4	Principles of Power System	Revised Edition	V.K. Mehta	S Chand	2022
T5	Direct Energy Conversion	Electronic Series Vol. 3	George W Sutton	Electronic Series Vol3 McGraw Hill	1966
T6	Power System Engineering	3rd Edition	D. P. Kothari, I. J. Nagrath	3 Edition, Mc Graw Hill	2019
T7	Power System Analysis And Design	Revised Edition	B.R. Gupta	S.Chand	2014
T8	A Course in Power System	Revised Edition	J B. Gupta	S. K. Kataria & Sons	2015

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Modern Power System Analysis,	1st Edition	Stevenson and Grainger	1 Edition, TMH publication	1964
R2	Elements of Power System	4th Edition	W. D. Stevenson, Elements of Power System, 4 Edition TMH	Tata McGraw-Hill (TMH)	1982

Online Resources

SN	Title	Description
01	NPTEL https://nptel.ac.in/	NPTEL provides complete video lectures from IIT professors covering transmission
2	SWAYAM https://onlinecourses.nptel.ac.in/e-learning	SWAYAM offers structured courses with certification on power systems, including per unit system, transmission lines, and protection. It is useful for conceptual clarity and exam preparation aligned with university syllabus.
03	MIT OpenCourseWare – Electric Power Systems https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/	Notes and videos from MIT covering aspects of power generation, transmission, and analysis. Useful for deeper understanding of advanced topics like transients and modelling.
04	MATLAB / ETAP Tutorials https://www.youtube.com/playlist?list=PLUJLsDLKTljd-05M3gmT_1pcF6lQ7ujy0	These tools help in practical understanding of short circuit analysis, load flow, and fault studies. They are especially useful for topics like Z-bus, symmetrical components, and system performance evaluation.
05	IEEE Xplore Digital Library https://ieeexplore.ieee.org/search/searchresult.jsp?newsearch=true&contentType=periodicals&queryText=power%20system	Provides research papers and articles on modern developments like insulation coordination, surge protection, and smart grids. Good for self-learning topics and seminar preparation.

Chapter 9

Subject : Electrical and Electronics Measurements (Sem: III)

Overview			
Course code:	EEPC233	Course Category:	PCC3
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	SL	
Hours/Week	2	-	2	2	6
Hours/Sem	30	-	30	30	90
Credits	2	-	1	-	3

9.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	100%	2
Labs	50%	50%	100%	1

9.3 Course Objectives

Pre-requisite Course Codes, if any.	Basics of Electrical and Electronics Engineering, Electrical system engineering and Electrical workshop .
Course Overview: In this Course student can get knowledge of various bridges ,transducers, instruments and also basic analog and digital electronics	
Course Objective: 1. To Understand the fundamental principles of analog measurement and the working of various measuring instruments 2. To Explain the construction, working, and applications of different types of Digital measuring instruments for electrical quantity measurement 3. To Demonstrate the procedure for balancing AC and DC bridges for determining unknown electrical parameters. 4. To Analyze the working and characteristics of various transducers used for measuring non-electrical quantities. 5. To analyze different types of biasing techniques for BJT , MOSFET and introduction to OP-AMP. 6. To apply concepts of digital electronics for number conversion ,combinational and sequential circuits	

9.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
EEPC233	CO Detail	Bloom's level
EEPC233.01	Illustrate the construction, working and characteristic of analog measuring instruments.	Analyze
EEPC233.02	Assess the characteristics of digital measuring instruments for measurement of electrical quantities.	Apply
EEPC233.03	Measure electrical parameters using AC and DC Bridges.	Apply
EEPC233.04	Illustrate the working of various types of transducers for measurement of non-electrical quantities	Analyze
EEPC233.05	Examine the characteristics of BJT, MOSFET and OP-AMP based on biasing techniques.	Analyze
EEPC233.06	Classify the conversion technique and logic gates used in combinational and sequential logic	Analyze

9.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Analog Measurement of Electrical Quantities	CO1	L4	T1, R1	4
	1.1	Classifications of analog instruments, Introduction to controlling and damping torque				
	1.2	Extension of range of ammeter and voltmeter, Electro-dynamometer type wattmeter				
	1.3	Electro-dynamometer type Power factor meter. Instrument Transformer: Current Transformer (CT)				
	1.4	Types of CT (measuring and protection), Potential Transformer (PT), Clamp meter				
2	Title	Digital Measurement of Electrical Quantities	CO2	L3	T1,R1	5
	2.1	Generalized Block diagram of digital instruments, comparison of digital over analog instruments				
	2.2	Resolution & sensitivity of digital meters, Digital voltmeter (Ramp type)				
	2.3	Ammeter, multi-meter, Digital frequency meter, Digital Tachometer				
	2.4	Digital Megger, and Digital Storage Oscilloscope				
	2.5	Current sensor (ACS712), Voltage sensor (B25)				
3	Title	AC-DC Bridges and Potentiometer	CO3	L3	T1,R1	4
	3.1	Measurement of resistance: Wheatstone, Kelvins Double bridge				
	3.2	Megger, earth resistance measurement by earth tester				
	3.3	Measurement of inductance and capacitance: Maxwell's bridge				
	3.4	Schering bridge.				
4	Title	Measurement of Non-electrical Quantities	CO4	L4	T1,R1	5
	4.1	Transducers: definition, Resistive, capacitive & inductive transducers, Optical and digital transducers				
	4.2	Measurement of temperature: Thermocouple, Thermistor, Resistance Temperature Detector (RTD)				
	4.3	Measurement of displacement: Linear and angular displacement using potentiometer, LVDT				
	4.4	Measurement of pressure: Piezoelectric, strain-gauge, capacitive and inductive type				
	4.5	Measurement of speed: Inductive and Hall Effect sensor				

5	Title	Basic Electronics and Operational Amplifiers	CO5	L4	T1,R1	4
	5.1	Construction and Operating Principle of Diodes, BJT and MOSFET				
	5.2	Biasing and DC analysis of BJT/ MOSFET.				
	5.3	Block Diagram of OP-AMP, Characteristics of OP-AMP, Application of OP-AMP as summing amplifier				
	5.4	Integrator and Differentiator				
6	Title	Digital Fundamentals and Applications	CO6	L4	T1,R1	4
	6.1	Introduction to Number system and conversions				
	6.2	Basic Gates and Boolean Algebra, Reduction Boolean expressions using K map,				
	6.3	Multiplexers, Sequential circuits,				
	6.4	Counters and Shift Registers				
1	Title	Analog Measurement of Electrical Quantities				4
	1.1	Classifications of analog instruments, Introduction to controlling and damping torque				
Self - Study	SS.1	Learning of various Analog and Digital Instruments				2 Hrs
	SS.2	Calculate the measured values and compare				
	SS.3	Various Number conversion from different number system				

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	To measure power using electro-dynamometer type wattmeter	CO1	2
2	To measure power factor using electro-dynamometer type wattmeter	CO1	2
1	To measure speed of motor using digital tachometer	CO2	2
2	To Measure earth resistance using digital megger	CO2	2
3	Measurement of capacitance using Schering's bridge	CO3	2
4	Measurement of High resistance and insulation resistance using Megger	CO3	2
5	Measurement of temperature using Thermistor or thermocouple	CO3	2
6	Current Measurement using Shunt, CT, and Hall Sensor.	CO4	2
7	Linear displacement measurement using LVDT	CO4	2
8	To study Op-amp as integrator.	CO5	2
9	To study op-amp as differentiator	CO5	2
10	To study input and output characteristic of CE amplifier.	CO5	2
11	To study Transfer characteristic of MOSFET	CO5	2
12	Design decade counter	CO6	2
13	Design 5 bit shift resistor	CO6	2
14	Design 8:1 multiplexer	CO6	2

Any other experiments based on syllabus which will help students to understand the topic/ concept.

9.6 Assessment Methodologies and Tools

Theory Assessment

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA 1	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
2	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
3	FA 1	6	CAT	Assignment	Take home Assignment	5	5	-
4	FA 2	6	CAT	Quiz	Online Assessment	5	5	20 min
5	ESE	1	ESE	Paper- Pencil	Class Room Test	40	60	2.5 Hrs

*IA = Internal Assessment; FA = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Assessment

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2 Hrs
2	Class Participation	-	CAT	Attendance	Record and Observation	5	10	2Hrs
3	Course Project	1	CAT	Course Project	Rubric Based	10	20	2 Hrs
4	ESE	1	ESE	Oral and Practical	Rubrics	25	50	–

9.7 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	PSO3
EEPC233.1	3	3			1	1		3				3		
EEPC233.2	3			2	1	1		3			2	2		
EEPC233.3	3		3		1	1		3				3	2	
EEPC233.4	3	2			1	1		3				1		
EEPC233.5	3		3		1	1		3			2	3	2	
EEPC233.6	3			2	1	1		3			2	3		

9.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
	WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.	Classification of analog instruments used in electrical systems like voltmeter, ammeter ,power factor meter
	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.	Modeling and analysis of different sensors and digital techniques widely used in electronic and electrical measurements
	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Learning analog and digital measuring instruments is a systematic approach of engineering
	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.	Measurement of various parameters helps in electrical and electronics measurements
	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	Electrical and electronic measurements ,analog and digital circuits gains the knowledge of technology

9.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	"A Course in Electrical and Electronic Measurements and Instrumentation,"	5	A.K. Sawhney	Dhanpat Rai Publications.	2015
T2	"A Course in Electrical and Electronic Measurements & Instrumentation,"	4	J.B. Gupta	Katson Publications	2018
T3	Digital Electronics	8	R. P. Jain	PTH publication	2016
T4	"Electrical and Electronic Measurement and Instrumentation,"	3	R. K. Rajput	S. Chand Publications	2020
T5	Electronics Circuits and Design	2	Robert Boylestad	McGraw Hill	2012

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	"Electrical Measurements and Measuring Instruments,"	4	E.W. Golding & F.C. Widdis,	Wheeler Publishing.	2015
R2	"Modern Electronic Instrumentation and Measurement Techniques	2	Helfric and Cooper	PHI	2016
R3	"Sensors Handbook"	2	Sabrie Soloman	McGraw Hill	2010
R4	"Sensors And Signal Conditioning"	2	Ramon Pallaá S-Areny and J. G. Webster	John Wiley & Sons, Inc.	2011
R5	Digital Electronics	3	B. P. Lathi	Pearson	2008

Online Resources

SN	Title	Description
O1	Electrical Measurement and Electronic instruments, By Prof. Avishek Chatterjee, IIT Kharagpur, weblink: https://onlinecourses.nptel.ac.in/noc24_ee117/preview	Various courses are available on NPTEL / Swayam to Learn the instruments and their applications

Chapter 10

Subject : Skill Enhancement Course MATLAB (Sem: III)

Overview			
Course code:	IGVE231	Course Category:	Skill Courses (VESC)
Sem:	III	Syllabus &Version:	SIGCE-NEP-R25-Y2

10.1 Teaching & Learning Scheme

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

10.2 Examination Scheme

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

10.3 Course Objectives

Pre-requisite Course Codes, if any.	Basic knowledge of electrical circuits (ASES112), network analysis, and engineering mathematics (ASBS111) (ASBS121) is required for effective use of MATLAB in Electrical Engineering applications. Students should be familiar with matrices, basic programming concepts, and electrical system fundamentals.
Course Overview: This course introduces MATLAB programming and simulation techniques for solving Electrical Engineering problems related to circuits, control systems, power systems, and signal analysis. It provides hands-on experience in mathematical modeling, data visualization, and Simulink-based industrial applications relevant to modern electrical engineering practices.	
Course Objectives 1. To explore the MATLAB environment and basic programming concepts. 2. To apply MATLAB for solving electrical engineering numerical problems. 3. To analyze electrical circuits and systems using MATLAB tools. 4. Use plotting and visualization techniques for engineering application. 5. To develop MATLAB programs for power systems, control systems, and signal processing applications. 6. To gain industry-oriented skills required for simulation and technical problem solving.	

10.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
IGVE231.1	Demonstrate the MATLAB environment and basic programming concepts.	Understand
IGVE231.2	Develop MATLAB programs using decision-making and looping statement	Apply
IGVE231.3	Apply matrix operations for solving electrical engineering problems.	Apply
IGVE231.4	Analyze engineering data using MATLAB plotting tools.	Analyze
IGVE231.5	Simulate electrical engineering systems using MATLAB and Simulink.	Apply
IGVE231.6	Apply MATLAB tools for engineering applications for data analysis.	Apply

10.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Introduction to MATLAB Environment	CO1	L2	T1,R1	4
	1.1	Introduction to MATLAB. Types of windows in MATLAB, command window, command history window, workspace and variable editor, current folder window.				
	1.2	Basic MATLAB commands, arithmetic operations, Variables, operator, constants and array.				
	1.3	Character and string				
	1.4	Script and function M file.				
2	Title	MATLAB Programming Fundamentals	CO2	L3	T1,R1	5
	2.1	Operators and expressions. Decision making statements: if, if-else, switch				
	2.2	Looping statements: for, while. Arrays and vectors				
	2.3	User-defined functions				
	2.4	Debugging techniques				
	2.5	MATLAB error and correction				
3	Title	Matrix Operations	CO3	L3	T1,R1	5

	3.1	Matrix creation and manipulation				
	3.2	Matrix algebra and operations				
	3.3	Determinants and inverse matrices				
	3.4	Solving simultaneous equations using MATLAB. Numerical methods for electrical engineering problems				
	3.5	Eigenvalues and eigenvectors. Applications in circuit analysis.				
4	Title	Graphics in MATLAB	CO4	L4	T1,R1	4
	4.1	Basics of 2D plotting. Multiple plots and subplot commands				
	4.2	3D plot.				
	4.3	Polar plot				
	4.4	Parametric plot, Labels, titles, legends, and formatting.				
5	Title	MATLAB & Simulink	CO5	L3	T1,R1	5
	5.1	Traditional window				
	5.2	Simulink window				
	5.3	Simulink Library				
	5.4	Simulink basic elements				
	5.5	Model creation in Simulink				
6	Title	Applications	CO6	L3	T1,R1	3
	6.1	Data analysis and statistics.				
	6.2	Ordinary Differential Equation				
	6.3	Curve fitting and Interpolation				

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	Study of MATLAB environment, command window, workspace, and basic commands	CO1	2
2	Program execution using scripts, functions, and input/output commands	CO1	2
3	MATLAB programs using decision-making statements (if-else, switch case)	CO2	2

4	MATLAB programs using loops, arrays, and user-defined functions	CO2	2
5	Matrix creation, manipulation, and matrix algebra operations using MATLAB	CO3	2
6	Solution of simultaneous electrical circuit equations using matrices in MATLAB	CO3	2
7	Plotting of electrical signals using 2D and subplot commands	CO4	2
8	To study basic 2D plotting in MATLAB using single plots, multiple plots, and subplot commands.	CO4	2
9	To study basic 3D plotting in MATLAB using single plots, multiple plots, and subplot commands.	CO4	2
10	To study and plot polar graphs using MATLAB.	CO4	2
11	To study Multiple plots and subplot commands	CO4	2
12	To study Matrix operations and array manipulations	CO4	2
10	To study Solving linear equations using MATLAB	CO4	2
11	To study the introduction to Simulink and block libraries	CO5	2
12	Study of MATLAB traditional window and basic MATLAB environment	CO5	2
13	Introduction to Simulink window and its features	CO5	2
14	Study of Simulink Library Browser and available block sets	CO5	2
15	Understanding Simulink basic elements such as sources, sinks, and continuous blocks	CO5	2
16	Creation of a basic model in Simulink	CO5	2
17	Simulation of simple mathematical operations using Simulink blocks	CO5	2
18	Generation of sine and square waves in Simulink	CO5	2
19	Study of signal routing and display blocks in Simulink	CO5	2
20	Creation and simulation of subsystem models	CO5	2
21	Model creation and analysis using integrator and gain blocks	CO5	2
22	Design of a simple feedback control system in Simulink	CO5	2
23	Simulation and verification of dynamic system models in Simulink	CO5	2
24	To study the Data analysis using MATLAB	CO6	2
25	To study the Statistical analysis and computation of mean, median, mode, and standard deviation	CO6	2
26	Graphical representation of statistical data using MATLAB	CO6	2

27	Solution of Ordinary Differential Equations (ODE) using MATLAB	CO6	2
28	Solving first-order differential equations using in Matlab	CO6	2
29	Solving higher-order differential equations in MATLAB	CO6	2
30	Curve fitting using polynomial fitting techniques	CO6	2
31	Linear and nonlinear curve fitting in MATLAB	CO6	2
32	Interpolation using linear interpolation method	CO6	2
33	Polynomial and spline interpolation in MATLAB	CO6	2
34	Comparison of interpolation techniques using graphical analysis	CO6	2
35	Data visualization and analysis using MATLAB plotting tools	CO6	2

** Any other experiments based on syllabus which will help students to understand the topic/concept.

10.6 Assessment Methodologies and Tools

Lab Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2
Course Project	1	CAT	Mini Project	Rubrics based	10	20	2
Class Participation	-	CAT	Attendance	Record and Observation	5	10	2
ESE	1	ESE	Oral and Practical	Rubrics	25	50	-

CAT Activity will be part of Term Work

10.7 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	PSO3
IGVE231.1	3	2	-	-	3	-	-	-	-	-	1	2	1	-
IGVE231.2	2	3	1	1	3	-	-	-	-	-	1	2	2	1

IGVE231.3	3	3	2	2	3	-	-	-	-	-	1	3	3	1
IGVE231.4	2	3	1	2	3	-	-	-	-	1	1	2	2	1
IGVE231.5	3	3	2	3	3	-	-	-	-	1	1	3	3	1
IGVE231.6	2	2	1	2	3	1	1	1	2	2	2	2	3	3

10.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
	WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline.	MATLAB programming and numerical computation require mathematical and scientific concepts for solving electrical engineering problems and simulations.
	WK2	Conceptually-based mathematics, numerical analysis, statistics, and formal aspects of computer and information science to support engineering analysis and modeling.	The course emphasizes MATLAB-based numerical methods, matrix operations, programming, and engineering analysis for electrical systems.
	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Students apply MATLAB tools for circuit analysis, power systems, control systems, and signal processing applications based on electrical engineering fundamentals.
	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline.	MATLAB and Simulink are used for modeling, simulation, and analysis of specialized electrical engineering systems and industrial applications.
	WK5	Knowledge that supports engineering design in a practice area.	MATLAB simulation and visualization techniques help students design and analyze engineering systems and technical solutions.
	WK6	Knowledge of engineering practice and contextual factors supporting professional engineering practice.	Industry-oriented MATLAB applications, technical documentation, and simulation practices prepare students for professional engineering environments.
	WK7	Comprehension of the role of engineering in society and identified issues in engineering practice.	MATLAB-based problem solving and engineering analysis support efficient and

			reliable solutions for modern industrial and societal electrical engineering applications.
	WK8	Engagement with selected knowledge in the research literature of the discipline.	Students use MATLAB tools and documentation to explore advanced engineering applications, simulation methods, and technical resources.

10.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers	Latest	Rudra Pratap	Oxford University Press	2010
T2	MATLAB Easy way of Learning	1st	S Swapna Kumar , S Swapna Kumar	PHI	2016
T3	MATLAB Essential for Problem Solving	1st	Manij Khanna ,Geeta Bhatt, Pwan Kumar	PHI	2016
T4	A Guide to MATLAB	1st	Brian R Hunt, Ronald L Lipsman, Jonathan M Rosenberg	Cambridge	2002
T5	MATLAB Programming for Engineers	6th Edition	Stephen J. Chapman	Cengage Learning	2019
T6	Applied Numerical Methods with MATLAB for Engineers and Scientists	4th Edition	Steven C. Chapra	McGraw Hill	2018

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Introduction to MATLAB and Simulink	1st Edition	William J. Palm III	McGraw Hill	2011
R2	MATLAB and Its Applications in Engineering	2nd Edition	Rajesh Kumar Gupta	S. Chand Publishing	2015
R3	Mastering MATLAB	1st Edition	Duane Hanselman, Bruce Littlefield	Pearson Education	2011
R4	Numerical Methods Using MATLAB	4th Edition	John H. Mathews, Kurtis Fink	Pearson Education	2004
R5	SIMULINK for Engineers	2nd Edition	Katsuhiko Ogata	Prentice Hall	2008

R6	Digital Signal Processing using MATLAB	3rd Edition	Vinay K. Ingle, John G. Proakis	Cengage Learning	2012
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Online Resources

SN	Title	Description
O1	MATLAB Onramp – MathWorks Official Course https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted	Free beginner-friendly course covering MATLAB environment, commands, variables, scripts, loops, functions, and plotting techniques
O2	MATLAB Tutorials – MathWorks Learning Portal https://www.mathworks.com/support/learn-with-matlab-tutorials .	Official tutorials and examples for MATLAB programming, matrices, visualization, Simulink, and engineering applications covering all course outcomes.
O3	MATLAB for Electrical Engineering Applications – YouTube Tutorials https://www.youtube.com/results?search_query=MATLAB+for+Electrical+Engineering&utm	Video tutorials explaining MATLAB applications in electrical circuits, power systems, signal processing, and electrical machine analysis.
O4	Power System Simulation using MATLAB Simulink https://www.mathworks.com/discovery/power-system-simulation.html?utm	Resource for modeling and simulation of electrical power systems, renewable energy systems, and smart grids using MATLAB and Simulink.
O5	Electrical Machine Simulation using MATLAB – YouTube Resources https://www.youtube.com/results?search_query=Electrical+Machine+Simulation+using+MATLAB&utm	Tutorials for induction motor, synchronous machine, and DC motor modeling and analysis using MATLAB and Simulink.
O6	MATLAB Documentation – MathWorks https://www.mathworks.com/help/matlab/?utm	Comprehensive documentation for MATLAB commands, plotting tools, matrix operations, debugging, and advanced engineering toolboxes.

Chapter 11

Subject : Comprehensive Soft Skills & Professional Development (Sem: III)

Overview			
Course code:	IGAE231	Course Category:	Ability 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
Hours/Sem	-	-	30	-	-	30
Credits	-	-	1	-	-	1

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

11.2 Examination Scheme

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

11.3 Course Objectives

Pre-requisite Course Codes, if any.	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: x. To develop effective verbal, non-verbal, written, and digital communication skills among students. x. To enhance personality development, self-confidence, interpersonal skills, and professional behavior. x. To train students in group discussions, teamwork, leadership, and collaborative problem-solving techniques.	

x.	To prepare students for professional recruitment processes through resume writing, interview preparation, and mock interview practice.
x.	To build awareness of workplace etiquette, corporate communication, time management, and professional ethics in modern work environments.
x.	To strengthen aptitude, reasoning, career planning, and personal branding skills for improving employability and career growth.

11.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	CO Detail	Bloom's level
IGAE 231.1	Demonstrate effective verbal and non-verbal communication using the 7Cs and self-awareness tools to enhance personality and confidence.	Apply
IGAE 231.2	Develop professional written communication including formal emails and LinkedIn profiles while practicing digital etiquette.	Create
IGAE 231.3	Participate actively and confidently in group discussions by applying group behaviour techniques and teamwork skills.	Apply
IGAE 231.4	Create structured and ATS-compliant resumes and prepare for interviews using the STAR method and professional etiquette.	Create
IGAE 231.5	Exhibit professional behaviour at the workplace through appropriate time management, ethical conduct, and corporate communication.	Apply
IGAE 231.6	Solve aptitude problems and outline a career plan using test strategies and personal branding tools.	Analyze

11.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Fundamentals of Communication & Personality	CO1	L3	T1 T2, R1 R2	4
	1.1	Importance of Soft Skills in Engineering & Career				
	1.2	Verbal & Non-verbal Communication, 7Cs of Effective Communication				
	1.3	Body Language, Facial Expressions & Grooming Etiquette				

	1.4	Self-awareness, Personality Types & SWOT Analysis, Activities: Icebreakers, Self-introduction Video & Confidence-building Exercises				
2	Title	Verbal, Written & Digital Communication Skills	CO2	L6	T3 T4, R3 R4	4
	2.1	Public Speaking, JAM & Storytelling Techniques				
	2.2	Professional Email Writing: Structure, Tone & Etiquette				
	2.3	Grammar Improvement & Vocabulary Enhancement				
	2.4	LinkedIn Profile Creation, Digital Behaviour & Personal Branding, Activities: Draft Emails, LinkedIn Review & Mock JAM Rounds				
3	Title	Group Discussion & Team Dynamics	CO3	L3	T5 T6, R5 R6	4
	3.1	Introduction to Group Discussion & Types of GDs				
	3.2	GD Techniques: Entry, Lead, Counter & Conclude				
	3.3	Group Behaviour, Leadership Roles & Team Dynamics				
	3.4	Teamwork, Cooperation & Collaborative Problem-solving, Activities: Mock GDs, Peer Feedback & Role Rotation				
4	Title	Resume Building & Interview Readiness	CO4	L6	T7 T8, R7 R8	4
	4.1	Resume Format, Keywords & Achievement Writing				
	4.2	ATS-friendly Resume Preparation for Engineers				
	4.3	HR & Technical Interview Questions				
	4.4	STAR Method, Interview Etiquette & Virtual InterviewsActivities: Resume Clinic, Mock Interviews & Peer Reviews				
5	Title	Workplace & Corporate Etiquette	CO5	L3	T10 T9, R1 R9	4
	5.1	Work Ethics & Professionalism				
	5.2	Time Management Tools: Pomodoro & Eisenhower Matrix				
	5.3	Email, Meeting & Call Etiquette				
	5.4	Work-from-home/Hybrid Professionalism & Accountability, Activities: Etiquette Checklist, Planner Setup & Roleplay				
6	Title	Aptitude Test Strategies & Career Planning	CO6	L4	T11 T12, R11 R12	4

	6.1	Overview of Quantitative, Reasoning & Verbal Aptitude
	6.2	Aptitude Test Strategies & Speed Improvement Techniques
	6.3	Previous Year Placement Aptitude Questions (TCS, Infosys, etc.)
	6.4	Career Goal Setting, Personal Branding & Self-pitch, Activities: Mini Aptitude Quiz, Pitch Presentation & Career Map Submission
Self - Study	SS.1	Self-analysis of personality using SWOT analysis and communication improvement plan
	SS.2	Creating and optimizing a professional LinkedIn profile and digital portfolio
	SS.3	Study of successful Group Discussion techniques through case studies and online GD sessions
	SS.4	Designing an ATS-friendly resume and practicing STAR-based interview responses
	SS.5	Exploring workplace ethics, professional etiquette, and productivity tools used in corporate environments
	SS.6	Solving aptitude test sets from placement companies and preparing a personal career roadmap

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	Conduct self-introduction video recording to evaluate verbal and non-verbal communication skills including body language and confidence.	CO1	2
2	Perform SWOT analysis and personality type assessment to understand self-awareness and personality development	CO1	2
3	Draft and submit professional emails based on given workplace scenarios focusing on tone, structure, and etiquette	CO2	2
4	Create and optimize LinkedIn profile to practice digital branding and professional online presence	CO2	2
5	Conduct mock group discussions with assigned topics focusing on entry, lead, counter, and conclusion techniques.	CO3	2
6	Perform role rotation activity in team tasks to understand leadership, cooperation, and teamwork dynamics.	CO3	2
7	Prepare ATS-friendly resume using proper keywords, achievements, and structured formatting.	CO4	2

8	Conduct mock interview sessions using STAR method with peer evaluation and feedback	CO4	2
9	Perform workplace roleplay activities focusing on email, meeting, and communication etiquette scenarios.	CO5	2
10	Create personal time management planner using Pomodoro and Eisenhower matrix techniques	CO5	2
11	Attempt mini aptitude tests covering quantitative, reasoning, and verbal sections with timed evaluation	CO6	2
12	Prepare and present personal career roadmap and self-pitch presentation for placement readiness	CO6	2

11.6 Assessment Methodologies and Tools

Lab Component

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 12	12	CAT	Practical / Experiments/Tutorial	Journal (Rubrics Based)	20	80%	
Attendance		CAT	Attendance Teachers Observation	Rubrics Based Record and Rubrics	5	20%	

CAT Activity will be part of Term Work

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	PSO3
IGAE 231.1	2		-	-	-	2	-	2	3	3	-		1	-
IGAE 231.2	2	2	-	-	2	2	-	2		3	-	2	2	1
IGAE 231.3			2	2	-	2	-	2		3	1		2	
IGAE 231.4	2				2	2	-	2	3	3		3	2	
IGAE 231.5	1	2		-	2	3	-	3	3	3	2	2	2	1
IGVE 231.6	2	3	2	1	2	2	-	2	2	3	2	3	2	2

11.8 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 essential for engineering environments.
2	WK2	Conceptually-based mathematics, numerical analysis, statistics, and formal aspects of computer and information science to support engineering analysis and modeling.	Aptitude preparation, reasoning ability, and analytical problem-solving activities enhance logical and quantitative thinking skills.
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	The course supports engineering professionalism through structured communication, teamwork, and workplace readiness practices.
4	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for accepted engineering practice.	Resume building, interview readiness, and corporate communication practices align students with industry expectations and professional engineering standards.
5	WK5	Knowledge that supports engineering design in a practice area.	Activities such as LinkedIn profile creation, self-pitch design, and digital branding help students present professional profiles effectively.
6	WK6	Knowledge of engineering practice including technologies, processes, and standards in practical situations.	Workplace etiquette, virtual meeting behavior, email etiquette, and hybrid work professionalism expose students to modern corporate practices.

7	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.
8	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.

11.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	<i>Soft Skills: Know Yourself and Know the World</i>	3rd	Dr. K. Alex	S. Chand Publishing	2019
T2	<i>Technical Communication: Principles and Practice</i>	3rd	Meenakshi Raman & Sangeeta Sharma	Oxford University Press	2015
T3	<i>Communication Skills for Engineers</i>	2nd	Sunita Mishra & C. Muralikrishna	Pearson Education India	2011
T4	<i>Personality Development and Soft Skills</i>	2nd	Barun K. Mitra	Oxford University Press	2016
T5	<i>Developing Soft Skills</i>	2nd	Krishna Mohan & Meera Banerji	Pearson Education	2015
T6	<i>Business Communication and Personality Development</i>	1st	Biswajit Das & Ipseeta Satpathy	Excel Books	2009
T7	<i>Interview and Group Discussion</i>	1st	T. Sudha	Tata McGraw Hill	2010
T8	<i>English and Soft Skills</i>	1st	S.P. Dhanavel	Orient BlackSwan	2010
T9	<i>Employability Skills</i>	1st	S.K. Bansal	Kalyani Publishers	2022
T10	<i>Quantitative Aptitude for Competitive Examinations</i>	Latest	R.S. Aggarwal	S. Chand Publishing	2024
T11	<i>A Modern Approach to Logical Reasoning</i>	Latest	R.S. Aggarwal	S. Chand Publishing	2024
T12	<i>Campus to Corporate: Your Roadmap to Employability</i>	1st	Gangadhar Joshi	Cengage Learning India	2021

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	<i>Soft Skills: Know Yourself and Know the World</i>	3rd	Dr. K. Alex	S. Chand Publishing	2019
R2	<i>Personality Development and Soft Skills</i>	2nd	Barun K. Mitra	Oxford University Press	2016
R3	<i>Business Communication</i>	2nd	Meenakshi Raman & Prakash Singh	Oxford University Press	2012
R4	<i>The 7 Cs of Communication: A Skills Workbook</i>	1st	Lucas Burns	Independently Published	2020
R5	<i>Body Language: How to Read Others' Thoughts by Their Gestures</i>	Revised	Allan Pease	Manjul Publishing	2017
R6	<i>Digital Communication Skills: A Training Manual</i>	1st	John Zinkin	Routledge	2021
R7	<i>Cracking the Campus Interview: Your Gateway to the Corporate World</i>	1st Edition	Sameer Sinha	McGraw Hill Education	2015
R8	<i>Group Discussion and Interview Skills</i>	1st Edition	Priyadarshi Patnaik & Barun K. Mitra	Cambridge University Press India	2011
R9	<i>Resumes That Get You Hired</i>	Updated	Patrice Rice	Career Press	2018
R10	<i>Workplace Etiquette: A Guide to Career Success</i>	1st	Barbara Pachter	Career Press	2014
R11	<i>Quantitative Aptitude for Competitive Examinations</i>	2024 Edition	R.S. Aggarwal	S. Chand Publishing	2024
R12	<i>A Modern Approach to Logical Reasoning</i>	2nd	R.S. Aggarwal	S. Chand Publishing	2024
R13	<i>The STAR Interview: How to Tell a Great Story, Nail the Interview</i>	1st	Misha Yurchenko	Independently Published	2019
R14	<i>Building a Career in Software: A Comprehensive Guide</i>	1st	Gaurav Vohra & Hema Ahuja	Notion Press	2023

Online Resources

SN	Title	Description
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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-gg	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 12

Subject : Applied Engineering Mathematics for Circuit Theory and Signal Processing (Sem: IV)

Overview			
Course code:	EEBSC241	Course Category:	BSC
Sem:	IV	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	SL	
Hours/Week	2	1		3	6
Hours/Sem	30	15		45	90
Credits	2		1	-	3

12.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	100%	2

12.3 Course Objectives

Pre-requisite Course Codes, if any.	Applied Mathematics for Electrical Engineering (EEBSC231), Engineering Mathematics-I & Engineering Mathematics-II
Course Overview: In this course students can get knowledge of various networks, Z-Transform and. Inverse Z-Transform and analysis of network and signal systems.	
Course Objective: 1.To understand the basic properties of signals & systems. 2. To familiarize with the Fourier Series and Fourier Transform of various functions. 3.To acquaint with the concept of Z-Transform and Inverse Z-Transform. 4.To analyze discrete time signals and system in Z-Transform domain 5.To learn frequency domain analysis of signals and systems. 6.To learn frequency domain analysis of signals and systems.	

12.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to
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CO	CO Detail	Bloom's level
EEBS241.1	Analyse electric circuit behavior through matrix operations	Analyze
EEBS241.2	Analyze the effect of switching conditions on electrical networks using differential equations	Analyze
EEBS241.3	Analyze time-domain signals and circuit responses using Laplace Transform	Analyze
EEBS241.4	Analyze time-domain signals and circuit responses using Laplace Transform	Analyze
EEBS241.5	Expand the periodic function by using Fourier series for real life problems and complex	Evaluate
EEBS241.6	Interpret the transformation of discrete time signal to Z domain.	Evaluate

12.5 Modules / Syllabus Content

Theory Assessment

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Analysis of Electric circuit behavior through matrix operations	CO1	L4	T1, R1	4
	1.1	Graph Theory and Network Topology: Introduction,				
	1.2	Graph of network, Tree, Co-tree,				
	1.3	Loop incidence matrix, Cut set matrix,				
	1.4	Tie set matrix and Loop current matrix, , Principle of duality.				
2	Title	Application of Differential Equations for analysing circuits with capacitors and inductors	CO2	L4	T1, R1	5
	2.1	Solution of first and second order differential equations for series R-L, R-C, R-L-C circuits, .				
	2.2	Solution of first and second order differential equations for parallel R-L, R-C, R-L-C circuits,				
	2.3	initial and final conditions in network elements, ,				
	2.4	time constants, steady state				
	2.5	time constants, transient state response.				

3	Title	Electrical Circuit Analysis Using Laplace Transforms	CO3	L4	T1, R1	4
	3.1	The Laplace transform and its application in electrical circuit analysis,				
	3.2	transient response to step, ramp and impulse signals				
	3.3	steady state response to step, ramp and impulse signals				
	3.4	step, ramp and impulse signals				
4	Title	Two port Network analysis	CO4	L4	T1, R1	4
	4.1	Open circuit parameters				
	4.2	short circuit parameters				
	4.3	transmission parameters, relationships between parameter sets				
	4.4	hybrid parameters, relationships between parameter sets,				
5	Title	Introduction to Signals and Systems	CO5	L6	T1, R1	5
	5.1	Definition of basic signals and system. Standard signals-step, ramp,pulse, impulse, real and complex exponentials and Sinusoids,				
	5.2	Classification of signals-Continuous time (CT) and Discrete time (DT) signals,Periodic				
	5.3	Aperiodic signals,Deterministics& Random signals,Even and odd, Energy & Power signals,				
	5.4	Classification of systems-Linear/ Non-Linear,Time variant/ Invariant, Causal/ Anticausal,				
	5.5	Stable/Unstable, Memory/Memory less system (Static and dynamic) , Basic operations on signals Folding, Scaling& Time shifting) Convolution in DT domain.				
6	Title	Z-Transform	CO6	L6	T1, R1	4
	6.1	Introduction, Definition, one sided and two-sided z- transform				
	6.2	ROC, Properties of ROC, Properties of z- transform.				
	6.3	Inverse z-Transform using partial fraction. Solution of difference equation (zero input and zero state response)				
	6.4	Discrete and Fast Fourier Transform:- DFT & IDFT, ,DIT FFT Algorithm (upto radix-2 only)				
Self - Study	SS.1	Learning various networks and parameters				2 Hrs
	SS.2	Calculate the parameters				

	SS.3	Calculate z-Transform	
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Lab Assessment

SN	Title of the Experiments	CO	Hrs
1	Simulation of DC Network using MATLAB	CO1	2
2	Mesh and Nodal Analysis using MATLAB	CO1	2
3	Verification of Network Theorems using MATLAB	CO1	2
4	Tie-Set and Cut-Set Matrix Analysis using MATLAB	CO1	2
5	Formation of Graph of an Electrical Network using MATLAB	CO1	2
6	Determination of Incidence Matrix using MATLAB	CO1	2
7	Determination of Tie-Set Matrix using MATLAB	CO1	2
8	Determination of Cut-Set Matrix using MATLAB	CO1	2
9	Loop Current Solution using Tie-Set Matrix using MATLAB	CO1	2
10	Node Voltage Solution using Cut-Set Matrix using MATLAB	CO1	2
11	Study how changing R, L, or C affects response speed	CO2	2
12	Solve first-order differential equation of an RC circuit.	CO2	2
13	Study under damped, over damped, and critically damped responses	CO2	2
14	Study of Laplace Transform and inverse Laplace Transform	CO3	2
15	Analysis of systems using Transfer Function and Frequency Response	CO3	2
16	To study the Analyze cascaded systems	CO4	2
17	Compute and verify open-circuit impedance parameters (Z_{11} , Z_{12} , Z_{21} , Z_{22}).	CO4	2
18	Find short-circuit admittance parameters (Y_{11} , Y_{12} , Y_{21} , Y_{22}).	CO4	2
19	Determine hybrid parameters (h_{11} , h_{12} , h_{21} , h_{22}).	CO4	2
20	Analyze cascaded networks using ABCD parameters.	CO4	2
21	Study behaviour of two-port network with frequency variation.	CO4	2
22	Perform operations like scaling and shifting	CO5	2
23	To study the Decompose a signal into even and odd components.	CO5	2
24	To study the Represent continuous signals using fine sampling.	CO5	2

25	Perform linear convolution of two signals.	CO5	2
26	To study the Compute auto-correlation and cross-correlation	CO5	2
27	Computation of Continuous-time Fourier Transform (CTFT)	CO6	2
28	Computation of Discrete-time Fourier Transform (DTFT)	CO6	2
29	Fast Fourier Transform (FFT) and spectrum analysis	CO6	2
30	Analysis of LTI system response using impulse response	CO6	2

Any other experiments based on syllabus which will help students to understand the topic/ concept.

12.6 Assessment Methodologies and Tools

Theory Assessment

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	IA1	1	CAT	Paper-pencil	Class room test	15	15	1hrs
2	IA2	1	CAT	Paper-pencil	Class room test	15	15	1hrs
3	FA1	6	CAT	Assignment	Take home assignment	5	5	-
4	FA2	6	CAT	Quiz	Online	5	5	20 min
5	ESE	1	ESE	Paper-pencil	Class Room test	40	60	2.5 Hrs

***IA** = Internal Assessment; **FA** = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Assessment

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2hours
2	Class Participation	-	CAT	Attendance	Record and Observation	5	10	2hours
3	Course project	1	CAT	Course Project	Rubrics based assessment	10	20	2 hours

4	ESE	1	ESE	Oral and Practical	Rubrics	25	50	-
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12.7 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	PSO3
EEBSC241.1	3	3			3			3				3		
EEBSC241.2	3			2	3			3				2		
EEBSC241.3	3		3		3			3				3	2	
EEBSC241.4	3	2			3			3				1		
EEBSC241.5	3				3			3				3	2	
EEBSC241.6	3			2	3			3				3		

12.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
	WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.	It develops theory-based understanding of mathematical and scientific principles in electrical engineering to analyze electrical circuits using linear algebra and network theory.
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.	Improve mathematical and analytical skills through Fourier Series and Fourier Transform for analyzing signals in time and frequency domains to model and analyze engineering systems used in communication, control, and signal processing applications.
	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Develops a theory-based understanding of engineering fundamentals through Laplace Transform for analyzing signals, transient responses, and dynamic circuit behavior using solution of differential equations and enhance analytical problem-solving and system analysis skills in electrical engineering.

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.	Elaborate application of Laplace Transform for analyzing time-domain signals, transient responses, and system models in circuit, control, communication, and power system applications to strengthen analytical and problem-solving skills.
WK8	Engagement with selected knowledge in the research literature of the discipline.	Engagement with selected knowledge in the research literature of the discipline and Discrete & Fast Fourier Transform

12.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Engineering Circuit Analysis	7th	W H Hayt, S M Durbin, J E Kemmerly	Tata Mc Graw-Hill	2012
T2	Network Analysis	3rd	M.E.Van Valkenburg	PHI	2002
T3	Networks and Systems,	2nd	D.Roy Choudhury	Age International	2002
T4	Linear Circuits	2nd	M.E.Van Valkenburg	PHI	2002
T5	DigitalSignalProcessing	1st	alivahanS	TMH	2012
T6	Signals and Systems	2nd	AlanV.Oppenheim,Alan V. Willsky and S. Hamid Nawab	Hall India	2012
T7	Signal &Systems	2nd	Haykin S and Van Veen B	Wiley	2002
T8	Theory and Problems of Signals and Systems	2nd	HweiP.Hsu,	Mc Graw	2012
T9	Continuous and Discrete Time Signals and Systems	2nd	Mrinal Mandal and Amir Asif	Mc Graw	2012
T10	Introduction to Signal&System	3rd	LinderD.K	Mc Graw	1999

Reference Books

S N	Title	Editio n	Authors	Publisher	Yea r
R 1	Network Analysis and Synthesis	2 nd	F.F.Kuo,	Matrix Publisher	2002

R 2	Linear Network Theory:Analysis,Properties,Design and Synthesis	2 nd	N. Balabanian and T.A.Bickart	Matrix Publishers	2002
R 3	Network Analysis and Synthesis	2 nd	C.L.Wadhwa	Mc Graw	2012
R 4	Network Analysis and Synthesis	2 nd	B.Somanathan Nair	Elsevier Publications	2012
R 5	DigitalSignal Processing:Principles,Algorithms and applications	2 nd	ProakisJ.G.andManolakisD.G	PHI	1995
R 6	Signal &S ystems	2 nd	NagrathI.J.,SharanS.N.andRanjanR	Mc Graw	2010
R 7	Signal&Systems	2 nd	Narayan Iyer	Mc Graw	2011
R 8	Introduction to Signal &Systems	2 nd	LindnerD.K	Mc Graw-Hill	2012
R 9	Signal&Systems	2 nd	Lathi B.P	Oxford	1998

Online Resources

SN	Title	Description
1	NPTEL/SwayamCourse:BasicElectricCircuitsByProf.AnkushSharma(IITKanpur); https://swayam.gov.in/nd1_noc19_ee36/preview	Introduction to basic electric circuits
2	NPTEL/SwayamCourse:BasicElectricalCircuits byProf.NagendraKrishnapura(IITMadras); https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee64/	Introduction to basic electric circuits
3	NPTELCourse:PrinciplesofSignalsAndSystemsByProf.RavindraArora,Dept.of Electrical Engineering, IIT Kanpur:- Weblink- https://nptel.ac.in/courses/108/104/108104100/	Introduction to signal and systems
4	NPTELCourse:SignalsAndSystemsByProf.KushalK.Shah,Dept.ofElectrical Engineering, IISE Bhopal:- Weblink - https://nptel.ac.in/courses/108/106/108106163/	Introduction to signal and systems

Chapter 13

Subject : Electrical Machine-II (Sem: IV)

Overview			
Course code:	EEPC241	Course Category:	Program Core Course-4
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	SL	
Hours/Week	3	-	2	3	6
Hours/Sem	45	-	30	45	120
Credits	3	-	1	-	4

13.2 Examination Scheme

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

13.3 Course Objectives

Pre-requisite Course Codes, if any.	Students should have basic knowledge of AC circuits, electromagnetic induction, magnetic circuits, and electrical machines. Understanding phasors, three-phase systems, and equivalent circuits will help in learning transformers and induction motors effectively. (EEPC231, ASES112)
Course Overview: This course introduces the fundamentals of transformers and induction machines, including their construction, working principles, performance characteristics, testing, and efficiency. It also covers different transformer connections, motor starting and speed control methods, and the operation of linear induction machines. Additionally, the course provides basic concepts related to the design of single-phase transformers used in electrical power and industrial systems.	
Course Objective:	
1. To expose the students to the concepts of single phase transformer and their applications	
2. To impart knowledge on performance and operation of an induction motor.	
3. To introduce the fundamentals of design of single-phase transformers.	

13.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPC241.01	Analyze operation and performance characteristics of transformers using test results.	Analyze
EEPC241.02	Examine the various transformer connections for different applications.	Analyze
EEPC241.03	Analyze operation and performance characteristics of three phase Induction motor using equivalent circuit based on test result.	Analyze
EEPC241.04	Illustrate the operation and performance of the single phase induction motor.	Apply
EEPC241.05	Illustrate the construction and working of linear induction machines.	Apply
EEPC241.06	Evaluate the design parameter of single-phase transformers.	Evaluate

13.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Single Phase Transformer and Autotransformer	CO1	L4	R1,R2,R3,R4	8
	1.1	Derive the EMF equation, Equivalent Circuit and Phasor diagram of Transformer.				
	1.2	Voltage Regulation of Transformer: - Voltage Regulation				
	1.3	Condition for Zero Voltage Regulation, Condition for Maximum Voltage Regulation.				
	1.4	Transformer Losses and Efficiency, Condition for Maximum Efficiency				
	1.5	Testing of Transformer: - OC and SC test,				
	1.6	Sumpner's Test.				
	1.7	Autotransformer:- Autotransformer Working				
	1.8	Advantages of Autotransformer over Two winding Transformer, Disadvantages.				
2	Title	Three Phase Transformers	CO2	L4	R1,R2,R3,R4	6
	2.1	Construction				
	2.2	Three phase transformer connections				

	2.3	Phasor groups				
	2.4	Parallel operation				
	2.5	Open delta or V-V connection				
	2.6	Three phase to two phase conversion (Scott connection).				
3	Title	Three Phase Induction Motors-Introduction	CO3	L4	R1,R2,R3,R4	8
	3.1	Construction, Principle of operation				
	3.2	Analysis of Equivalent circuit				
	3.3	Torque-speed characteristics in braking, motoring and generating regions				
	3.4	Losses and efficiency				
	3.5	Circle diagram				
	3.6	Speed control methods including V/f method				
	3.7	Starting methods				
	3.8	Cogging and crawling				
4	Title	Single phase Induction Motor	CO4	L3	R1,R2,R3,R4	6
	4.1	Principle of operation				
	4.2	Double field revolving theory				
	4.3	Equivalent circuit of single phase induction motor				
	4.4	Determination of equivalent circuit parameters from no load and block rotor test				
	4.5	starting methods.				
	4.6	Shaded Pole Induction Motor				
5	Title	Linear Induction Machine	CO5	L3	R1,R2,R3,R4	5
	5.1	Construction, Types				
	5.2	Working, Feature				
	5.3	Thrust Equation,				
	5.4	Characteristics, Equivalent circuit				
	5.5	Control, Application				

6	Title	Introduction to Design of Single phase transformers	CO6	L6	R1,R2,R3,R4	6
	6.1	Review on construction and parts of transformer				
	6.2	Output equation				
	6.3	Main Dimensions, Specific electric and magnetic loadings				
Self - Study	SS.1	Parallel Operation: No load Operation, On load Operation: - Equal Voltage Operation and Unequal Voltage Operation				3 HRS
	SS.2	Isolation Transformer working and its applications				
	SS.3	Excitation Phenomenon in transformers				
	SS.4	Harmonics in three phase transformers				
	SS.5	Suppression of harmonics, Oscillating neutral phenomenon				
	SS.6	Three Phase Induction Motor No load and blocked rotor test				
	SS.7	Need of starter, Types of starters				

Laboratory Component

SN	Title of the experiment	CO	Hrs
1	O.C & S.C. Test on 1 Φ Transformer	CO1	2
2	Sumpner's Test on 1 Φ Transformer	CO1	2
3	Load Test on 1 Φ Transformer	CO1	2
4	Parallel operation of 1 Φ Transformer	CO1	2
5	Scott connection of transformer	CO2	2
6	Load Test on 3 Φ Transformer	CO2	2
7	O.C & S.C. Test on 3 Φ Transformer	CO2	2
8	Open Delta test on 3 Φ Transformer	CO2	2
9	Load test on three phase squirrel cage IM	CO3	2
10	Load test on three phase slip ring IM	CO3	2
11	No load and Blocked rotor test on three phase IM	CO3	2
12	Circle diagram of three phase IM	CO3	2
13	Load test on Single phase IM	CO4	2

14	Study of starting methods of 1 Φ Induction motors	CO4	2
15	No load and Blocked rotor test on Single phase IM	CO4	2
16	Study of Construction, characteristics and application of Linear Induction Machine	CO5	2
17	Design of single phase transformer (Design Sheet).	CO6	2

**Any other experiments based on syllabus which will help students to understand the topic/concept.

13.6 Assessment Methodologies and Tools

Theory Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA 1	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
FA 1	6	CAT	Quiz	Online Assessment	5	5	20 min
FA 2	6	CAT	Assignments	Take Home Assignment	5	5	-
ESE	1	ESE	Paper- Pencil	Class Room Test	60	60	2.5 hrs

***IA** = Internal Assessment; **FA** = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2
Industry Visit	1	CAT	Field Visit	Rubrics Based	5	10	2
Design Sheet	1	CAT	Sheet/ AutoCAD	Rubrics Based	5	10	2
Class Participation	-	CAT	Attendance	Record and Observation	5	10	2

ESE	-	ESE	Oral and Practical	Rubrics	25	50	2
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CAT Activity will be part of Term Work

13.7 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	PSO3
EEPC241.1	3	2	1	3		1		3			2	3	3	
EEPC241.2	3	3	2	2		1		3			1	3	3	
EEPC241.3	3	2	1	3		1		3			2	3	2	
EEPC241.4	3	2	1	2		2		3			2	3	2	
EEPC241.5	3	2				1					2	3	3	
EEPC241.6	3	2	3	3	3			3	2		2	3	3	2

13.8 Course to Knowledge and Attitude Profile (WK) Mapping

#	WK#	WK Statement	Justification of Mapping
1	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	learn engineering fundamentals such as transformer principles, EMF equation, losses, and efficiency.
2	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.	acquire knowledge related to transformer construction, operation, and applications in electrical systems.
3	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.	Performance analysis of induction motors and the design of transformers involve mathematical calculations such as efficiency, losses, regulation, and design parameters, which require numerical and analytical methods.
4	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.	Transformer design requires consideration of efficiency, material utilization, insulation, and cost-effective operation, which aligns with engineering design principles and efficient resource usage.

5	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	practical exposure such as transformer testing, motor operation, and design procedures, which reflect real-world engineering practices and technological applications.
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13.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Electrical Machinery	VII	Dr. P.S.Bhimhra	Khanna Publication	2014
T2	Generalized Theory of Electrical Machines	V	Dr. P.S.Bhimhra	Khanna Publication	2011
T3	Electrical Machines	4	Nagrath and Kothari	TMH Publication	2010
T4	Electrical Machine Design	6	A.K. Sawhney	Dhanpat Rai & Co	2017

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Performance and Design of AC Machines'	3	M.G.Say	CBS Publication	1983
R2	Electric Machines	3	Ashfaq Husain	Dhanpat Rai and co. publications	2015
R3	Electric Machines	2	M.V. Deshpande	PHI	2010
R4	Electrical Machines'	2	Smarajit Ghosh	Pearson	2010

Online Resources

SN	Title	Description
O1	Electrical Machines – II By Prof. Tapas Kumar Bhattacharya (IIT Kharagpur) https://nptel.ac .	concepts of electrical machines such as synchronous machines, induction motors, machine dynamics, and performance analysis.
O2	Electrical Machines By Prof. Bhuvaneshwari (IIT Delhi) https://swayam.gov.in/nd1_noc19_ee69/preview	fundamentals of electrical machines including transformers, DC machines, and AC machines

Chapter 14

Subject : Electrical Power Systems -II (Sem: IV)

Overview			
Course code:	EEPC242	Course Category:	Program Core Course-5
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	SL	
Hours/Week	3	-	2	3	8
Hours/Sem	45	-	30	45	120
Credits	3	-	1	-	4

14.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	40%	60%	100%	2
Labs	50%	50%	100%	1

14.3 Course Objectives

Pre-requisite Course Codes, if any.	Students should have prior knowledge of electrical power system fundamentals, synchronous machines, transmission lines, network analysis, control systems, and numerical methods.
Course Overview: This course focuses on the analysis and operation of modern power systems, including power system transients, stability, and load flow studies using various numerical methods. It also covers economic operation, load frequency control, voltage regulation, and power system security to ensure reliable and efficient power system performance. Additionally, the course introduces concepts of power interchange and energy management in interconnected power systems.	
Course Objective:	
1. To understand power system operation, economics, and scheduling. 2. To analyze power system stability and transient behavior. 3. To apply numerical methods for load flow and stability studies. 4. To understand power system control and power interchange concepts.	

14.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPC242.01	Examine the power system transient using the wave equation and Bewely lattice diagram.	Analyze
EEPC242.02	Explore the power system stability using Swing equation and Equal area criterion.	Analyze
EEPC242.03	Formulate load flow problem and solve it by using different methods.	Apply
EEPC242.04	Evaluate the various operating parameters for efficient operation of the power system considering constraints in operation.	Apply
EEPC242.05	Analyze steady state and dynamic behaviour based single area load frequency control.	Analyze
EEPC242.06	Illustrate the concept of interchange of power and security.	Understand

14.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Power System Transients	CO1	L4	R1,R2,R3,R4	7
	1.1	Introduction, recovery transient due to removal of short circuit				
	1.2	arcing grounds, capacitance switching,				
	1.3	current chopping phenomenon. Travelling waves				
	1.4	Wave equation				
	1.5	reflection and refraction of waves				
	1.6	attenuation and distortion				
	1.7	Bewely lattice diagram.				
2	Title	Power System Stability	CO2	L4	R1,R2,R3,R4	7
	2.1	Introduction to stability, types of stability,				
	2.2	Power angle curve, dynamics of synchronous machine (only derivation)				

	2.3	power angle equation, steady state stability,				
	2.4	Swing equation (Numerical)				
	2.5	transient stability				
	2.6	factors affecting the transient stability.				
	2.7	equal area criterion, application of equal area criterion (Numerical)				
3	Title	Load Flow Studies	CO3	L3	R1,R2,R3,R4	7
	3.1	Introduction, formation of Y bus using step by step method				
	3.2	Load flow problem				
	3.3	Gauss-Seidel method				
	3.4	Newton- Raphson method				
	3.5	Decoupled load flow method (only derivation)				
	3.6	Fast decoupled load flow method				
	3.7	comparison of load flow method				
4	Title	Economic Operation of Power System	CO4	L3	R1,R2,R3,R4	7
	4.1	Generator operating cost, input-output curve				
	4.2	Heat rate and IFC curve				
	4.3	Constraints in operation				
	4.4	Coordinate equation				
	4.5	Exact coordinate equation				
	4.6	Bmn coefficients (only derivation)				
	4.7	transmission loss formula (only derivation). Optimal unit commitment.				
5	Title	Automatic Generation and Voltage control	CO5	L4	R1,R2,R3,R4	6
	5.1	Introduction, Load frequency control (single area)				
	5.2	speed governing system and transfer function				
	5.3	steam turbine				

	5.4	generator load model				
	5.5	Automatic Voltage Regulator				
	5.6	Concept of Tie Line				
6	Title	Power system security and Interchange of power	CO6	L2	R1,R2,R3,R4	5
	6.1	Power system security: Introduction, System state classification				
	6.2	security analysis, contingency analysis.				
	6.3	Interchange of power: Introduction, Multiple utility interchange transaction				
	6.4	power pools, types of interchange- capacity and diversity interchange,				
	6.5	energy banking.				
Self - Study	SS.1	typical cases of line terminations,				3 hrs
	SS.2	some techniques for improving transient stability				
	SS.3	formation of Y bus using singular transformation				
	SS.4	Inherent procedure of solving co-ordination equation				
	SS.5	AVR loop				
	SS.6	Thermal control				
	SS.7	steady state and dynamic response				

Laboratory Assessment

SN	Title of the experiment	CO	Hrs
1	Study of power system transients using simulation (short circuit removal and recovery transient)	CO1	2
2	Simulation of travelling waves on transmission line and study of reflection and refraction	CO1	2
3	Transient stability of single machine.	CO2	2
4	Application of Equal Area Criteria (Determine the critical clearing angle and time)	CO2	2
5	Y bus formation by singular matrix transformation Y bus formation by adding one element at a time.	CO3	2

6	Gauss Siedel Load flow	CO3	2
7	Optimal loading of generator	CO4	2
8	Simulation of LFC of Isolated power system under different conditions	CO5	2
9	Simulation of LFC of Two Area power system under different conditions	CO5	2
10	Simulation of single-area Load Frequency Control (LFC) system	CO5	2
11	Study of Power System Security and System State Classification	CO6	2
12	Simulation of Multiple Utility Interchange Transaction	CO6	2

** Any other experiments based on syllabus which will help students to understand the topic/concept.

14.6 Assessment Methodologies and Tools

Theory Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA 1	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	1hrs
FA 1	1	CAT	Quiz	Online Assessment	5	5	20 min
FA 2	1	CAT	Assignments	Take Home Assignment	5	5	-
ESE	1	ESE	Paper- Pencil	Class Room Test	60	60	2.5hrs

*IA = Internal Assessment; FA = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

Lab Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
Exp 1 – Exp 10	10	CAT	Practical	Journal (Rubrics Based)	10	20	2
Seminar/ Presentation	1	CAT	Presentation	Rubrics based	10	20	2
Class Participation	49	CAT	Attendance	Record and Observation	5	10	2

ESE		ESE	Oral and Practical	Rubrics	25	50	
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CAT Activity will be part of Term Work

14.7 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	PSO3
EEPC242.01	3	2		2	2	2					2	3	2	
EEPC242.02	3	3		2	2	2					2	3	3	
EEPC242.03	3	3		2	3						2	3	3	
EEPC242.04	3	2	1		2	2				3	1	3	3	
EEPC242.05	3	3		2	3	2					2	3	3	
EEPC242.06	3	2			2	2				2	2	3	2	2

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 natural sciences applicable to the discipline and awareness of relevant social sciences.	Analysis of power system transients and stability requires understanding of fundamental physical principles such as electrical circuits, electromagnetic energy, and system dynamics derived from natural science.
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.	Power system operation, load flow studies, and stability analysis involve mathematical modelling, numerical methods, and computational techniques such as Gauss–Seidel and Newton–Raphson methods.
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	All course objectives depend on core electrical engineering fundamentals including power system analysis, network theory, and system operation principles.
4	WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice	The course provides specialized knowledge in power system stability, economic operation, load flow analysis, and power system control,

		areas in the engineering discipline; much is at the forefront of the discipline.	which are key practice areas in electrical power engineering.
5	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	The course includes practical applications such as system modelling, simulation, and operational control of power systems, reflecting real-world engineering practice.
6	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.	Power interchange and system control involve coordination between utilities and reliable supply of electricity, which directly impacts public safety, reliability, and societal infrastructure.

14.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Power System Analysis and Design,	4	B.R. Gupta,	S. Chand,	1998
T2	Power System Engineering	3	D. P. Kothari, I. J. Nagrath,	Mc Graw Hill	2019
T3	Electrical power system,	4	Wadhwa C.L.	New Age International,	2010
T4	Principles of Power System,	4	Mehta V.K.,	S. Chand	2022
T5	Modern power system Analysis,	4	D. P. Kothari, I. J. Nagrath,	Mc Graw Hill	2019
T6	Power System Analysis-Operation and Control,	3	Chakrabarti A, Halder S.,	PHI	2010
T7	Power Generation operation and control,	2	Allen Wood, Bruce F. Wollenberg,	Wiley India	1996

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Power System Analysis,	3	Hadi Saadat,	TMH publications	2010
R2	Modern power system analysis,	1	Turan Gonen,	Wiley	1988
R3	Modern power system analysis,	1	Stevenson and Grainger,	TMH publication,	1994
R4	Power System Analysis,	2	Hadi Saadat,	TMH publications,	2002

Online Resources

SN	Title	Description
O1	Power System Analysis, Prof. A.K. Sinha, IIT Kharagpur https://onlinecourses-archive.nptel.ac.in/noc18_ee16?utm_source=chatgpt.com	fundamental power system concepts with numerical methods and derivations.
O2	Power System Engineering, By Prof. Debapriya Das, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_ee15/preview?utm_source=chatgpt.com	concepts with derivations and practical applications.
O3	Power System Protection, By Prof. Ashok Kumar Pradhan, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc23_ee111/preview?utm_source=chatgpt.com	power system protection used in industries like Power Grid and ABB.
O4	Operation and Planning of Power Distribution Systems, By Prof. Sanjib Ganguly, IIT Guwahati https://nptel.ac.in/courses/117103149	automation technologies and integration of distributed energy resources
O5	Power System Dynamics, Dr. M.L. Kothari, IIT Delhi https://nptel.ac.in/courses/108102080	the dynamic behavior and stability of power systems under normal and disturbed conditions.
O6	Power Systems Analysis By Prof. Arindam Ghosh, Department of Electrical Engineering IIT Kanpur :-Web link- https://nptel.ac.in/courses/108/106/108106098/	concepts and numerical problem-solving techniques used in practical power system operation and analysis.

Chapter 15

Subject : Electromagnetic Fields & Waves (Sem: IV)

Overview			
Course code:	EEPC244	Course Category:	Program Core Course
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	SL	
Hours/Week	3	-	-	3	6
Hours/Sem	45	-	-	45	90
Credits	3	-	-	-	3

15.2 Course Objectives

Pre-requisite Course if any	Basic Electrical Engineering (ASES112) and Basic Vectors
Course Overview: This course covers the fundamental principles of electric and magnetic fields, transitioning from static charges to time-varying electromagnetic waves.	
Course Objective: To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies. To acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Electro - magnetic wave systems. To acquire the knowledge of time varying Electric Wave that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of the Electric field. To acquire the knowledge of time varying magnetic that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of Magnetic field Recognize common sources of EMI, including natural and man-made sources.	

15.3 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPC244.1	Apply vector calculus concepts along with physical principles and properties to effectively solve problems encountered in everyday life.	Apply
EEPC244.2	Solve the electrostatic problems using coulombs law and gauss's law.	Analyze
EEPC244.3	Derive the dielectrics, boundary conditions and capacitance	Analyze
EEPC244.4	Solve the magnetic field problems using the laws of magnetism and vector calculus	Analyze
EEPC244.5	Apply the Maxwell's equations to understand the electromagnetic wave propagation	Evaluate
EEPC244.6	Explain EMC regulation and methods of eliminating interferences	Understand

15.4 Modules / Syllabus Content

Theory Component

Module No.	Unit	Topic	CO	Bloom's Level	Reference	Hrs
1	Title	Vector Analysis	CO1	L3	T1, R2	
	1.1	Vector analysis				
	1.2	Cartesian, Cylindrical and Spherical coordinate systems				
	1.3	Introduction to Gradient, divergence, and curl of a coordinate system				
	Self Study	SS.1: Relationship between the coordinate systems SS.2: Properties of coordinate system			3hr/week	
2	Title	Electrostatics	CO2	L4	T1, R2	
	2.1	Coulomb's law and its applications				
	2.2	Electric field intensity, Electric flux density				
	2.3	Gauss's law and its applications				
	2.4	Electrostatic potential, Divergence theorem				

	2.5	Convection and Conduction current				
	2.6	Poisson's and Laplace's equations and solutions				
	Self Study	SS.1: Electric flux densities for various charge distributions such as line, surface, and volume			3hr/week	
3	Title	Electrostatics Applications	CO3	L4	T1, R2	
	3.1	Current and current density				
	3.2	Continuity of current				
	3.3	Conductor properties and boundary conditions				
	3.4	The nature of dielectric materials				
	3.5	Capacitances ,energy density in electric field				
	Self Study	SS.1: Boundary conditions for perfect dielectric materials				
4	Title	Magnetostatic Fields	CO4	L4	T1, R2	
	4.1	Bio Savart's law, Ampere's circuit law				
	4.2	Magnetic flux and Magnetic flux density, Magnetic flux density in free space				
	4.3	Magnetic force				
	4.4	Magnetic Scalar & Vector potential				
	4.5	Stroke's theorem				
	Self Study	SS.1: Conductor and magnetic materials				3hr/week
5	Title	Maxwell's Equations and Electromagnetic Waves	CO5	L5	T1, T2, R2	
	5.1	Faraday's laws, Lenz's law ,				
	5.2	Maxwell's equations in differential and integral forms , displacement current , Electromagnetic wave for time varying field				
	5.3	Electromagnetic Wave equation, Wave Parameters				

	5.4	Poynting Theorem					
	Self Study	SS.1: Propagation of wave in waves in free space SS.2: Propagation of wave in lossless dielectric SS.3: Propagation of wave in conductors, skin depth					3hr/week
6	Title	Applications of Electromagnetic Waves	CO6	L2	T2, R2		
	6.1	EMI / EMC, EMI Sources , Effects of EMI , EMC standards					
	6.2	Testing Methods for EMI/EMC, Methods to suppress EMI-Grounding and shielding.					
	6.3	Practical issues of EMI/EMC non compliances, biological effects of EMI / EMC , ESD , EMP					
	Self Study	SS.1: biological effects of EMI / EMC , ESD , EMP					3hr/week

15.5 Assessment Methodologies and Tools

Theory Assessment

Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
IA-1	1	CAT	Paper – Pen	Class Room Test	IA-1: 15	15	1hrs
IA-2	1	CAT	Paper – Pen	Class Room Test	IA-2: 15	15	1hrs
FA 1	6	CAT	Paper – Pen	Live Assignment	FA 1: 5	5	30 min
FA 2	6	CAT	Quiz	Online	FA 2: 5	5	20 min
ESE	1	ESE	Paper- Pen, Pencil	Class Room Test	60	ESE: 60 %	2.5 Hrs

***IA** = Internal Assessment; **FA** = Formative Assessment;

IA-1 will be conducted after completion of 40-50% Syllabus ; IA-2 will be conducted after completion of 80-100% syllabus

15.6 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	PSO3
EEPC244.1	3	3		3	3	-	-	-	-	-	-	-	3	3
EEPC244.2	3	3		3	3	-	-	-	-	-	-	-	3	3
EEPC244.3	3	3		3	3	-	-	-	-	-	-	-	3	3
EEPC244.4	3	3		3	3	-	-	-	-	-	-	-	3	3
EEPC244.5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
EEPC244.6	3	3	3	3	2	2	-	-	-	-	-	-	2	3

15.7 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
2	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the 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.

5	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	Engineers must identify where interference originates to determine the appropriate mitigation technology
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15.8 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Engineering Electromagnetics	Ninth Edition	William H. Hayt, John A. Buck, Jaleel M. Akhtar	McGraw Hill India	2020
T2	Elements of Electromagnetics	Fourth Edition	Mathew O Sadiku	Oxford University Press	2014

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Electromagnetics with Applications	Fifth Edition	Kraus and Fleish	McGraw Hill International Editions	2010
R2	Schaum's Outline of Electromagnetics	Third Edition (Schaum's Outline Series)	Joseph. A. Edminister	Tata McGraw Hill	2010
R3	Fundamentals of Electromagnetic Theory	Second Edition	Saroj K. Dash, Smruti R. Khuntia.,	Prentice Hall	2011
R4	"Electromagnetic Waves", McGraw Hill India, 2006	First Edition	R K Shevgaonkar,	McGraw Hill India	2006
R5	Electromagnetic Waves and Radiating Systems	Second Edition	Edward C. Jordan, Keith G. Balmain,	Pearson India	2015

Online Resources

SN	Title	Description
O1	NPTEL Course: https://archive.nptel.ac.in/courses/108/104/108104087/	Course in Electromagnetics Field & Wave theory

Chapter 16

Subject : Engineering Fundamentals and Technical Skills (Sem: IV)

Overview			
Course code:	IGVS241	Course Category:	Vocational and Skill Enhancement Course
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	-	-		2	-	2
Hours/Sem	-	-		30	-	30
Credits	-	-		1	-	1

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

16.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	-	-
Labs/ Demo/ Activity	100%	-	100%	1

16.3 Course Objectives

Pre-requisite Course Codes, if any.	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:

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

To apply Java programming concepts, object-oriented principles, and data structures for developing efficient solutions to coding and real-world programming problems.

To understand and implement SQL queries, joins, subqueries, indexing, and aggregate functions for effective database management and data retrieval.

To enhance algorithmic thinking and coding efficiency through optimization techniques, modular arithmetic, and competitive programming strategies.

To strengthen analytical reasoning, debugging abilities, and optimization skills for solving computational and logical problems efficiently.

To apply advanced algorithms, graph techniques, string algorithms, and number theory concepts in solving complex programming and real-world competitive coding challenges.

16.4 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)

16.5 Modules / Syllabus Content

Demo Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
	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	<u>Activity</u> : Develop Python programs to perform searching and sorting techniques such as Linear Search, Binary Search, Bubble Sort, and Selection Sort.				
	1.5	<u>Activity</u> : 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, ArrayList, 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	<u>Activity</u> : Develop Java programs to perform searching and sorting algorithms such as Linear Search, Binary Search, Bubble Sort, and Merge Sort.				
	2.5	<u>Activity</u> : 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	<u>Activity</u> : Develop SQL queries using nested subqueries for data analysis and conditional retrieval.				
	3.4	<u>Activity</u> : 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	<u>Activity</u> : Implement prefix sum algorithms to perform efficient range sum and cumulative data analysis operations.				
	4.4	<u>Activity</u> : 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	<u>Activity</u> : Analyze different programming problem statements and identify inputs, outputs, constraints, and expected solutions.				
	5.4	<u>Activity</u> : 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	<u>Activity</u> : Develop programs for dynamic graph queries and real-time pathfinding applications using graph data structures.				

	6.4	<u>Activity</u> : Design optimized coding solutions for industry-level problem statements using advanced algorithms and data structures.
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16.6 Assessment Methodologies and Tools

Lab Component

	Activity	12	CAT	Activity	Journal (Rubrics Based)	20	80	2 Hrs.
	Attendance		CAT	Attendance Teachers Observation	Record	5	20	2 Hrs.

(Note: Add separate row for each assessment type)

CAT Activity will be part of Term Work

16.7 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	PSO3
IGVS241.1	-	-	-	-	-	2	-	2	3	3	-	2	-	-
IGVS241.2	2	2	-	-	2		-	-	3	3	-		2	-
IGVS241.3	-		2	2	-		-	-			-		2	-
IGVE241.4	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	2

16.8 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 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 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.

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

Reference Books

SN	Title	Edition	Authors	Publisher	Year
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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 17

Subject : Mini Project-I (Sem: IV)

Overview			
Course code:	EEPR245	Course Category:	PRC
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	SL	
Hours/Week	-	-	2	-	2
Hours/Sem	-	-	30	-	30
Credits	-	-	1	-	1

17.2 Examination Scheme

Component	CAT	ESE	TOTAL	CREDITS
Theory	-	-	-	-
Labs	50%	50%	100%	1

17.3 Course Objectives

Pre-requisite Course Codes, if any.	Basics of Electrical and Electronics Engineering((ASES112)), Electrical system engineering and Electrical workshop (ASES112).
Course Overview: In this Course student can get knowledge of various bridges ,transducers, instruments and also basic analog and digital electronics	
Course Objective: 1. To encourage students to identify real-world engineering problems and propose solutions. 2. To develop research and analytical skills through literature review and need assessment. 3. To promote teamwork, leadership, and project management skills 4. To enhance practical knowledge of electrical components, circuit design, and fabrication. 5. To foster innovation, entrepreneurship, and societal impact. 6. To address societal challenges by working on projects related to sustainability, energy efficiency, and smart technologies	

17.4 Course Outcomes

Lab Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEPR245.1	Identify engineering problems based on critical thinking and creative approach to sort out the emerging issues with valid solution	Analyse
EEPR245.2	Implement engineering solutions by designing, assembling the designed system to validate the solution.	Analyse
EEPR245.3	Perform testing, debugging, and evaluation of engineering projects using appropriate tools and techniques to validate performance.	Apply
EEPR245.4	Demonstrate teamwork and applying project management skills in a group and managing resources efficiently	Apply
EEPR245.5	Apply ethical and professional responsibilities in engineering project execution by considering social and environmental impacts while adhering to professional standards.	Analyze
EEPR345.6	Communicate engineering concepts and findings effectively through structured technical documentation, project reports, and oral presentations	Apply

17.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	Project Identification and Formulation	CO1	L4		
	1.1	Definition of Project, Characteristics of project, type of project				
	1.2	Initial selection of project as per domain				
	1.3	Steps in Project Management				
2	Title	Project Selection Consideration & Feasibility Studies	CO2	L3	R1	3
	2.1	Project cycle, Project Identification, preparation				
	2.2	Project Implementation, Project Analysis				
3	Title	Project Planning & Scheduling	CO3	L2	R3	4
	3.1	Network based Scheduling Technique				
	3.2	Determination of critical path				
	3.3	Analysis of Slack activities				
	3.4	PERT & Its computation				
4	Title	Project Finance & Estimation of Project Cost	CO4	L2	R2	4
	4.1	Sources of Project finance				
	4.2	Need for estimation of project cost				
	4.3	Preparation of project cost estimate				
	4.4	Procurement & Control of Project material and Equipment				
5	Title	Project Execution, Monitoring & Control	CO5	L3	R1	4
	5.1	Project organization Structure & culture				
	5.2	Setting the base line, Monitoring & controlling timed performance				
	5.3	Indices to Monitor project				
	5.4	Forecasting Final Project Cost				
6	Title	Generic Structure for detail Project Report	CO6	L2	R3	6
	6.1	Context / background, Problem to be addressed, Project Objectives, Target Beneficiaries				

	6.2	Project Strategy, legal framework, Environmental impact assessment, Ongoing Initiatives
	6.3	Technology Issues, Management arrangement, Means of finance & project budget
	6.4	Time Frame, Risk Analysis, Evaluation, Success Criteria
	6.5	Financial & economic analysis, sustainability
	6.6	Project management software packages- PRISM software, INSTAPLAN, SUCCESS PLAN

A. General Guidelines for Mini Project Execution

1. Formation of Student Groups

- Students shall form groups of 3 to 4 members.
- Each group should have a faculty supervisor for guidance.
- Groups must remain fixed throughout the semester.

2. Selection of Project Topic

- Students should conduct a survey and identify a problem statement.
- The problem should be approved by the faculty supervisor or an internal departmental committee.
- The problem statement should be relevant to electrical engineering and align with industry trends.
- Preference should be given to projects that impact society positively, such as solutions for rural electrification, renewable energy deployment, or community-based smart systems.

3. Implementation Plan

- Students shall prepare a Gantt Chart/PERT/CPM chart covering weekly activities.
- Each group must maintain a logbook to record weekly progress, supervisor inputs, and troubleshooting notes.
- Students should conduct literature surveys and use reference materials such as application notes, research papers, and technical datasheets.

4. Design and Fabrication Guidelines

- Initial design and testing should be conducted using software tools such as LTspice, Eagle, Multisim, or OrCAD.
- Students should prepare electrical/mechanical drawings, schematics, and layouts before starting fabrication.
- The prototype should be implemented using general-purpose PCB/Bakelite boards; breadboards should be avoided.
- If required, a PCB design should be developed and fabricated in the lab.

5. Devices, Components, and Systems to be Used

- Passive components: Resistors, capacitors, inductors, etc.
- Semiconductor devices: Diodes, transistors (BJT, MOSFET, IGBT), voltage regulators, logic gates, op-amps, etc.
- Embedded systems: General-purpose microcontrollers (Arduino, Raspberry Pi, PIC, etc.).
- Electrical Machines: DC motors, AC motors, relays, transformers, etc.

- Sensors and actuators: Temperature, proximity, motion sensors, etc.

6. Testing and Debugging

- Students should use lab equipment such as power supplies, multimeters, oscilloscopes (CRO, DSO), function generators, etc.
- Problems encountered during testing must be recorded and analyzed in the project logbook.
- The final working model should be validated against the initial problem statement.

B. Suggested Application Domains

Students are encouraged to choose topics from the following domains or propose innovative ideas:

1. Home/Office Automation
2. Renewable Energy Systems
3. Energy Conservation & Storage
4. Battery Charging and Protection
5. Electrical System Protection
6. Lighting Control & Smart Grids
7. Wireless Power Transfer
8. Electrical Components Testing & Measurement
9. Non-Conventional Energy Generation
10. Robotics & Automation
11. Smart City Solutions (IoT-based systems)
12. Biomedical and Health Monitoring Systems
13. Community Engagement Solutions (e.g., smart public lighting, solar-powered rural Electrification, accessible technology for differently-abled individuals)

Note: Faculty can offer any other project based on the syllabus which will help students to understand the topic/concept and implement it for real-life application.

C. Report Submission Guidelines

- The final report must be as per the department guidelines.
- It should include an abstract, literature review, methodology, implementation details, results, and conclusions.
- Students should be encouraged to publish their project work in conferences, journal and competitions.

17.6 Assessment Methodologies and Tools

Lab Assessment

Assessment		Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Mini Project	1	CAT	Log Book	Rubrics Based	5	10	2 Hrs
		2	CAT	Presentation	Rubrics Based	5	10	2 Hrs
		1	CAT	Model & Report	Rubrics Based	5	10	2 Hrs
		1	CAT	Paper Publication	Rubrics Based	5	10	2 Hrs
2	Class Participation	-	CAT	Attendance	Record and Observation	5	10	2Hrs
3	ESE	1	ESE	Oral and Practical	Rubrics	25	100	-

17.7 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	PO 10	PO 11	PSO1	PSO2	PSO3
EEPR245.1	3	3	3	3	3			3			2	3	3	
EEPR245.2	3	3	3	3	2	3		3			2	3	3	
EEPR245.3	3	3	3	3	3			2			3	3	3	
EEPR245.4	3	2	3	3	3	3	3	3		3	3	3	3	3
EEPR245.5	3	3	3	3	3	3		3	3	2	2	3	3	3
EEPR345.6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

17.8 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 the discipline and awareness of relevant social sciences.	By critical thinking and creative approach to sort out the emerging issues with social science to find out valid solution
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.	Implement the design solution by modelling different Projects, the circuit tracing, PCB designing and component mounting
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	Design project with a systematic approach and applying engineering fundamentals
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.	Design of different Projects, the circuit tracing, PCB designing, mounting of components, testing of components
5	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.	While building project its environmental impact, recyclable components with optimum cost is considered
6	WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.	Throughout technical knowledge of the project , its components and applications are incurred
7	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.	Design of project and its implementation based on safety and sustainability maintained considering social responsibility
8	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 design of project as per current research related with the topic and evaluate the emerging issues
9	WK9	Ethics, inclusive behaviour 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.	Execution of project with group members with all professional ethical practices, responsibilities and awareness about diversity

17.9 Resources

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	Project Management	2nd	Rajeev Gupta	PHI	2014
R2	Project Management	2nd	R. B. Khanna	PHI	2013
R3	Project Management	1st	Subhash Chandra Das	PHI	2012
R4	Project	8th	Prasanna Chandra	Mc Graw Hill	2014
R5	The Art of Electronics	3rd	P. Horowitz and W. Hill	Cambridge University Press,	2015
R6	Printed Circuit Board	2nd	R. S. Khandpur	McGraw-Hill	2005
R7	Electronics: Learning Arduino and Raspberry Pi	3rd	Simon Monk, Hacking	McGraw-Hill	2017

Software Tools:

SN	Title	Link / Description
1	LTspice – Analog circuit simulation	https://www.analog.com/en/resources/design-tools-and-calculators/ltspice-simulator.html :
2	Eagle – PCB design	https://www.udemy.com/course/pcb-design-with-eagle/
3	OrCAD – Circuit design and analysis	https://www.cadence.com/en_US/home/tools/pcb-design-and-analysis/orcad.html
4	Multisim – Virtual electronics lab	https://www.udemy.com/topic/multisim/
5	Tinkercad – Online circuit design and simulation	https://www.tinkercad.com/
6	Arduino IDE – Embedded programming	https://arduino-ide.en.softonic.com/
7	Raspbian OS – Raspberry Pi development	https://www.raspberrypi.com/software/
8	Electronics For You	https://www.electronicsforu.com/magazine
9	Circuit Digest	https://circuitdigttpest.com/
10	Electronics Hub	https://www.electronicshub.org/
11	GitHub	https://github.com/

Chapter 18:

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

18.1 Teaching & Learning Scheme

Components	Classroom Instruction		Lab instructions		Teamwork/ Self learning	Total
	L	T	P	D	SL	
Hours/Week	-	-	1	2	1	4
Hours/Sem	-	-	30	30	15	60
Credits	-	-	2		-	2

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

18.2 Examination Scheme

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

18.3 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.
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18.4 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)

18.5 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 ownership: 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, Freemium 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

18.6 Assessment Methodologies and Tools

Lab Component

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Exp 1 – Exp 10	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.**

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	PSO3
IGEM231.1	2	2	-	-	-	3	2	-	2	2	2	-	3	-
IGEM231.2	2	2	-	-	-	3	-	-	2	2	2	-	3	-
IGEM231.3	2	2	3	-	-	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	3	2	2	3	-

18.8 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.

18.9 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

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	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma	The purpose of Innovation, Business Models, and Entrepreneurship is to help readers understand how innovation, business models, and entrepreneurship work together to create and grow successful businesses.
02	https://onlinecourses.nptel.ac.in/noc21_mg63/preview	-

Chapter 19:

Subject- Design Thinking (Sem IV)

Overview			
Course code:	IGEM241	Course Category:	Entrepreneurship /Eco / Mgmt.
Sem:	IV	Syllabus & Version:	SIGCE-NEP-R25-Y2

19.1 Teaching & Learning Scheme

Components	Classroom Instruction		Lab instructions		Teamwork/ 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	-	-	-	-
Lab & Term Work	100%	-	100%	2

19.3 Course Objectives

Pre-requisite Course / Knowledge	
Course Overview: This course introduces students to the principles, process, and practical application of design thinking as a human-centered 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.	

19.4 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)
IGH241.3	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)

19.5 Modules / Syllabus Content

Demo 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-	SS.1	Self-Learning: Case Studies from various domains				

Study	SS.2	Self-Learning: Empathy and User Research	
	SS.3	Self-Learning: Creating a Persona – A Step-by-step guide with tips and examples	
	SS.4	Self-Learning: How to run an effective ideation workshop: A step-by-step guide	
	SS.5	Self-Learning: Various case studies related to prototyping	
	SS.6	Self-Learning: To find End Goals of test: Desirability, Feasibility and Viability	

Laboratory Component (Suggested List of Experiments)

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

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: <i>Says, Thinks, Feels, and Does</i> . 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.

19.6 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	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.
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.
2. Learners will perform minimum 10 experiments at least 1 experiment from each module.

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	PSO3
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	

19.8 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.

19.9 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	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-centred 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/imb24mg37/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 20:

Subject - AI Tools (SEM IV)

Overview			
Course code:	EEVS242	Course Category:	Vocational and skill Enhancement
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	-	4
Hours/Sem	-	-	30	30	-	60
Credits	-	-	2		-	2

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

20.2 Examination Scheme

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

20.3 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.	

20.4 Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	CO Detail	Bloom's level
EEVS242.1	Use AI tools effectively for content creation and communication	Apply(L3)
EEVS242.2	Create a brand logo or product concept artwork using multiple prompt variations; evaluate image quality, consistency, and prompt effectiveness across different AI image generation tools	Evaluate(L5)
EEVS242.3	Develop a small application using AI-assisted coding; compare manually written code with AI-generated code in terms of readability, efficiency, and maintainability.	Analyze(L4)
EEVS242.4	Conduct efficient AI-supported research	Analyze(L4)
EEVS242.5	Design automated workflows integrating multiple AI tools	Create(L6)

20.5 Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	Title	AI for Writing & Content Creation	CO1	Apply	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	Apply	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	Analyze	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	Analyze	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	Create	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.	1hr/ wk
	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

20.6 Assessment Methodologies and Tools

Lab Component

#	Assessment	How Many	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Exp 1 – Exp 10	10	CAT	Practical / Experiments/Tutorials	Journal (Rubrics Based)	15	30	2 hrs
2	Classroom Participation	1	CAT	Presentation	Rubrics Based	5	10	-
3	Attendance		CAT	Attendance	Record Based	5	10	-
4	ESE		ESE	Oral and Practical	Rubrics based	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.
5. Each practical will be assessed considering **30% work of lab +10% Home work +10% attendance**.
6. ESE will be combination of execute any one program from exp1-exp10 followed by Oral by external examiner.

20.7 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	PSO3
EEVS242.1	3	2	2	3	2	-	3	-	-	-	-	3	3	3
EEVS242.2	2	2	3	3	3	2	2	-	-	-	-	3	3	3
EEVS242.3	3	3	3	3	2	-	3	-	-	-	-	3	3	3
EEVS242.4	3	3	2	3	2	2	3	-	-	-	-	3	3	3
EEVS242.5	2	3	3	3	3	3	3	-	-	-	-	3	3	3

20.8 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

20.9 Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Prompt Engineering for Generative AI	1st	James Phoenix, Mike Taylor	O'Reilly Media,	2024
T2	Generative AI for Software Developers	1st	Saurabh Shrivastava et al.	Packt Publishing,	2025
T3	Generative AI: Techniques, Models and Applications	1st	Rajan Gupta, Sanju Tiwari, Poonam Chaudhary	Springer	2025
T4	AI Tools for Everyone: Your Guide to Artificial Intelligence	1st	Aditya Basu		2025
T5	AI Prompt Engineering Absolute Beginner's Guide	1st	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 Ed	David Foster	O'Reilly Media ISBN: 978-1-098-13418-1	2019
R4	Modern Generative AI with ChatGPT and OpenAI Models	1st	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