Department of Electrical Engineering

CURRICULUM AND SYLLABI

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

Board of Studies Approval Date:	22/4/2026
Academic Council Approval Date:	30/6/2026

Prof. M. K. Alam **HOD (Electrical Engg)**	**Dr. V. P. Patil** **Dean (Academics)**	**Dr. Sunil Chavan** **Principal**

Document Control

a. Document History

Ver.	Effective Date	Compiled By	Approved by	Description
0.0	8 May 2026	NEP CELL	AC	Initial Version and template and curriculum Structure (Version SIGCE-NEP-R25-Y2-III and IV Sem 2026-27)
1.0	22 April 2026	BOS	AC and GB	Detailed Syllabus (VersionSIGCE-NEP-R25-Y2-III and IV sEM 2026-27)

b. Document Approvals

i) The latest version is :- **Version 1.0(SIGCE-NEP-R25-Y2)**
ii) COMPILED by :- **NEP Cell and BOS**

iii) APPROVED by :-
a) **BOS** in its meeting held on 22 April 2026
b) **Academic Council in its meeting held on 30 June 2026**
c) **Governing Body in its meeting held on**

Dr. Sunil Chavan
Member Secretary
Governing Body / CDC

Table of Contents

***Chapter 1*: Preamble** **1**

***Chapter 2* Vision, Mission and Outcomes** **3**

2.1 Vision and Mission of SIGCE 3

Vision *3*

Mission *3*

2.2 Vision and Mission of Computer Engineering 3

Vision of the Department *3*

Mission of the Department *3*

2.3 Program Education Outcomes 3

2.4 Program Outcomes 4

2.5 Program Specific Outcomes 5

2.6 Knowledge and Attitude Profile (WK) 5

***Chapter 3* Curriculum Structure and Scheme** **6**

3.1 Nomenclature of the Course Categories 6

3.2 Credit Distribution Structure 7

3.3 Components of Curriculum 8

3.4 Course Codes – Letter Placement and Meaning 9

3.5 Comparison of SIGCE credit structure with the G.R recommendation 10

3.6 Semester wise allocation of credits 11

Semester 1 *11*

Semester 2 *12*

Semester 3 *13*

Semester 4 *13*

3.7 Program Examination Scheme 14

***Chapter 4* Indicative List of Courses** **15**

4.1 BSE Courses 15

4.2 Humanities Courses 15

- Entrepreneurship and Business Model development 15
- Design Thinking 15

4.3 Co-Curricular Courses 15

4.4 MDMs (offered by Institute and Industry) 16

4.5 Open Elective 16
4.6 Program Elective 16

Chapter 5 **Mapping and Justification** **17**

5.1 Indicative Mapping of Courses to PO 17
5.2 Indicative Mapping of Courses to WK 17
5.3 Mapping Justification 17

Chapter 6 **29**

Chapter 7 **37**

Chapter 8 **44**

Chapter 9 52

Chapter 10 60

Chapter 11 67

Chapter 12 75

Chapter 13 82

Chapter 14 89

Chapter 15 96

Chapter 16 102

Chapter 17 111

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

Vision of the Department

To mould socially committed, ethical and competent electrical engineers.

Mission of the Department

M 1 :- To provide a conducive environment for teaching & learning.

M 2 :- To provide educational programs for improvement in academics and ethics.

M 3 :- To motivate students for participation in social & industrial activities.

2.3 Program Education Outcomes

PEO 1 :- To train students to identify, comprehend and solve the problems with creative and critical reasoning skills.
PEO 2 :- Be a practicing engineer in design, research, testing and manufacturing areas of electrical engineering.
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 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

PSO 1 :- Understand concept and application of electrical machines, power systems and control system.
PSO 2 :- Assess performance of electrical system to maintain its functioning.
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

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

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	04		49	84	52.50
	PE	Program Elective					03	04	06		13		
	RM	Research Methodology							02		02		
	CP	Community Engagement							02		02		
	PR	Project				01	01	02	02		06		
	IN	Internship / OJT								12	12		
MDM + OE	MM	Multidisciplinary Minor					04	04	03	03	14	22	13.75
	OE	Open Elective			02	02	02	02			08		
SEC (Skill Enhance-ment Courses)	VS	Voc. and Skill Enhancement	02	02	02	03		01			10	24	15
	AE	Ability Enhancement	02	02	01	02	01				08		
	IK	Indian Knowledge System		02							02		
	VE	Value Education	02		02						04		
HSSM	EM	Entrepreneurship / Mgmt.			02						02	02	1.25
CC (LLC)	CC	Co-Curricular	01	01	01						03	03	1.87
Total			21	21	22	22	19	21	19	15	160	**160**	**100**

Components of Curriculum

Curriculum Component	Curriculum Content %	Total number of contact hours	Total number of credits
Basic Science	12.5		20
Engineering Science	5.63		09
Program Core	28.13		45
Program Elective	8.13		13
Research Methodology	1.25		02
Community Engagement	1.25		02
Project	3.75		06
Internship / OJT	7.5		12
Multidisciplinary Minor	8.75		14
Open Elective	5		08
Voc. and Skill Enhancement	6.25		10
Ability Enhancement	5		08
Indian Knowledge System	1.25		02
Value Education	2.5		04
Entrepreneurship / Mgmt.	1.25		02
Co-Curricular	1.88		03
Any other (Please specify)			
		Total number of Credits:	160

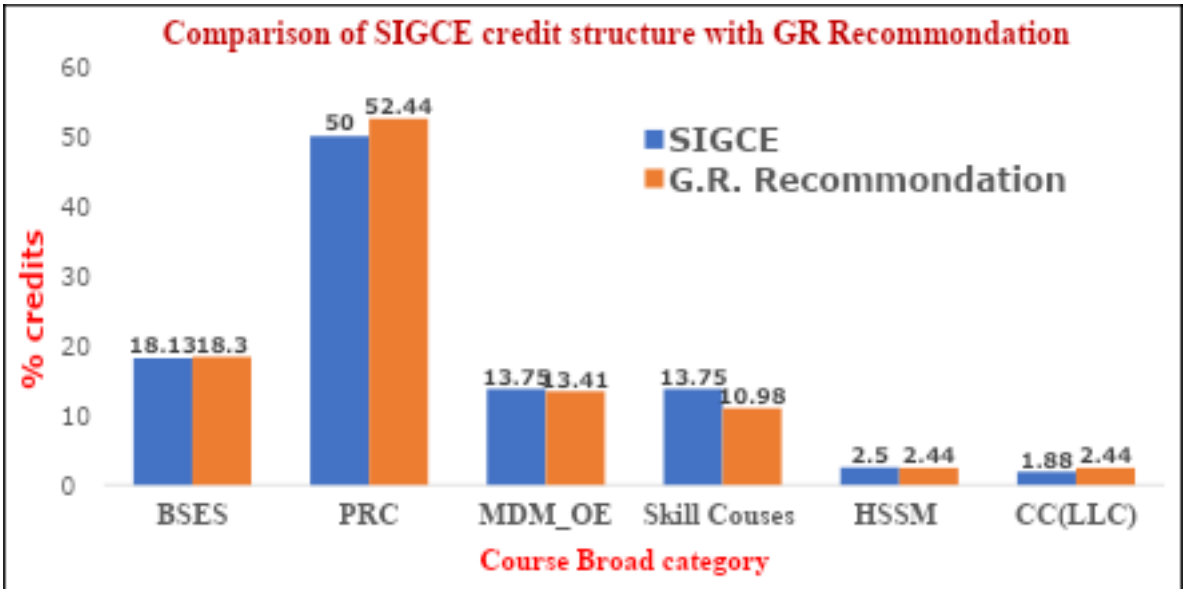
Course Codes – Letter Placement and Meaning

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 numberof course in that Course Category offered by a specific department*

Comparison of SIGCE credit structure with the G.R recommendation



Semester wise allocation of credits

Semester 1

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme						Credit Assigned			
				CR		Lab							
				L	T	P	D	SL	TE	L	T	P/D	TC
ASBS111	BSES	Applied Mathematics-I	Compulsory	3	1	-		4	**8**	3	1	-	**4**
ASBS112	BSES	Applied Physics	Any one from this Bucket (Choice – Based)	2	-	2	-	2	**6**	2	1	-	**3**
ASBS113		Applied Chemistry											
ASBS114		Energy Science											
ASBS115		Material Science											
ASBS116		Biology for Engineers											
	BSES	Engineering Mechanics Environmental Science	Any one from this Bucket (Choice – Based	2	-	2	-	2	**6**	2	1	-	**3**
	BSES	Basic Electrical & Electronics (ELECT/MECH)	Any one from this Bucket	2	-	2	-	2	**6**	2	1	-	**3**
		Digital System Fundamental (AIML/AIDS) Computer System Fundamental (COMP/IOT)											
	SEC	Engineering Graphics	Any one from this Bucket	-	-	2	2	-	**4**	-	-	2	**2**
		Engineering Workshop											
	SEC	C Programming	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
	SEC	Universal Human Values Indian Knowledge System (IKS)	Any one from this Bucket (Choice – Based)	-	-	2	2	-	**4**	-	-	2	**2**
	CC	Co-Curricular Course Professional and Communication Ethics	Any One from the List	-	-	2#	-	-	**2**	-	-	1	**2**
TOTAL				9	1	14	6	6	**40**	9	4	7	**21**

Semester 2

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme						Credit Assigned			
				CR		Lab							
				L	T	P	D	SL	TE	L	T	P/D	TC
ASBS111	BSES	Applied Mathematics-II	Compulsory	3	1	-		4	**8**	3	1	-	**4**
ASBS112	BSES	Applied Physics	Any one from this Bucket (Choice – Based)	2	-	2	-	2	**6**	2	1	-	**3**
ASBS113		Applied Chemistry											
ASBS114		Energy Science											
ASBS115		Material Science											
ASBS116		Biology for Engineers											
	BSES	Engineering Mechanics Environmental Science	Any one from this Bucket (Choice – Based	2	-	2	-	2	**6**	2	1	-	**3**
	BSES	Program Core Course-1	Program Specific	2	-	2	-	2	**6**	2	1	-	**3**
	SEC	Engineering Graphics	Any one from this Bucket	-	-	2	2	-	**4**	-	-	2	**2**
		Engineering Workshop											
	SEC	Java Programming (Core)	Compulsory	-	-	2	2	-	**4**	-	-	2	**2**
	SEC	Universal Human Values Indian Knowledge System (IKS)	Any one from this Bucket (Choice – Based)	-	-	2	2	-	**4**	-	-	2	**2**
	CC	Co-Curricular Course Professional and Communication Ethics	Any One from the List	-	-	2#	-	-	**2**	-	-	1	**2**
TOTAL				9	1	14	6	6	**40**	9	4	7	**21**

Semester 3

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme						Credit Assigned			
				CR		Lab		SL	TE	L	T	P/D	TC
				L	T	P	D						
EEBS231	**BSC**	Applied Mathematics for Electrical Engineering	Compulsory	2	1	0	0	3	6	2	1	-	**3**
EEPC231	**PCC**	Electrical Machines - I	Compulsory	3	0	2	0	3	8	3		1	**4**
EEPC232	**PCC**	Electrical Power System -I	Compulsory	3	0	2	0	3	8	3		1	**4**
CEEPC233	**PCC**	Electrical and Electronics Measurement	Compulsory	2	0	2	0	2	6	2		1	**3**
IGOE23X	**OE**	Open Elective	Any one from this Bucket	2	0	0	0	2	4	2			**2**
IGVE231	**VESC**	Skill Enhancement Course- Matlab	Compulsory	0	0	2	2	0	4			2	**2**
IGAE231	**AEC**	Comprehensive Soft Skill and Professional Development	Compulsory	0	0	2	0	-	3			1	**1**
IGEM231	**HSSM**	Entrepreneurship and Business Model Development	Compulsory	0	0	2	2	-	4			2	**2**
IGCC231	**CC**	Co-Curricular Course-2	Any one from this Bucket	0	0	2	0	-	2			1	**1**
TOTAL				12	1	14	4	13	44	12	1	10	**22**

Semester 4

Course Code	Broad Catg.	Course Name	Course Choice	Teaching Scheme						Credit Assigned			
				CR		Lab		SL	TE	L	T	P/D	TC
				L	T	P	D						
EEBS241	BSC	Applied Engineering Mathematics for Circuit Theory and Signal Processing	Compulsory	2	0	2	0	2	6	2		1	3
EEPC241	PCC	Electrical Machines -II	Compulsory	3	0	2	0	3	8	3		1	4
EEPC24[2	PCC	Electrical Power Systems -II	Compulsory	3	0	2	0	3	8	3		1	4
EEPC243	PCC	Electromagnetic Field and Waves	Compulsory	3	0	0	0	3	6	3		0	3
IGOE24X	OE	Open Elective -II	Any one from this Bucket	2	0	0	0	2	4	2			2
IGHS241	VSEC	1) Design Thinking	Compulsory	0	0	2	2	-	4			2	2
IGVE241	AEC	2) Basic Technical Training	Compulsory	0	0	1	1	-	2			1	1
IGVE242	AEC	AI Tools	Compulsory	0	0	2	2	-	4			2	2
EEPR245	PRC	MINI PROJECT-1	Compulsory	0	0	2	0	-	2			1	1
TOTAL				12	0	17	7	12	48	12	0	12	22

3.8 Program Examination Scheme

SEM: 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	IA 1	IA 2	FA	ESE	Total	CIE	ESE	Total
EEBS231	BSC	Applied Mathematics for Electrical Engineering	Compulsory	3	15	15	10	60	100	0	0	25	125	15	15	10	60	100	100	0	100
EEPC231	PCC	Electrical Machines - I	Compulsory	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
EEPC232	PCC	Electrical Power System -I	Compulsory	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
EEPC233	PCC	**Electrical and Electronics Measurement**	Compulsory	3	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
IGOE231	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	VESC	**Skill Enhancement Course**	Compulsory						0	25	25	50	50						50	50	100
IGAE231	AEC	**Comprehensive Soft Skill and Professional Development**	Compulsory						0	25	0	25	25						100		100
IGEM231	HSSM	**Entrepreneurship and Business Model Development**	Compulsory						0	25	0	25	25						100		100
IGCC231	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

Sem IV

Course Code	Broad Categ.	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	BSC	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	PCC	Electrical Machines -II	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
EEPC242	PCC	Electrical Power Systems -II	4	15	15	10	60	100	25	25	50	150	15	15	10	60	100	50	50	100
EEPC243	PCC	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
IGVE242	AEC	AI TOOLS	2	0	0	0	0	0	25	25	50	50	0	0	0	0	0	50	50	100
IGVE241	AEC	Basic Technical Training	1	0	0	0	0	0	25	0	25	25	0	0	0	0	0	100	0	100
IGHS241	VSEC	Design Thinking	2	0	0	0	0	0	50	0	50	50	0	0	0	0	0	100	0	100
EEPR245	PRC	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

Chapter 4
Indicative List of Courses

4.1 BSE Courses

- Applied Mathematics
- Applied Physics
- Applied Chemistry
- Energy Science
- Material Science
- Biology for Engineers
- Basic Electrical Engg. (BEE)
- Digital Systems (DS)
- Engg. Mechanics (EM)
- Environmental Science for Engineers (EVS)

4.2 Humanities Courses

- Entrepreneurship and Business Model development
- Design Thinking

4.3 Co-Curricular Courses

- Social Science and Community Services
- Health, wellness and mindfulness
- Basics of Photography and Visual Communication
- Video editing
- Theatre and Drama
- Analytical and Aptitude Skills
- Healthy Cooking & Nutrition.

4.4 MDMs (offered by Institute and Industry)

SN	LIST OF MDM	COURSE CODE	Semester
1.	Fundamentals of Power System Engineering	MDM351X	V
2	Fundamentals of renewable energy sources	MDM352X	V
3	Measurement and Control Engineering	MDM361X	VI
4	Solar Energy generation system	MDM362X	VI
5	Electric machine and Control	MDM471X	VII
6	Wind Energy Generation System	MDM472X	VII
7	Microgrid and Smart Grid	MDM481X	VIII
8	Industrial Automation	MDM482X	VIII

4.5 Open Elective

SN	LIST OF SUGGESTED OPEN ELECTIVES	COURSE CODE	Semester
1	Financial Management	IGOE231	III
2	Financial Literacy	IGOE232	III
3	FINTECH	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
9	Nutrition, Lifestyle diseases and their management	IGOE351	V
10	Digital Business Management	IGOE352	V
11	Brand Management Consumer Behaviour	IGOE353	V
12	Ecosystem organization and anthropogenic impacts	IGOE354	V
13	Cyber Security and Laws	IGOE361	VI
14	Project Management	IGOE362	VI
15	Human Resource Management	IGOE363	VI
16	Managerial Skill Development	IGOE364	VI

4.6 Program Elective

Sr. No.	List of Elective	Course Code	Semester
1	Renewable energy and Energy Storage	EEPE351X	V
2	Microcontroller and its application	EEPE351X	V
3	Electric and Hybrid vehicle	EEPE351X	V
4	High Voltage AC -DC Transmission System	EEPE352X	V
5	High Voltage Engg	EEPE352X	V
6	High Power Switching Converters	EEPE352X	V
7	Electric Traction	EEPE361X	VI
8	Electric Vehicle Design	EEPE361X	VI
9	Automation and control.	EEPE361X	VI
10	Micro Grid and Smart Grid	EEPE471X	VII
11	Power Quality and FACTS	EEPE471X	VII
12	Energy Audit and Management	EEPE471X	VII
13	Lighting System Design	EEPE472X	VII
14	Power System Planning and Reliability	EEPE472X	VII
15	IOT	EEPE472X	VII
16	AIML	EEPE472X	VII

`

Chapter 5
Mapping and Justification

5.1 Indicative Mapping of Courses to PO

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	
OE- Financial Management	III														
OE- Financial Literacy	III														
OE- Fintech	III	3	3	3	2	2	2			2	2		2	2	2
Disaster Management and Mitigation Measures	III	3	2	2			3	3							
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														
Co-Curricular Course-2	III														
Applied Engineering	IV	3	3	3	2	3			3				3	2	

Mathematics for Circuit Theory and Signal Processing															
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			
1) Design Thinking	IV														
2) Basic Technical Training	IV	2	2	2	2	2	2		2	3	3	2	2	2	2
AI Tools	IV														
Community Engg. Project (CEP)/Field Project (FP)	IV	2	2	2	1	2	2	2	1	2	2	2			
MINI PROJECT-1	IV	3	3	3	3	3	3	3	3	3	3	3	3	3	3

(Note: Please write actual course name and to be mentioned for all Courses from Sem I to Sem 8)

5.2 Indicative Mapping of Courses to WK

Course Name	Semester	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
Applied Mathemat	III	X	X	X					X	

ics for Electrical Engineering										
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			
OE-Fintech	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									
Co-Curricular Course-2	III									
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			
Open Elective –II (Leadership Management)	IV	X	X				X		X	X
Open Elective –II (Principles and Practices of Management)	IV					X	X	X	X	X
Design Thinking	IV									
Basic Technical Training	IV	X	X	X	X	X	X	X	X	
AI Tools	IV									
Community Engg. Project (CEP)/Field Project (FP)	IV	X				X		X	X	X
MINI PROJECT-1	IV	X	X	X	X	X	X	X	X	X

(Note: Please write actual course name and to be mentioned for all Courses from Sem I to Sem 8)

5.3 Mapping Justification

Courses		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
OE- Fintech	WK 1	Students learn the fundamentals, evolution, and applications of FinTech.
	WK 2	The course covers AI, cybersecurity, analytics, digital payments, and mobile money systems.
	WK 3	Students analyze business models, market feasibility, risks, and startup strategies.
	WK 4	The course develops entrepreneurial mindset, innovation capability, and startup planning skills.
	WK 5	Students understand regulations, compliance, cybersecurity, and risk management in FinTech.
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
Open Elective –II (Leadership Management)	WK1	Understanding leadership concepts and theories
	WK2	Analyzing leadership and team challenges
	WK6	Developing social responsibility and leadership awareness
	WK8	Promoting ethical leadership and values.
	WK9	Improving teamwork and collaboration skills
Open Elective –II (Principles and Practices of Management)	WK5	The emphasis is on efficient resource utilization, organizational effectiveness and technology impact, aligning with optimization, sustainability thinking, and long-term operational efficiency in engineering and management systems.
	WK6	Application-focused areas such as managerial skills, organizing, directing, controlling and real-life problem solving reflect practical knowledge of engineering and management practices and tools used in professional environments.
	WK7	Evaluation of modern management practices and organizational decision-making highlights the role of management in societal

		development, responsible leadership and sustainable organizational growth, aligning with engineering's societal responsibilities
	WK8	The emphasis includes analysis of management theories, evaluation of emerging practices and technology impact, demonstrating critical thinking, awareness of evolving knowledge and the ability to assess contemporary issues.
	WK9	Managerial applications inherently involve ethical decision-making, leadership behavior, inclusivity, organizational culture and responsible conduct, aligning with professional ethics, diversity awareness and respectful workplace practices.
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.
Community Engg. Project (CEP)/Field Project (FP)	WK1	Community problem identification using surveys is supported by a systematic understanding of natural sciences, which helps interpret environmental and technical factors. Awareness of social sciences helps understand human behavior and local community conditions. Together, this knowledge ensures accurate problem analysis and effective engineering solutions.
	WK5	Designing engineering solutions requires knowledge of efficient resource use, environmental impact, and reuse of materials. These concepts ensure solutions are sustainable, cost-effective, and environmentally responsible. They also support proper evaluation of long-term project impact and resource optimization.
	WK7	Engineering work in community projects requires understanding its role in society, especially regarding public safety and sustainable development. This ensures solutions are safe, responsible, and socially beneficial. It also builds accountability in real-world engineering practice.
	WK8	Awareness of current research literature helps in applying critical thinking to community problems. It supports the use of innovative and

		evidence-based engineering solutions. It also improves evaluation of project outcomes using updated knowledge and best practices.
	WK9	Ethical understanding ensures fairness and responsibility during community surveys and project work. Inclusive behavior promotes respect for diversity in gender, age, and background. These values guide professional communication and responsible engineering practice.
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

(Note: Please write the actual course name and to be mentioned for all Courses from Sem I to Sem 8. Add additional rows for each course as per number of WKs mapping)

Chapter 6
Subject 1

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

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

Overview			
Course code:	EEBSC231	**Course Category:**	Basics Science
Sem:	III	**Syllabus &Version:**	SIGCE-NEP-R2025-Y2

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

Examination Scheme

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

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.

Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	CO Detail	Bloom's level
EEBSC231.01	Apply the concept of Laplace transform and inverse Laplace transform to solve the real integrals in engineering problems.	Apply
EEBSC231.02	Analyze electrical signal using Fourier series and Fourier transform	Analyze
EEBSC231.03	Illustrate the use of matrix algebra to solve the engineering problems	Apply
EEBSC231.04	Apply the concepts of vector calculus in the field of Electrical Engineering.	Apply
EEBSC231.05	Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.	Apply
EEBSC231.06	Find the extremals of the functional using the concept of Calculus of variation.	Apply

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 eat, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and tn, $n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem,change of scale Property	CO1	L1	T1, R1	1
	1.2	Multiplication by t, Division by t,	CO1	L3	T1, R1	1
	1.3	Laplace Transform of derivatives	CO1	L3	T1, R1	1
	1.4	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform	CO1	L3	T1,T6, R1	1

	1.5	Inverse Laplace transform by Partial fraction.	CO1	L3	T1, R1	1
2	Title	Fourier Series & Fourier Transform	CO2	L3	T2,R5	5
	2.1	Definition of Fourier series, Dirichlet's conditions	CO2	L1	T2,R5	1
	2.2	Fourier series of even and odd functions	CO2	L3	T2,R5	1
	2.3	Definition of Fourier Transform, single sided and Double sided Fourier Transform	CO2	L3	T2,R5	1
	2.4	Fourier Transform of unit step signal,ramp signal,exponential signal,sinusoidal signal, gate function,sigma function & impulse function,pulse function.	CO2	L3	T2,R5	2
3	Title	**Matrix Theory**	CO3	**L3**	T3,R4	4
	3.1	Characteristic equation, Definition of Eigen values and Eigen vectors and its properties	CO3	L1,L2	T3,R4	1
	3.2	Examples based on properties of Eigen values and Eigen vectors	CO3	L3	T3,R4	1
	3.3	Cayley-Hamilton theorem (Without proof) and examples	CO3	L3	T3,R4	2
4	Title	**Vector Differentiation and Integral**	CO4	**L3**	T4,R3	4
	4.1	Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof)	CO4	L1,L2	T3,R4	1
	4.2	Properties of vector field: Solenoidal vector fields	CO4	L2,L3	T3,R4	1
	4.3	Irrotational (conservative) vector fields	CO4	L2,L3	T3,R4	1
	4.4	Vector integral: Line Integral	CO4	L3	T3,R4	1
5	Title	**Statistical Techniques**	CO5	**L3**	T1,R1,R2	4
	5.1	Karl Pearson's Coefficient of correlation (r)	CO5	L1,L3	T1,R1,R2	1
	5.2	Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks)	CO5	L1,L3	T1,R1,R2	1
	5.3	Lines of regression,Fitting of the first degree curve	CO5	L1,L3	T1,R1,R2	2
6	Title	**Calculus of Variations**	CO6	**L3**	T2,R3	4
	6.1	Euler-Lagrange equation (Without Proof), When F does not contain y	CO6	L3	T2,R3	1
	6.2	Euler-Lagrange equation (Without Proof),When F does not contain x	CO6	L3	T2,R3	1
	6.3	Euler-Lagrange equation (Without Proof),When F contains x, y, y'	CO6	L3	T2,R3	1
	6.4	Isoperimetric problems-Lagrange Method.	CO6	L3	T2,R3	1
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.	3 Hrs			

		5.Covariance, fitting of an exponential curve. 6.Brachistochrone Problem, Variational Problem, Hamilton Principle, Principle of Least action, Several dependent variables.	

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

Assessment Methodologies and Tools

Theory Assessment

	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
	IA1	1	CAT	Paper – Pencil	Class Room Test	15	10	30 min
	IA2	1	CAT	Paper – Pencil	Class Room Test	15	10	30 min
	FA1	6	CAT	Quiz	Online	5	5	10 min
	FA2	1	CAT	Open Book Test	Class Room Test	5	5	10 min
	ESE	1	ESE	Paper- Pencil	Class Room Test	60		2.3 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	i) Journal (Rubrics Based)	15	50%	1
	Assignments	6	CAT	Take Home Assignment	ii) Rubrics Based	5	40%	1
	Class Participation	32	CAT	Attendance	iii) Record and Observation	5	10%	1

Batchwise Tutorial to be conducted.

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
EEBSC231.01	3	3									3		2	
EEBSC231.02	3	3									3			
EEBSC231.03	3	3									3		2	
EEBSC231.04	3	3									3			
EEBSC231.05	3	3									3		3	
EEBSC231.06	3	3									3		2	

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.

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

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=urfILCPQYYY&list=PLyG0oabETl8uu8u7JSd2rYgE0p61phhqK	Calculus of Variations
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-R2025-Y2

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**

Examination Scheme

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

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.

Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO	**CO Detail**	**Bloom's level**
EEPC232.01	Analyze basic laws of magnetism & magnetic circuit.	Analyze
EEPC232.02	Analyze the principle of energy conversion in singly excited magnetic circuits.	Analyze
EEPC232.03	Examine construction & working principle of DC machine & its application.	Analyze
EEPC232.04	Evaluate the performance of DC machines by conduction of various tests.	Evaluate
EEPC232.05	Identify and classify electrical engineering materials based on their conductivity, resistivity &insulation property.	Apply
EEPC232.06	Examine construction & working principle of special purpose machines.	Analyze

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	CO1	L2	**T1, R3**	1
	1.2	Magnetic field and circuit	CO1	L2	**T1, R3**	1
	1.3	Compare electrical & magnetic circuit	CO1	L4	**T1, R3**	1
	1.4	Series & parallel magnetic circuit	CO1	L3	**T1, R3**	1
	1.5	Flux linkage & leakage flux	CO1	L4	**T1, R3**	1
2	**Title**	**Electromechanical Energy Conversion**	CO2	L4	**T2, R2**	7
	2.1	Electromechanical Energy Conversion principle	CO2	L2	**T2, R2**	1
	2.2	Energy stored in magnetic field	CO2	L3	**T2, R2**	1
	2.3	Field and co energy	CO2	L4	**T2, R2**	1
	2.4	Force and torque equations	CO2	L3	**T2, R2**	1
	2.5	Torque in singly excited systems	CO2	L4	**T2, R2**	1
	2.6	MMF in distributed windings	CO2	L4	**T2, R2**	1
	2.7	Magnetic field in rotating machines, Rotating MMF	CO2	L4	**T2, R2**	1

3	Title	**DC Machines**	CO3	L4	**T1, T2, T 5, R4**	8
	3.1	Construction and working principle of DC machine	CO3	L2	**T1, T2, T 5, R4**	1
	3.2	Types of DC machines	CO3	L2	**T1, T2, T 5, R4**	1
	3.3	Armature reaction	CO3	L4	**T1, T2, T 5, R4**	1
	3.4	concept of back EMF	CO3	L3	**T1, T2, T 5, R4**	1
	3.5	Torque equations	CO3	L3	**T1, T2, T 5, R4**	1
	3.6	Characteristics of DC generators and motors (speed – torque and performance)	CO3	L4	**T1, T2, T 5, R4**	1
	3.7	Losses and efficiency	CO3	L4	**T1, T2, T 5, R4**	1
	3.8	Application of DC Motor	CO3	L4	**T1, T2, T 5, R4**	1
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	CO4	L2	**T3, R1,R2**	1
	4.2	3-point & 4- point Starter	CO4	L4	**T3, R1,R2**	1
	4.3	Factors Controlling motor speed,	CO4	L4	**T3, R1,R2**	1
	4.4	Speed control (Flux Control method &Armature control method),	CO4	L3	**T3, R1,R2**	1
	4.5	Braking methods (Rheostatic braking &Plugging)	CO4	L3	**T3, R1,R2**	1
	4.6	Swinburne's test	CO4	L5	**T3, R1,R2**	1
	4.7	Hopkinson's test	CO4	L5	**T3, R1,R2**	1
	4.8	Retardation test	CO4	L5	**T3, R1,R2**	1
5	Title	**Electrical Engineering material**	CO5	L3	T4	7
	5.1	Electrical conducting material, High conductivity materials	CO5	L2	T4	1
	5.2	Material of high resistivity	CO5	L2	T4	1
	5.3	Electrical carbon materials	CO5	L2	T4	1
	5.4	Magnetic Materials, Types of magnetic materials,	CO5	L2	T4	1
	5.5	Insulating Materials	CO5	L2	T4	1
	5.6	Electrical properties of insulating material	CO5	L3	T4	1
	5.7	Classification of insulating material.	CO5	L3	T4	1
6	Title	**Special Machines**		L4	T3,R1	
	6.1	Introduction of special machine,	CO6	L2	T3,R1	1
	6.2	Stepper motor, Types of stepper motor,	CO6	L2	T3,R1	1
	6.3	Variable reluctance stepper motor, Permanent magnet stepper motor	CO6	L4	T3,R1	1
	6.4	Construction & Working Principle of BLDC Motor.	CO6	L4	T3,R1	1
Self -Study	SS	1) B-H Curve, Hysteresis loop & hysteresis loss, Magnetic saturation, Retentivity & coercivity, Magnetic circuits of Transformers, DC machines &Induction motor	3 HRS			

		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	

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.

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	30 min
	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	30 min
	FA-I	6	CAT	Quiz	Online Assessment	5	5	20 min
	FA-II	6	CAT	Assignment	Take Home Assignment	5	5	2 Hrs
	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%	---

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
EEPC232.01	3	3										3		
EEPC232.02	3	3										3		
EEPC232.03	3	3										3		

EEPC232.04	3			3								3	3	
EEPC232.05	3											3		
EEPC232.06	3	3										3		
EEPC232	3	3		3								3	3	

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 to support detailed analysis and modelling applicable to the discipline.	**Analyze principle of magnetism, Electromechanical energy conversion devices , DC Machine& special purpose machine.**
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.**

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,	24th 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-R2025-Y2

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**

Examination Scheme

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

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: iv) Understand the electrical and physical parameters affecting transmission and distribution lines. v) Analyze the performance of short, medium, and long transmission lines under different operating conditions. vi) Gain knowledge of cable construction, insulation, and earthing practices for safe power system operation. vii) Apply methods for symmetrical fault analysis using modern computational techniques. viii) Evaluate unsymmetrical faults using symmetrical component theory. ix) Understand lightning effects and implement insulation coordination for system protection.

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

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 .	CO1	L2	T4,T6,R1, R2	1
	1.2	Inductance of three phase three wire line with symmetrical and unsymmetrical spacing	CO1	L3	T4,T6,R1, R2	2
	1.3	Capacitance of transmission line, capacitance of three phase line with symmetrical and unsymmetrical spacing,	CO1	L3	T4,T6,R1, R2	1

	1.4	**Per Unit (PU) system-** Introduction and advantage of PU system	CO1	L2	T6, R1	1
	1.5	**Insulators**: Type of insulators, string efficiency	CO1	L2	T3, T4, R2	1
2	**Title**	**Performance of Transmission Line**	**CO2**			4
	2.1	Classification and modelling of short, medium and long lines	CO2	L2	T4,T6,R1	
	2.2	regulation and efficiency of short and medium lines	CO2	L3	T4,T6,R1, R2	
	2.3	Ferranti effect, evaluation and estimation of generalized circuit constant (ABCD) for short and medium lines	CO2	L4	T6, T7, R2	
	2.4	surge impedance loading.	CO2	L2	T6, R1	
3	Title	**Electric Cable and Earthing**	**CO3**			4
	3.1	**Electric Cable:** Classification and construction of cable, insulation resistance of cable	CO3	L2	T4, T8, R2	
	3.2	capacitance of single core and three core cable, grading of cable.	CO3	L3	T4, T8, R2	
	3.3	**Earthing:** Earthing definition, soil resistivity, step and touch potentials	CO3	L2	T3, T4, R2	
	3.4	measurement of earth resistance, soil resistivity, neutral grounding and its methods.	CO3	L3	T3, T4, R2	
4	Title	**Symmetrical Fault Analysis and Component**	**CO4**			6
	4.1	Introduction, transient on a transmission line, selection of Circuit breaker	CO4	L2	T6, T7, R1	
	4.2	short circuit MVA. Algorithm for SC studies,	CO4	L3	T6, T7, R1	
	4.3	Z Bus formulation. Symmetrical component transformation	CO4	L4	T7, R1	
	4.4	phase shift in star-delta transformers	CO4	L3	T6, R2	
	4.5	sequence impedances and sequence network of transmission line	CO4	L4	T7, R1	
	4.6	synchronous machine and transformer, power invariance	CO4	L4	T6, R1	
5	Title	**Unsymmetrical Fault Analysis**	**CO5**			4
	5.1	Types of unsymmetrical faults, Analysis of shunt type unsymmetrical faults:	CO5	L2	T7, R1	
	5.2	single line to ground (SLG) fault	CO5	L4	T7, R1	
	5.3	line to line (L-L) fault	CO5	L4	T7, R1	
	5.4	double line to ground (LLG) fault.	CO5	L4	T7, R1	
6	Title	**Lightning and Insulation Coordination**	**CO6**			3
	6.1	Lightning phenomenon, mechanism of Lightning stroke, over voltages due to Lightning	CO6	L2	T4, R2	
	6.2	protection against surges, surge arresters, surge capacitor, surge reactor and surge absorber .	CO6	L2	T4, R2	

	6.3	**Insulation Coordination**:- Volt time curve, Basic Insulation Level, Insulation coordination between Line and substation	CO6	L4	T4, R2	
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.

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	30 min
	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	30 min
	FA 1	6	CAT	Quiz	Online Assessment	5	5	20 min
	FA 2	6	CAT	Assignments	Take Home Assignment	5	5	30 min
	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
	Industry Visit	1	CAT	Presentation	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%	---

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	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	

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, that supports engineering design and operations in a practice area.	Includes application of advanced fault analysis techniques, use of computational methods (Z-bus), and practical engineering tools.
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.

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	2nd 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/courses/108104720	NPTEL provides complete video lectures from IIT professors covering transmission line parameters, ABCD constants, faults, and insulation coordination. These courses closely match Mumbai University topics like transmission line modelling, fault analysis, and surge phenomena.
O2	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.

O3	MIT OpenCourseWare – Electric Power Systems https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/	Free lecture notes and videos from MIT covering fundamentals of power generation, transmission, and system analysis. Useful for deeper understanding of advanced topics like transients and system modelling.
O4	MATLAB / ETAP Tutorials https://www.youtube.com/playlist?list=PLUJLsDLKTIjd-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.
O5	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-R2025-Y2

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

Examination Scheme

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

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 ele**ctronics**	
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	

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

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Analog Measurement of Electrical Quantities**	**CO1**		**T1, R1**	**4**
	1.1	Classifications of analog instruments, Introduction to controlling and damping torque	1	L2	T1,R1	1
	1.2	Extension of range of ammeter and voltmeter, Electro-dynamometer type wattmeter	1	L2	T1,R1	1
	1.3	Electro-dynamometer type Power factor meter. Instrument Transformer: Current Transformer (CT)	1	L3	T1,R1	1
	1.4	Types of CT (measuring and protection), Potential Transformer (PT), Clamp meter	1	L2	T1,R1	1
2	**Title**	**Digital Measurement of Electrical Quantities**				5
	2.1	Generalized Block diagram of digital instruments, comparison of digital over analog instruments	2	L2	T1,R1	1
	2.2	Resolution & sensitivity of digital meters, Digital voltmeter (Ramp type)	2	L3	T4,R1	1
	2.3	Ammeter, multi-meter, Digital frequency meter, Digital Tachometer	2	L2	T4,R1	1
	2.4	Digital Megger, and Digital Storage Oscilloscope	2	L2	T4,R1	1
	2.5	Current sensor (ACS712), Voltage sensor (B25)	2	L2	T4,R4	1
3	**Title**	**AC-DC Bridges and Potentiometer**				4
	3.1	Measurement of resistance: Wheatstone, Kelvins Double bridge	3	L3	T1,R4	1
	3.2	Megger, earth resistance measurement by earth tester	3	L2	T1,R4	1
	3.3	Measurement of inductance and capacitance: Maxwell's bridge	3	L3	T1,R4	1
	3.4	Schering bridge.	3	L2	T1,R4	1
4	**Title**	**Measurement of Non-electrical Quantities**				5

	4.1	**Transducers:** definition, Resistive, capacitive & inductive transducers, Optical and digital transducers	4	L2	T1,R4	1
	4.2	Measurement of temperature: Thermocouple, Thermistor, Resistance Temperature Detector (RTD)	4	L3	T1,R4	1
	4.3	Measurement of displacement: Linear and angular displacement using potentiometer, LVDT	4	L3	T1,R4	1
	4.4	Measurement of pressure: Piezoelectric, strain-gauge, capacitive and inductive type	4	L3	T1,R4	1
	4.5	Measurement of speed: Inductive and Hall Effect sensor	4	L3	T1,R4	1
5	Title	**Basic Electronics and Operational Amplifiers**				4
	5.1	Construction and Operating Principle of Diodes, BJT and MOSFET	5	L2	T4,T5	1
	5.2	Biasing and DC analysis of BJT/ MOSFET.	5	L3	T4,T5	1
	5.3	Block Diagram of OP-AMP, Characteristics of OP-AMP, Application of OP-AMP as summing amplifier	5	L2	T4,T5	1
	5.4	Integrator and Differentiator	5	L3	T4,T5	1
6	Title	**Digital Fundamentals and Applications**				4
	6.1	Introduction to Number system and conversions	6	L3	T3,R5	1
	6.2	Basic Gates and Boolean Algebra, Reduction Boolean expressions using K map,	6	L3	T3,R5	1
	6.3	Multiplexers, Sequential circuits,	6	L2	T3,R5	1
	6.4	Counters and Shift Registers	6	L2	T3,R5	1
1	**Title**	**Analog Measurement of Electrical Quantities**	**CO1**		**T1, R1**	**4**
	1.1	Classifications of analog instruments, Introduction to controlling and damping torque	1	L2	T1,R1	1
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 electrodynamometer 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.

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	30 min
2	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	30 min
3	FA 1	6	CAT	Assignment	Take home Assignment	5	5	45 min
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	36	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	–

Suggested CO-PO/PSO/PEO Correlation Matrix

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

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
EEPC233.01	3	3			1	1		3				3		
EEPC233.02	3			2	1	1		3			2	2		
EEPC233.03	3		3		1	1		3				3	2	
EEPC233.04	3	2			1	1		3				1		
EEPC233.05	3		3		1	1		3			2	3	2	
EEPC233.06	3			2	1	1		3			2	3		

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

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 Boylstead	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

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

Subject: Skill Enhancement Course MATLAB

Sem: III

Overview			
Course code:	IGVE231	**Course Category:**	Skill Courses (VESC)
Sem:	III	**Syllabus &Version:**	SIGCE-NEP-R2025-Y2

Teaching & Learning Scheme

Components	Class room Instruction		Lab instructions	Team work/ Self learning	Total
	L	D	P	SL	
Hours/Week	-	2	2	-	4
Hours/Sem	-	30	30	-	**60**
Credits	-	1	1	-	**2**

Examination Scheme

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

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.

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

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Introduction to MATLAB Environment**	**CO1**			**4**
	1.1	Introduction to MATLAB. Types of windows in MATLAB,command window, command history window, workspace and variable editor, current folder window.	CO1	2		1
	1.2	Basic MATLAB commands, arithmetic operations, Variables, operator, constants and array.	CO1	2	T2, R3	1
	1.3	Character and string	CO1	3		1
	1.4	Script and function M file.	CO1	2		1
2	**Title**	**MATLAB Programming Fundamentals**	**CO2**			**5**
	2.1	Operators and expressions. Decision making statements: if, if-else, switch	CO2	3	T2, R3	1
	2.2	Looping statements: for, while. Arrays and vectors	CO2	3	T3, R4	1
	2.3	User-defined functions	CO2	3	T4, R3	1
	2.4	Debugging techniques	CO2	3		1
	2.5	MATLAB error and correction	CO2	4		1
3	**Title**	**Matrix Operations**	**CO3**			**5**

	3.1	Matrix creation and manipulation	CO3	3	T5, R4	1
	3.2	Matrix algebra and operations	CO3	3	T5, R4	1
	3.3	Determinants and inverse matrices	CO3	3	T6, R4	1
	3.4	Solving simultaneous equations using MATLAB. Numerical methods for electrical engineering problems	CO3	4	T6, R4	1
	3.5	Eigenvalues and eigenvectors. Applications in circuit analysis.	CO3	4	T5, R2	1
4	**Title**	**Graphics in MATLAB**	**CO4**			**4**
	4.1	Basics of 2D plotting. Multiple plots and subplot commands	CO4	3	T5, R2	1
	4.2	3D plot.	CO4	3	T5, R2	1
	4.3	Polar plot	CO4	3	T5, R2	1
	4.4	Parametric plot, Labels, titles, legends, and formatting.	CO4	3	T5, R2	1
5	**Title**	**MATLAB & Simulink**	**CO5**			**5**
	5.1	Traditional window	CO5	3	T5, R2	1
	5.2	Simulink window	CO5	3	T5, R2	1
	5.3	Simulink Library	CO5	3	T5, R2	1
	5.4	Simulink basic elements	CO5	3	T5, R2	1
	5.5	Model creation in Simulink	CO5	3	T5, R2	1
6	**Title**	**Applications**	**CO6**			**3**
	6.1	Data analysis and statistics.	CO6	3	T5, R2	1
	6.2	Ordinary Differential Equation	CO6	3	T5, R2	1
	6.3	Curve fitting and Interpolation	CO6	3	T5, R2	1

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.

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	36	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

Suggested CO-PO/PSO/PEO Correlation Matrix

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

CO	PO 1	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
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

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.

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

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

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

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

Overview			
Course code:	**IGAE231**	**Course Category:**	Ability Enhancement Course
Sem:	III	**Syllabus & Version:**	SIGCE-NEP-R2025-Y2

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*

Examination Scheme

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

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. xi) To enhance personality development, self-confidence, interpersonal skills, and professional behavior. xii) To train students in group discussions, teamwork, leadership, and collaborative problem-solving techniques. xiii) To prepare students for professional recruitment processes through resume writing, interview preparation, and mock interview practice. xiv) To build awareness of workplace etiquette, corporate communication, time management, and professional ethics in modern work environments. xv) To strengthen aptitude, reasoning, career planning, and personal branding skills for improving employability and career growth.

Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGVE 231.01	Demonstrate effective verbal and non-verbal communication using the 7Cs and self-awareness tools to enhance personality and confidence.	Apply
IGVE 231.02	Develop professional written communication including formal emails and LinkedIn profiles while practicing digital etiquette.	Create
IGVE 231.03	Participate actively and confidently in group discussions by applying group behaviour techniques and teamwork skills.	Apply
IGVE 231.04	Create structured and ATS-compliant resumes and prepare for interviews using the STAR method and professional etiquette.	Create
IGVE 231.05	Exhibit professional behaviour at the workplace through appropriate time management, ethical conduct, and corporate communication.	Apply
IGVE 231.06	Solve aptitude problems and outline a career plan using test strategies and personal branding tools.	Analyze

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	Fundamentals of Communication & Personality	**CO1**		**T1 T2, R1 R2**	**4**
	1.1	Importance of Soft Skills in Engineering & Career	CO1	Understand (L2)		1
	1.2	Verbal & Non-verbal Communication, 7Cs of Effective Communication	CO1	Apply (L3)		1
	1.3	Body Language, Facial Expressions & Grooming Etiquette	CO1	Apply (L3)		1
	1.4	Self-awareness, Personality Types & SWOT Analysis, Activities: Icebreakers, Self-introduction Video & Confidence-building Exercises	CO1	Analyze (L4)		1
2	**Title**	**Verbal, Written & Digital Communication Skills**	**CO2**		**T3 T4, R3 R4**	**4**
	2.1	Public Speaking, JAM & Storytelling Techniques	CO2	Apply (L3)		1
	2.2	Professional Email Writing: Structure, Tone & Etiquette	CO2	Create (L6)		1
	2.3	Grammar Improvement & Vocabulary Enhancement	CO2	Apply (L3)		1
	2.4	LinkedIn Profile Creation, Digital Behaviour & Personal Branding, Activities: Draft Emails, LinkedIn Review & Mock JAM Rounds	CO2	Create (L6)		1
3	Title	**Group Discussion & Team Dynamics**	**CO3**		**T5 T6, R5 R6**	**4**
	3.1	Introduction to Group Discussion & Types of GDs	**CO3**	Understand (L2)		1
	3.2	GD Techniques: Entry, Lead, Counter & Conclude	**CO3**	Apply (L3)		1
	3.3	Group Behaviour, Leadership Roles & Team Dynamics	**CO3**	Analyze (L4)		1
	3.4	Teamwork, Cooperation & Collaborative Problem-solving, Activities: Mock GDs, Peer Feedback & Role Rotation	**CO3**	Apply (L3)		1
4	Title	**Resume Building & Interview Readiness**	**CO4**		**T7 T8, R7 R8**	**4**
	4.1	Resume Format, Keywords & Achievement Writing	CO4	Create (L6)		1

	4.2	ATS-friendly Resume Preparation for Engineers	CO4	Create (L6)		1
	4.3	HR & Technical Interview Questions	CO4	Apply (L3)		1
	4.4	STAR Method, Interview Etiquette & Virtual InterviewsActivities: Resume Clinic, Mock Interviews & Peer Reviews	CO4	Apply (L3)		1
5	Title	**Workplace & Corporate Etiquette**	**CO5**		**T10 T9, R1 R9**	**4**
	5.1	Work Ethics & Professionalism	CO5	Understand (L2)		1
	5.2	Time Management Tools: Pomodoro & Eisenhower Matrix	CO5	Apply (L3)		1
	5.3	Email, Meeting & Call Etiquette	CO5	Apply (L3)		1
	5.4	Work-from-home/Hybrid Professionalism & Accountability, Activities: Etiquette Checklist, Planner Setup & Roleplay	CO5	Apply (L3)		1
6	Title	**Aptitude Test Strategies & Career Planning**	**CO6**		**T11 T12, R11 R12**	**4**
	6.1	Overview of Quantitative, Reasoning & Verbal Aptitude	**CO6**	Understand (L2)		1
	6.2	Aptitude Test Strategies & Speed Improvement Techniques	**CO6**	Apply (L3)		1
	6.3	Previous Year Placement Aptitude Questions (TCS, Infosys, etc.)	**CO6**	Analyze (L4)		1
	6.4	Career Goal Setting, Personal Branding & Self-pitch, Activities: Mini Aptitude Quiz, Pitch Presentation & Career Map Submission	**CO6**	Create (L6)		1
Self -Study	SS.1	Self-analysis of personality using SWOT analysis and communication improvement plan	CO1	Analyze (L4)		1
	SS.2	Creating and optimizing a professional LinkedIn profile and digital portfolio	CO2	Create (L6)		1
	SS.3	Study of successful Group Discussion techniques through case studies and online GD sessions	CO3	Apply (L3)		1
	SS.4	Designing an ATS-friendly resume and practicing STAR-based interview responses	CO4	Create (L6)		1
	SS.5	Exploring workplace ethics, professional etiquette, and productivity tools used in corporate environments	CO5	Apply (L3)		1
	SS.6	Solving aptitude test sets from placement companies and preparing a personal career roadmap	CO6	Analyze (L4		1

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

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	*(Chose any one of the Following)* Attendance Teachers Observation	*(Chose any one of the Following)* Rubrics Based Record and Rubrics	5	20 %	

CAT Activity will be part of Term Work

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
IGVE 231.01	2		-	-	-	2	-	2	3	3	-		1	-
IGVE 231.02	2	2	-	-	2	2	-	2		3	-	2	2	1
IGVE 231.03			2	2	-	2	-	2		3	1		2	
IGVE 231.04	2				2	2	-	2	3	3		3	2	
IGVE 231.05	1	2		-	2	3	-	3	3	3	2	2	2	1
IGVE 231.06	2	3	2	1	2	2	-	2	2	3	2	3	2	2

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 analy tical 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.

Resources

Textbooks

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

Reference Books

SN	Title	Edition	Authors	Publisher	Year
R1	*Soft Skills: Know Yourself and Know the World*	3rd Edition	Dr. K. Alex	S. Chand Publishing	2019
R2	*Personality Development and Soft Skills*	2nd Edition	Barun K. Mitra	Oxford University Press	2016
R3	*Business Communication*	2nd Edition	Meenakshi Raman & Prakash Singh	Oxford University Press	2012

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

Online Resources

SN	Title	Description
O1	https://www.coursera.org/courses?query=communication%20skills	Offers professional courses on communication skills, public speaking, teamwork, and workplace communication from leading universities.
O2	https://www.linkedin.com/learning	Provides industry-oriented learning modules on professional communication, LinkedIn profile building, leadership, interview preparation, and career development.
O3	https://www.toastmasters.org	A global platform for improving public speaking, confidence, leadership, and presentation skills through practical activities.
O4	https://learning.tcsionhub.in/career-edge	Free employability enhancement program covering communication skills, resume writing, interview preparation, aptitude, and workplace etiquette.
O5	https://www.geeksforgeeks.org/aptitude-gq	Provides quantitative aptitude, logical reasoning, verbal ability practice questions, and placement preparation resources.
O6	https://www.yoodli.ai	AI-powered platform for practicing speeches, interviews, group discussions, and improving communication confidence with feedback.

Chapter 12

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

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-R2025-Y2

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**

Examination Scheme

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

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.

Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
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

Modules / Syllabus Content

Theory Assessment

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Analysis of Electric circuit behavior through matrix operations**	**CO1**		**T1, R1**	**4**
	1.1	Graph Theory and Network Topology: Introduction,	**CO1**	L2	T1,T2,T3 R3,R4	1
	1.2	Graph of network,Tree,Co-tree,	**CO1**	L5	T1,T2,T3 R3,R4	1
	1.3	Loop incidence matrix, Cut set matrix,	**CO1**	L5	T1,T2,T3 R3,R4	1
	1.4	Tie set matrix and Loop current matrix, , Principle of duality.	**CO1**	L2	T1,T2,T3 R3,R4	1
2	**Title**	**Application of Differential Equations for analysing circuits with capacitors and inductors**				5
	2.1	Solution of first and second order differential equations for series R-L,R-C,R-L-C circuits,.	CO2	L4	T1,T2,T3 R3,R4	1
	2.2	Solution of first and second order differential equations for parallel R-L,R-C,R-L-C circuits,	CO2	L4	T1,T2,T3 R3,R4	1

	2.3	initial and final conditions in network elements, ,	CO2	L2	T1,T2,T3 R3,R4	1
	2.4	time constants, steady state	CO2	L2	T1,T2,T3 R3,R4	1
	2.5	time constants, transient state response.	CO2	L3	T1,T2,T3 R3,R4	1
3	Title	**Electrical Circuit Analysis Using Laplace Transforms**				4
	3.1	The Laplace transform and its application in electrical circuit analysis,	CO3	L5	T7,T8 R7,R8	1
	3.2	transient response to step, ramp and impulse signals	CO3	L3	T7,T8 R7,R8	1
	3.3	steady state response to step, ramp and impulse signals	CO3	L3	T7,T8 R7,R8	1
	3.4	step, ramp and impulse signals	CO3	L2	T7,T8 R7,R8	1
4	Title	**Two port Network analysis**				4
	4.1	Open circuit parameters	CO4	L4	T1,T2,T3 R3,R4	1
	4.2	short circuit parameters	CO4	L4	T1,T2,T3 R3,R4	1
	4.3	transmission parameters, relationships between parameter sets	CO4	L4	T1,T2,T3 R3,R4	1
	4.4	hybrid parameters, relationships between parameter sets,	CO4	L4	T1,T2,T3 R3,R4	1
5	Title	**Introduction to Signals and Systems**				5
	5.1	**Definition of basic signals and system.** Standard signals-step, ramp,pulse, impulse, real and complex exponentials and Sinusoids,	CO5	L2	T7,T8 R7,R8	1
	5.2	Classification of signals-Continuous time (CT) and Discrete time (DT) signals,Periodic	CO5	L2	T7,T8 R7,R8	1
	5.3	Aperiodic signals,Deterministics& Random signals,Even and odd, Energy & Power signals,	CO5	L2	T7,T8 R7,R8	1
	5.4	Classification of systems-Linear/ Non-Linear,Time variant/ Invariant, Causal/ Anticausal,	CO5	L2	T7,T8 R7,R8	
	5.5	Stable/Unstable, Memory/Memory less system (Static and dynamic) , Basic operations on signals Folding, Scaling& Time shifting) Convolution in DT domain.	CO5	L2	T7,T8 R7,R8	1
6	Title	**Z-Transform**				4
	6.1	Introduction, Definition, one sided and two-sided z- transform	CO6	L2	T7,T8 R7,R8	1
	6.2	ROC, Properties of ROC, Properties of z-transform.	CO6	L2	T7,T8 R7,R8	1
	6.3	Inverse z-Transform using partial fraction. Solution of difference equation (zero input and zero state response)	CO6	L3	T7,T8 R7,R8	1

	6.4	**Discrete and Fast Fourier Transform**:- DFT & IDFT, ,DIT FFT Algorithm (upto radix-2 only)	CO6	L5	T7,T8 R7,R8	1
Self -Study	SS.1	Learning various networks and parameters	2 Hrs			
	SS.2	Calculate the parameters				
	SS.3	Calculate z-Transform				

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 (Z11, Z12, Z21, Z22).	CO4	2
18	Find short-circuit admittance parameters (Y11, Y12, Y21, Y22).	CO4	2
19	Determine hybrid parameters (h11, h12, h21, h22).	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.

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	30 min
2	IA2	1	CAT	Paper-pencil	Class room test	15	15	30 min
3	FA1	6	CAT	Assignment	Take home assignment	5	5	30 min
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	36	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	-

Suggested CO-PO/PSO/PEO Correlation Matrix

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

CO #	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
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		

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

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

SN	Title	Edition	Authors	Publisher	Year
R1	Network Analysis and Synthesis	**2nd**	F.F.Kuo,	Matrix Publisher	**2002**
R2	Linear Network Theory:Analysis,Properties,Design and Synthesis	**2nd**	N. Balabanian and T.A.Bickart	Matrix Publishers	**2002**
R3	Network Analysis and Synthesis	**2nd**	C.L.Wadhwa	Mc Graw	**2012**
R4	Network Analysis and Synthesis	**2nd**	B.Somanathan Nair	Elsevier Publications	**2012**
R5	DigitalSignal Processing:Principles,Algorithms and applications	**2nd**	ProakisJ.G.andManolakisD.G	**PHI**	**1995**
R6	Signal &S ystems	**2nd**	NagrathI.J.,Sharan S.N.andRanjanR	Mc Graw	**2010**
R7	Signal&Systems	**2nd**	Narayan Iyer	Mc Graw	**2011**
R8	Introduction to Signal &Systems	**2nd**	LindnerD.K	Mc Graw-Hill	**2012**
R9	Signal&Systems	**2nd**	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:BasicElectricalCircuitsbyProf.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

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

Subject: Electrical Machine-II (Sem- IV)

Overview			
Course code:	**EEPC241**	**Course Category:**	Program Core Course-4
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R2025-Y2

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**

Examination Scheme

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

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.

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

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Single Phase Transformer and Autotransformer**	**CO1**			**8**
	1.1	Derive the EMF equation, Equivalent Circuit and Phasor diagram of Transformer.	**CO1**	L3	T1, T3, R2	1
	1.2	Voltage Regulation of Transformer: - Voltage Regulation	**CO1**	L3	T1, T3, R1	1
	1.3	Condition for Zero Voltage Regulation, Condition for Maximum Voltage Regulation.	**CO1**	L4	T1, R1	1
	1.4	Transformer Losses and Efficiency, Condition for Maximum Efficiency	**CO1**	L4	T1, T3, R1	1
	1.5	Testing of Transformer: - OC and SC test,	**CO1**	L3	T1, R2	1
	1.6	Sumpner's Test.	**CO1**	L2	T1, R1	1
	1.7	**Autotransformer:-** Autotransformer Working	**CO1**	L2	T1, R2	1

	1.8	Advantages of Autotransformer over Two winding Transformer, Disadvantages.	**CO1**	L2	T1, R2	1
2	**Title**	**Three Phase Transformers**	CO2			6
	2.1	Construction	CO2	L2	T1, T3, R2	1
	2.2	Three phase transformer connections	CO2	L2	T1, R2	1
	2.3	Phasor groups	CO2	L4	T1, R1	1
	2.4	Parallel operation	CO2	L4	T1, R1	1
	2.5	Open delta or V-V connection	CO2	L3	T1, R2	1
	2.6	Three phase to two phase conversion (Scott connection).	CO2	L2	T1, R2	1
3	Title	**Three Phase Induction Motors-Introduction**	CO3			8
	3.1	Construction, Principle of operation	CO3	L2	T1, T3, R2	1
	3.2	Analysis of Equivalent circuit	CO3	L4	T1, R1	1
	3.3	Torque-speed characteristics in braking, motoring and generating regions	CO3	L4	T1, R1	1
	3.4	Losses and efficiency	CO3	L4	T1, R1	1
	3.5	Circle diagram	CO3	L3	T1, R1	1
	3.6	Speed control methods including V/f method	CO3	L3	T1, R2	1
	3.7	Starting methods	CO3	L2	T1, R2	1
	3.8	Cogging and crawling	CO3	L2	T1, R2	1
4	Title	**Single phase Induction Motor**	CO4			6
	4.1	Principle of operation	CO4	L2	T1, T3, R2	1
	4.2	Double field revolving theory	CO4	L4	T1, R1	1
	4.3	Equivalent circuit of single phase induction motor	CO4	L4	T1, R1	1
	4.4	Determination of equivalent circuit parameters from no load and block rotor test	CO4	L3	T1, R1	1
	4.5	starting methods.	CO4	L2	T1, R2	1
	4.6	Shaded Pole Induction Motor	CO4	L2	T1, R2	1
5	Title	**Linear Induction Machine**	CO5			5
	5.1	Construction, Types	CO5	L2	T1, R2	1
	5.2	Working, Feature	CO5	L2	T1, R2	1
	5.3	Thrust Equation,	CO5	L3	T2, R1	1
	5.4	Characteristics, Equivalent circuit	CO5	L4	T2, R1	1
	5.5	Control, Application	CO5	L2	T2, R2	1
6	Title	**Introduction to Design of Single phase transformers**	CO6			6
	6.1	Review on construction and parts of transformer	CO6	L2	T4, R1	2
	6.2	Output equation	CO6	L3	T4, R1	2
	6.3	Main Dimensions, Specific electric and magnetic loadings	CO6	L3	T4, R1	2
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 1Φ Transformer	CO1	2
2	Sumpner's Test on 1Φ Transformer	CO1	2
3	Load Test on 1Φ Transformer	CO1	2
4	Parallel operation of 1Φ Transformer	CO1	2
5	Scott connection of transformer	CO2	2
6	Load Test on 3Φ Transformer	CO2	2
7	O.C & S.C. Test on 3Φ Transformer	CO2	2
8	Open Delta test on 3Φ 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 1Φ 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.

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	30 min
	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	30 min
	FA 1	6	CAT	Quiz	Online Assessment	5	5	20 min

	FA 2	6	CAT	Assignments	Take Home Assignment	5	5	30 min
	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 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	49	CAT	• Attendance	• Record and Observation	5	10	2
	ESE	-	ESE	• Oral and Practical	• Rubrics	25	50	2

CAT Activity will be part of Term Work

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
EEPC241.01	3	2	1	3		1		3			2	3	3	
EEPC241.02	3	3	2	2		1		3			1	3	3	
EEPC241.03	3	2	1	3		1		3			2	3	2	
EEPC241.04	3	2	1	2		2		3			2	3	2	
EEPC241.05	3	2				1					2	3	3	
EEPC241.06	3	2	3	3	3			3	2		2	3	3	2

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	acquire knowledge related to transformer construction, operation, and applications in electrical systems.

		discipline; much is at the forefront of the discipline.	
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.

Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Electrical Machinery	VII Edition	Dr. P.S.Bhimhra	Khanna Publication	2014
T2	Generalized Theory of Electrical Machines	V Edition	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-R2025-Y2

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**

Examination Scheme

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

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.

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

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	**Power System Transients**	**CO1**			**7**
	1.1	Introduction, recovery transient due to removal of short circuit	CO1	L2	T2, R1	1
	1.2	arcing grounds, capacitance switching,	CO1	L2	T3, R2	1
	1.3	current chopping phenomenon. Travelling waves	CO1	L2	T3, R3	1
	1.4	Wave equation	CO1	L3	T5, R1	1
	1.5	reflection and refraction of waves	CO1	L3	T5, R2	1
	1.6	attenuation and distortion	CO1	L2	T2,R4	1
	1.7	Bewely lattice diagram**.**	CO1	L4	T5, R2	1
2	**Title**	**Power System Stability**	CO2			7
	2.1	Introduction to stability, types of stability,	CO2	L2	T2 R1	1
	2.2	Power angle curve, dynamics of synchronous machine (only derivation)	CO2	L4	T5 R3	1
	2.3	power angle equation, steady state stability,	CO2	L3	T5 R2	1
	2.4	Swing equation (Numerical)	CO2	L3	T5 R1	1

	2.5	transient stability	CO2	L4	T2R3	1
	2.6	factors affecting the transient stability.	CO2	L4	T2, R1	1
	2.7	equal area criterion, application of equal area criterion (Numerical)	CO2	L4	T5, R2	1
3	**Title**	**Load Flow Studies**	CO3			7
	3.1	Introduction, formation of Y bus using step by step method	CO3	L3	T5 R1	1
	3.2	Load flow problem	CO3	L2	T2, R2	1
	3.3	Gauss-Seidel method	CO3	L3	T5 R1	1
	3.4	Newton- Raphson method	CO3	L3	T5 R3	1
	3.5	Decoupled load flow method (only derivation)	CO3	L4	T5 R2	1
	3.6	Fast decoupled load flow method	CO3	L4	T5 R2	1
	3.7	comparison of load flow method	CO3	L4	T5 R3	1
4	Title	**Economic Operation of Power System**	CO4			7
	4.1	Generator operating cost, input-output curve	CO4	L2	T7, R2	1
	4.2	Heat rate and IFC curve	CO4	L3	T7, R1	1
	4.3	Constraints in operation	CO4	L2	T7, R3	1
	4.4	Coordinate equation	CO4	L3	T7, R2	1
	4.5	Exact coordinate equation	CO4	L3	T7, R2	1
	4.6	Bmn coefficients (only derivation)	CO4	L4	T7, R1	1
	4.7	transmission loss formula (only derivation). Optimal unit commitment.	CO4	L4	T7, R2	1
5	Title	**Automatic Generation and Voltage control**	CO5			6
	5.1	Introduction, Load frequency control (single area)	CO5	L3	T2, R1	1
	5.2	speed governing system and transfer function	CO5	L3	T2, R2	1
	5.3	steam turbine	CO5	L2	T2, R3	1
	5.4	generator load model	CO5	L3	T2, R1	1
	5.5	Automatic Voltage Regulator	CO5	L3	T2, R2	1
	5.6	Concept of Tie Line	CO5	L2	T2, R3	1
6	Title	**Power system security and Interchange of power**	CO6			5
	6.1	**Power system security:** Introduction, System state classification	CO6	L2	T6, R1	1
	6.2	security analysis, contingency analysis.	CO6	L2	T6, R2	1
	6.3	**Interchange of power:** Introduction, Multiple utility interchange transaction	CO6	L2	T6, R3	1
	6.4	power pools, types of interchange- capacity and diversity interchange,	CO6	L2	T6, R2	1
	6.5	energy banking.	CO6	L2	T6, R1	1
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.

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	30 min
	IA 2	1	CAT	Paper – Pencil	Class Room Test	15	15	30 min
	FA 1	1	CAT	Quiz	Online Assessment	5	5	20 min
	FA 2	1	CAT	Assignments	Take Home Assignment	5	5	30 min
	ESE	1	ESE	Paper- Pencil	Class Room Test	60	100	2.3 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
	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	

CAT Activity will be part of Term Work

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

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 areas in the engineering discipline; much is at the forefront of the discipline.	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.
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.

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,	Willey 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-R2025-Y2

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**

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: 1. To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies. 2. 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. 3. 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. 4. 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	

5. Recognize common sources of EMI, including natural and man-made sources.

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

Modules / Syllabus Content

Theory Component

Module No.	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	Vector Analysis	**CO1**		**T1, R2**	
	1.1	Vector analysis	1	L3	**T1, R2**	1
	1.2	Cartesian, Cylindrical and Spherical coordinate systems	1	L3	**T1, R2**	1
	1.3	Introduction to Gradient, divergence, and curl of a coordinate system	1	L3	**T1, R2**	2
	Self Study	SS.1: Relationship between the coordinate systems SS.2: Properties of coordinate system	1	L3	**T1, R2**	3hr/week
2	**Title**	Electrostatics	CO2		**T1, R2**	
	2.1	Coulomb's law and its applications	2	L4	**T1, R2**	1
	2.2	Electric field intensity, Electric flux density	2	L4	**T1, R2**	2
	2.3	Gauss's law and its applications	2	L4	**T1, R2**	2
	2.4	Electrostatic potential,Divergence theorem	2	L4	**T1, R2**	2
	2.5	Convection and Conduction current	2	L4	**T1, R2**	1
	2.6	Poisson's and Laplace's equations and solutions	2	L4	**T1, R2**	1
	Self Study	SS.1: Electric flux densities for various charge distributions such as line, surface, and volume	2	L4	**T1, R2**	3hr/week

3	Title	Electrostatics Applications	CO3		**T1, R2**	
	3.1	Current and current density	3	L4	**T1, R2**	1
	3.2	Continuity of current	3	L4	**T1, R2**	1
	3.3	Conductor properties and boundary conditions	3	L4	**T1, R2**	2
	3.4	The nature of dielectric materials	3	L4	**T1, R2**	1
	3.5	Capacitances ,energy density in electric field	3	L4	**T1, R2**	2
	Self Study	SS.1: Boundary conditions for perfect dielectric materials	3	L4	**T1, R2**	3hr/week
4	Title	Magnetostatic Fields	CO4		**T1, R2**	
	4.1	Bio Savart's law, Ampere's circuit law	4	L4	**T1, R2**	2
	4.2	Magnetic flux and Magnetic flux density, Magnetic flux density in free space	4	L4	**T1, R2**	1
	4.3	Magnetic force	4	L4	**T1, R2**	1
	4.4	Magnetic Scalar & Vector potential	4	L4	**T1, R2**	2
	4.5	Stroke's theorem	4	L4	**T1, R2**	1
	Self Study	SS.1: Conductor and magnetic materials	4	L4	**T1, R2**	3hr/week
5	Title	Maxwell's Equations and Electromagnetic Waves	CO5		**T1, T2, R2**	
	5.1	Faraday's laws, Lenz's law ,	5	L3	**T1, T2, R2**	1
	5.2	Maxwell's equations in differential and integral forms , displacement current , Electromagnetic wave for time varying field	5	L3	**T1, T2, R2**	3
	5.3	Electromagnetic Wave equation, Wave Parameters	5	L3	**T1, T2, R2**	2
	5.4	Poynting Theorem	5	L3	**T1, T2, R2**	1
	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	5	L3	**T1, T2, R2**	3hr/week
6	Title	Applications of Electromagnetic Waves	CO6		**T2, R2**	
	6.1	EMI / EMC, EMI Sources , Effects of EMI , EMC standards	6	L2	**T2, R2**	1
	6.2	Testing Methods for EMI/EMC, Methods to suppress EMI-Grounding and shielding.	6	L2	**T2, R2**	2
	6.3	Practical issues of EMI/EMC non compliances, biological effects of EMI / EMC , ESD , EMP	6	L2	**T2, R2**	2

	Self Study	SS.1: biological effects of EMI / EMC , ESD , EMP	6	L2	**T2, R2**	3hr/week

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	IA-1: 15	IA-1: 15 %	30 min
	IA-2	1	CAT	Paper – Pencil	Class Room Test	IA-2: 15	IA-2: 15 %	30 min
	FA 1	6	CAT	Paper – Pencil	Live Assignment	FA 1: 5	FA 1: 5 %	30 min
	FA 2	6	CAT	Quiz	Online	FA 2: 5	FA 2: 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

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

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	**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.
2	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	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).
3	WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.	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).
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.	The knowledge of time-varying fields provides the theoretical basis for several core engineering specializations: Antenna Design and Wave Propagation, Instrumentation and Medical Imaging
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

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	Second	Edward C.	Pearson India	2015

	Radiating Systems	Edition	Jordan, Keith G. Balmain,		

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:	**IGVE241**	**Course Category:**	Vocational and Skill Enhancement Course
Sem:	IV	**Syllabus & Version:**	SIGCE-NEP-R25-Y2

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***

Examination Scheme

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

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:

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

Course Outcomes

Course Outcomes (CO): At the End of the course students will be able to		
CO #	**CO Detail**	**Bloom's level**
IGVE241.1	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)
IGVE241.2	Develop Java-based solutions using programming fundamentals, object-oriented concepts, data structures, algorithms, and debugging techniques for software development and coding challenges.	Apply (L3)
IGVE241.3	Design and execute SQL queries using joins, subqueries, aggregate functions, indexing, and views for efficient database management and data retrieval applications.	Understand (L2)

IGVE241.4	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)
IGVE241.5	Demonstrate effective problem-solving abilities through optimization techniques, debugging strategies, test case validation, and analytical reasoning for computational problems.	Analyze (L4)
IGVE241.6	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)

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	CO1			
	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	CO1			
	1.3	**Object-Oriented Programming in Python** 1. Classes and Objects 2. Inheritance and Polymorphism 3. Constructors and Encapsulation	CO1			
	1.4	**Activity**: Develop Python programs to perform searching and sorting techniques such as Linear Search,				

		Binary Search, Bubble Sort, and Selection Sort.				
	1.5	**Activity**: Analyze the time complexity of different algorithms and implement optimized coding solutions for placement-oriented problems.				
2	**Title**	**Core Java Programming and Problem Solving**	**CO2**	Apply (L3)	T2, R2	5
	2.1	**Java Programming Fundamentals** 1. Variables, Data Types, Operators, and Input/Output 2. Conditional Statements and Looping Constructs 3. Methods, Arrays, and String Handling	CO2			
	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	CO2			
	2.3	**Object-Oriented Programming in Java** 1. Classes, Objects, and Constructors 2. Inheritance, Polymorphism, and Abstraction 3. Encapsulation and Interface Concepts	CO2			
	2.4	**Activity**: Develop Java programs to perform searching and sorting algorithms such as Linear Search, Binary Search, Bubble Sort, and Merge Sort.	CO2			
	2.5	**Activity**: Create Java classes and objects to model real-world applications using constructors and methods.				
3	Title	**SQL Basics and Intermediate**	**CO3**	Apply (L3)	T3, r3	4
	3.1	Understanding SQL Syntax, Writing Complex Queries, Advanced Joins (INNER OUTER, CROSS)	**CO3**			

	3.2	Nested Subqueries, Indexing Techniques, Aggregate Functions (GROUP BY, HAVING) Using Views for Query Simplification	**CO3**			
	3.3	**Activity**: Develop SQL queries using nested subqueries for data analysis and conditional retrieval.	**CO3**			
	3.4	**Activity**: Develop a database application using views to generate summarized reports from multiple tables.	**CO3**			
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	**CO4**			
	4.2	Dynamic Array Usage in Problem Solving, Applying Modular Arithmetic in Coding Challenges	**CO4**			
	4.3	**Activity**: Implement prefix sum algorithms to perform efficient range sum and cumulative data analysis operations.	**CO4**			
	4.4	**Activity**: Solve competitive programming challenges involving modular arithmetic and large number computations efficiently.	**CO4**			
5	Title	**Problem Solving Techniques**	**CO5**	Apply (L3)	T5, R5	4
	5.1	Understanding Problem Statements,Optimizing Solutions (Time and Space Complexity)	**CO5**			
	5.2	Test Case Generation and Validation, Debugging Advanced Logical Errors	**CO5**			
	5.3	**Activity**: Analyze different programming problem statements and identify inputs, outputs, constraints, and expected solutions.	**CO5**			
	5.4	**Activity**: Develop automated test scenarios to verify the accuracy and reliability of coding solutions.	**CO5**			
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)	**CO6**			
	6.2	Number Theory (Primality Testing, GCD, LCM, Chinese Remainder Theorem), Real- world Case Studies in Competitive Programming	**CO6**			
	6.3	**Activity**: Develop programs for dynamic graph queries and real-time pathfinding applications using graph data structures.	**CO6**			
	6.4	**Activity**: Design optimized coding solutions for industry-level problem statements using advanced algorithms and data structures.	**CO6**			

Assessment Methodologies and Tools

Lab Component

Sr no	Assessment	Nos	Category	Assessment Instrument	Assessment Method	Marks	% Wt	Duration
1	Activity	12	CAT	Activity	Journal (Rubrics Based)	20	80	2 Hrs.
2	Attendance		CAT	Attendance Teachers Observation	Record	5	20	2 Hrs.

CAT Activity will be part of Term Work

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
GVE241.1	-	-	-	-	-	2	-	2	3	3	-	2	-	-
GVE241.2	2	2	-	-	2		-	-	3	3	-		2	-
GVE241.3	-		2	2	-		-	-			-		2	-
GVE241.4	2	2	-	-	-	2	-	2	3		-	3		-
GVE241.5	-		-	-	2		-	3		3	2			
GVE241.6	2	3	2	-	2	2	-	-	2	3	2	3	2	2

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.

Resources

Textbooks

SN	Title	Edition	Authors	Publisher	Year
T1	Python Programming: An Introduction to Computer Science	3rd	John Zelle	Franklin, Beedle & Associates	2016
T2	Java: The Complete Reference	11th	Herbert Schildt	McGraw Hill	2019
T3	Learning SQL	3rd	Alan Beaulieu	O'Reilly Media	2020
T4	Database System Concepts	7th	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	2019
T5	*Problem Solving with Algorithms and Data Structures using Python*	3rd	Bradley N. Miller, David L. Ranum	Franklin, Beedle & Associates	2011
T6	*Algorithm Design*	1st	Jon Kleinberg, Éva Tardos	Pearson	2005

Reference Books

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

Online Resources

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

Chapter 17

Subject: Mini Project-I (Sem: IV)

Overview			
Course code:	EEPR245	Course Category:	PRC
Sem:	IV	Syllabus & Version:	SIGCE-NEP-R2025-Y2

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

Examination Scheme

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

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	

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

Modules / Syllabus Content

Theory Component

Module	Unit	Topic	CO	Blooms Level	Reference	Hrs
1	**Title**	Project Identification and Formulation	**CO1**	**2**	**R1**	**3**
	1.1	Definition of Project, Characteristics of project, type of project		2	R2	2
	1.2	Initial selection of project as per domain		2	R2	1
	1.3	Steps in Project Management		2	R2	1
2	**Title**	Project Selection Consideration & Feasibility Studies	CO2	3	R1	3
	2.1	Project cycle, Project Identification, preparation		2	R1,R2	2
	2.2	Project Implementation, Project Analysis		3	R2,R3	1
3	Title	Project Planning & Scheduling	CO3	2	R3	4
	3.1	Network based Scheduling Technique		2	R3	1
	3.2	Determination of critical path		3	R3	1
	3.3	Analysis of Slack activities		3	R3	1
	3.4	PERT & Its computation		3	R1,R3	1
4	Title	Project Finance & Estimation of Project Cost	CO4	2	R2	4
	4.1	Sources of Project finance		2	R2	1
	4.2	Need for estimation of project cost		2	R2	1
	4.3	Preparation of project cost estimate		3	R3	1
	4.4	Procurement & Control of Project material and Equipment		2	R3	1
5	Title	Project Execution, Monitoring & Control	CO5	3	R1	4
	5.1	Project organization Structure & culture		2	R1	1
	5.2	Setting the base line, Monitoring & controlling timed performance		3	R2,R3	1
	5.3	Indices to Monitor project		2	R2	1
	5.4	Forecasting Final Project Cost		2	R2	1
6	Title	Generic Structure for detail Project Report	CO6	2	R3	6
	6.1	Context / background, Problem to be addressed, Project Objectives, Target Beneficiaries	CO6	2	R2	1
	6.2	Project Strategy, legal framework, Environmental impact assessment, Ongoing Initiatives	CO6	2	R2	1
	6.3	Technology Issues, Management arrangement, Means of finance & project budget	CO6	3	R2	1
	6.4	Time Frame, Risk Analysis, Evaluation, Success Criteria	CO6	3	R2	1
	6.5	Financial & economic analysis, sustainability	CO6	3	R2	1
	6.6	Project management software packages- PRISM software, INSTAPLAN, SUCCESS PLAN	CO6	3	R2	1

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.

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	15	CAT	Attendance	Record and Observation	5	10	2Hrs
3	ESE	1	ESE	Oral and Practical	Rubrics	25	100	-

Suggested CO-PO/PSO/PEO Correlation Matrix

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

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
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

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

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 Education	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	hs://circuitdigttpest.com/
10	Electronics Hub	https://www.electronicshub.org/
11	GitHub	https://github.com/