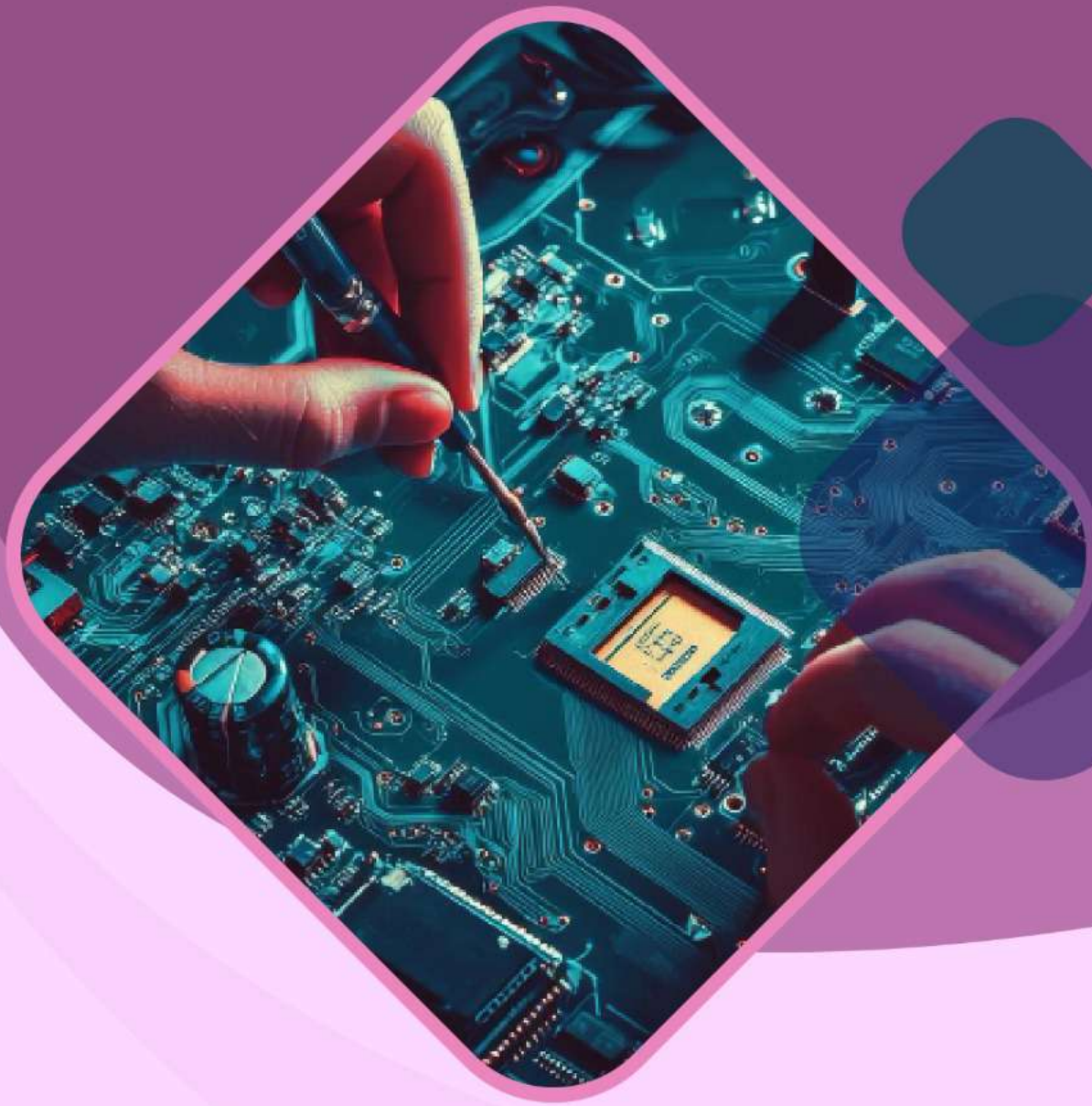
NEW HORIZON COLLEGE OF ENGINEERING

Department of
Electrical and Electronics Engineering

Academic Year 2026-27



3rd and 4th Semester Scheme and Syllabus

BATCH - 2025-2029

CREDITS: 160

NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electrical and Electronics Engineering
Academic Year 2026-27

3rd and 4th Semester Scheme & Syllabus
BATCH: 2025-2029
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NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and Management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.
- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.
- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

QUALITY POLICY

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level

VALUES

- Academic freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To evolve into a centre of excellence in Electrical and Electronics Engineering for bringing out contemporary engineers, innovators, researchers and entrepreneurs for serving nation and society.

MISSION

- To provide suitable forums to enhance the teaching-learning, research and development activities.
- Framing and continuously updating the curriculum to bridge the gap between industry and academia in the contemporary world and serve society.
- To inculcate awareness and responsibility towards the environment and ethical values.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide good learning environment to develop entrepreneurship capabilities in various areas of Electrical and Electronics Engineering with enhanced efficiency, productivity, cost effectiveness and technological empowerment of human resource.

PEO2: To inculcate research capabilities in the areas of Electrical and Electronics Engineering to identify, comprehend and solve problems and adopt themselves to rapidly evolving technology.

PEO 3: To create high standards of moral and ethical values among the graduates to transform them as responsible citizens of the nation.

PEO TO MISSION STATEMENT MAPPING

PEOs	MISSION OF THE DEPARTMENT		
	M1	M2	M3
PEO1	3	3	2
PEO2	3	3	2
PEO3	2	2	3

KNOWLEDGE AND ATTITUDE PROFILE (WK)

S. No	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.
3	WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
4	WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
5	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 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.

PROGRAM OUTCOMES (POs)

S.No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2	Problem Analysis	PO2: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3	Design/Development of Solutions	PO3: 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	Conduct Investigations of Complex Problems	PO4: 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	Engineering Tool Usage	PO5: 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	The Engineer and The World	PO6: 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	Ethics	PO7: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8	Individual and Collaborative Team work	PO8: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9	Communication	PO9: 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	Project Management and Finance	PO10: 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	Life-Long Learning	PO11: 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)

PEOs to POs mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**
PEO 1	3	3	3	3	3	2	2	2	2	2	2	3	3
PEO 2	3	3	3	3	3	2	2	2	2	2	2	3	3
PEO 3	2	2	2	2	2	3	3	3	3	2	2	2	2

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Apply knowledge of electrical machines, circuit analysis, electronics, power systems, control, instrumentation, power electronics, signal processing, and embedded systems to analyse, design, and implement solutions for real-world applications using modern hardware and software tools.

PSO2: Design and develop innovative solutions in renewable energy, electric vehicles, smart grids, and automation with focus on environmental sustainability and societal needs.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electrical and Electronics Engineering

Scheme of Teaching and Examinations for 2025- 2029 BATCH (2025 Scheme)

III Semester																	
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW & SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAE31	Numerical Methods, Vector Spaces and Transforms	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25EEE32	DC Machines and Transformers	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25EEL32	DC Machines and Transformers Laboratory	EE	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25EEE33	Electric Circuit Theory	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25EEL33	Electric Circuit Theory Laboratory	EE	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25EEE34	Measurements and Instrumentation	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
7	PCC	25EEE35	Digital Logic Design	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
8	AEC	25EEE36X	Ability Enhancement Course – III	EE	If the course is a Theory							30	3	50	50	**100**
					1	0	0	0	1	15	15					
					If the course is a Laboratory											
					0	0	1	0	1	30	-					
9	PROJ	25CPD37	Community Project using Innovation and Design Thinking	Any Dept	0	0	1	0	1	-	30	30	3	50	50	**100**
10	NCMC	25NSS30	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED30	Physical Education and Sports	-												
		25YOG30	Yoga	-												
		25MUS30	Music	-												
Total									**19**	300/ **315**	300/ **285**	**600**	**27**	**500**	**450**	**950**

11	Skill Lab*	25SLC30	Skill Lab-I	-	0	0	1	0	1	-	30	30	--	100	-	**100**
12	NCMC**	25DMAT31	Basic Applied Mathematics -I	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PROJ**: Mini Project work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

25DMAT31*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Skill Lab*: Students admitted to the 2025 Scheme of all Undergraduate Engineering programmes through regular admission shall successfully complete five (05) Skill Labs. Students admitted through lateral entry under the 2025 Scheme shall successfully complete four (04) Skill Labs. The prescribed skill labs shall be completed between the 3rd and 7th semesters. Completion of the prescribed number of Skill Labs is mandatory for the award of the degree. However, the additional Skill Lab credits shall not be considered for the award of rank, calculation of the Programme Cumulative Grade Point Average (CGPA), or vertical progression. The successful completion of the prescribed Skill Labs shall, however, be reflected in the Eighth Semester Grade Card.
Students shall attend to these skill Labs during Saturdays, Sundays, general holidays, vacations and Summer Semesters with an aim that students acquire skills of their choice to become industry ready graduates.

Ability Enhancement Course – III (1-0-0-0 or 0-0-1-0)			
25EEE361	Digital Logic Design Laboratory (0-0-1-0)	25EEE364	555 IC Laboratory (0-0-1-0)
25EEE362	MATLAB Programming for Problem Solving (0-0-1-0)	25EEE365	Bio Inspired Design and Innovation (1-0-0-0)
25EEE363	Virtual Instrumentation Using LabVIEW (0-0-1-0)		

Community Project using Innovation and Design Thinking: A community is a social unit or group of people sharing socially-significant characteristics, such as place, set of norms, culture, religion, values, customs, or identity. The Community Project using Innovation and Design Thinking course involves addressing complex issues within such a community through a human-centered lens. By integrating design thinking methodologies, these projects move beyond traditional service to focus on empathy, iterative problem-solving, and the creation of sustainable, innovative solutions. Whether establishing welfare initiatives like orphanages, implementing renewable energy systems, or developing environmental technologies, the process begins with deep community engagement to uncover latent needs before defining specific challenges.
This experiential learning activity encourages students to identify, analyze, and address real-life problems by synthesizing engineering knowledge with creative strategy. The design thinking framework guides students through stages of empathy, ideation, and rapid prototyping, ensuring that the final interventions are not only technically sound but also culturally appropriate and user-validated. This approach promotes social responsibility and civic engagement while fostering interdisciplinary collaboration and the practical application

of theoretical concepts. By navigating the ambiguity of real-world constraints through an innovative mindset, students contribute meaningfully to community welfare and sustainable development. Students may undertake these projects individually or in collaborative groups 2 to 4 members.

CIE:
The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the rubrics.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electrical and Electronics Engineering

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IV Semester																
S. No.	**Course and Course Code**		**Course Title**	**BoS**	**Credit Distribution**				**Overall Credits**	**TLP Contact Hours / Sem**	**TW & SL / Sem**	**Total Hours /Sem**	**Exam Hrs**	**Marks**		
					L	**T**	**P**	**S**						**CIE**	**SEE**	**Total**
1	BSC	25MAE41	Complex Analysis, Optimization and Probability Distributions	BS	3	0	0	0	3	45	45	90	3	50	50	**100**
2	PCC	25EEE42	Analog Electronics and Integrated Circuits	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
3	PCCL	25EEL42	Analog Electronics and Integrated Circuits Laboratory	EE	0	0	1	0	1	30	-	30	3	50	50	**100**
4	PCC	25EEE43	Microcontroller and Embedded Systems	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
5	PCCL	25EEL43	Microcontroller and Embedded Systems Laboratory	EE	0	0	1	0	1	30	-	30	3	50	50	**100**
6	PCC	25EEE44	Synchronous and Induction Machines	EE	3	0	0	0	3	45	45	90	3	50	50	**100**
7	PCCL	25EEL44	Synchronous and Induction Machines Laboratory	EE	0	0	1	0	1	30	-	30	3	50	50	**100**
8	PEC	25EEE45X	Professional Elective Course-I	EE	If the course is a Theory							90	3	50	50	**100**
					3	0	0	0	3	45	45					
					If the course is an Integrated											
					2	0	1	0	3	60	30					
9	AEC	25EEE46X	Ability Enhancement Course – IV	EE	If the course is a Laboratory							30	3	50	50	**100**
					0	0	1	0	1	30	-					
10	PROJ	25EPP47	Environmental Science Project	EE	0	0	2	0	2	-	60	60	3	50	50	**100**

11	NCMC	25NSS40	National Service Scheme	-	0	0	0	0	0	-	30	30	--	50	--	**50**
		25PED40	Physical Education and Sports	-												
		25YOG40	Yoga	-												
		25MUS40	Music	-												
								Total	**21**	**345**	**315**	**660**	**30**	**550**	**500**	**1050**

12	NCMC	25DMAT41*	Basic Applied Mathematics -II	BS	0	0	0	0	0	15	15	30	--	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PROJ**: Mini Project work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Skill Development Activity, **TW & SL-** Term Work & Self Learning, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

25DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Professional Elective Course-I (3-0-0-0) or (2-0-1-0)			
25EEE451	Electromagnetic Field Theory (3-0-0-0)	25EEE454	Object Oriented Programming using JAVA (2-0-1-0)
25EEE452	Principles of Communication Systems (3-0-0-0)	25EEE455	Machine Learning Fundamentals (3-0-0-0)
25EEE453	Utilization of Electrical energy (3-0-0-0)		

Ability Enhancement Course – IV (0-0-1-0)			
25EEE461	AutoCAD for Electrical Engineering	25EEE464	PCB Design Laboratory
25EEE462	Advanced Arduino Programming	25EEE465	Scilab for DC Machines and Transformers
25EEE463	Programming Using RoboDK		

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues

and apply scientific and engineering principles to design feasible and sustainable solutions. Central to this course is the alignment with the United Nations Sustainable Development Goals (SDGs), providing a global framework for students to address urgent environmental challenges through localized action.

The topics under environment include, but are not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, and soil erosion. By exploring these themes, students contribute to the realization of specific global targets, including Clean Water and Sanitation, Affordable and Clean Energy, Climate Action, Life Below Water, and Life on Land.

The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and the proposal of remedial or preventive measures. These interventions are aimed at improving biodiversity, air quality, and thermal comfort while promoting Responsible Consumption and Production and Sustainable Cities and Communities. Students can take up the project individually or in a group not exceeding four members. Participants are also encouraged to opt for Interdisciplinary Projects, fostering the collaborative thinking essential for achieving a sustainable balance between human activity and the natural world.

CIE:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the project work shall be based on the rubrics. The marks awarded for the project report shall be the same for all the batches mates.

National Service Scheme /Physical Education/Yoga/ Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PED) (Sports and Athletics), Yoga (YOG), and Music (MUS) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester and IV semester (for 2 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. Students may opt for different activities/options across semesters. For instance, a student participating in PE during 3rd semester may choose NSS in the 4th semester or Yoga or Music.

III SEMESTER
SYLLABUS

NUMERICAL METHODS, VECTOR SPACES AND TRANSFORMS
(Common for ECE, EEE & ME)

Course Code	**25MAE31**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25MAE31.1	Apply numerical techniques to solve engineering problems involving nonlinear equations and estimation of unknown data values.
25MAE31.2	Analyze engineering problems and select appropriate numerical techniques to obtain accurate approximate solutions.
25MAE31.3	Apply the concepts of vector spaces, inner product spaces, orthogonality, and linear transformations to represent and solve engineering and scientific problems.
25MAE31.4	Analyze harmonic components of periodic signals using Fourier series and interpret their significance in engineering systems.
25MAE31.5	Understand the concepts of Fourier transforms and their significance in the analysis of continuous-time engineering systems.
25MAE31.6	Apply the concepts of Z-transforms, their properties in the analysis of discrete-time engineering systems.

MODULE-1	**NUMERICAL SOLUTIONS AND INTERPOLATION**	**25MAE31.1**	**9 Hours**

Numerical solution of algebraic and transcendental equations - Newton-Raphson Method. Interpolation / Extrapolation: Newton's forward and backward formulae for equal intervals, Newton divided differences, Lagrange's formulae for unequal intervals.

Self-study	Numerical solution of algebraic and transcendental equations using bisection method, Regula – Falsi method. Inverse Lagrange interpolation
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.11, 29.13, Text Book 2: 19.2, 19.3.

MODULE-2	**NUMERICAL INTEGRATION, SOLUTION OF DIFFERENTIAL EQUATIONS**	**25MAE31.2**	**9 Hours**

Numerical integration by Simpson's 1/3rd, 3/8th & Weddle's rules. Application of numerical integration to velocity, area and volume. Numerical solution to 1st order & 1st degree ordinary differential equations by Taylor's series method, Modified Euler's method and Runge-Kutta method of 4th order.

Self-study	Numerical differentiation, Numerical integration by Trapezoidal rule. Numerical solution to 1st order & 1st degree ordinary differential equations by Picard's method.
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 30.7, 30.8, 30.10, Text Book 2: 19.5, 21.1.

MODULE-3	**VECTOR SPACES AND LINEAR TRANSFORMATIONS**	**25MAE31.3**	**9 Hours**

Vector Space examples, Subspaces, Linear dependence and Independence, Spanning Sets, Basis and dimension. Inner product space, Orthogonal and Orthonormal basis by Gram Schmidt orthogonalization process. Introduction to Linear Transformations, matrix of linear transformation, rank and nullity theorem

Self-study	Verifying the given basis is Orthogonal and Orthonormal basis. Orthogonal compliment, projection mapping.
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.

MODULE-4	**FOURIER SERIES**	**25MAE31.4**	**9 Hours**

Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period 2l, Fourier series of full wave & half wave rectifiers, triangular wave, square wave and saw-toothed wave functions. Half range series-Problems. Practical harmonic analysis, variation of periodic current.

Self-study	Complex Fourier Series, Half range practical harmonic analysis.
Text Book	Text Book 1: 10.2, 10.4, 10.5, 10.6, 10.7, 10.11, Text Book 2: 11.1, 11.2,

MODULE-5	**FOURIER TRANSFORMS AND Z - TRANSFORMS**	**25MAE31.5 25MAE31.6**	**9 Hours**

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transform. Convolution theorem.

Z-transform definition, Z-transforms of some standard functions, properties, damping rule, shifting rule, initial and final value theorems. Inverse Z- transforms by partial fractions method. Convolution theorem. Solution of difference equations using Z-transform	
Self-study	Finite Fourier Transforms, Problems on initial and final value theorems of Z – transforms.
Text Book	Text Book 1: 22.4, 22.5, 23.3, 23.4, 23.5, 23.6, 23.9, 23.15, 23.16 Test Book 2: 11.7, 11.8

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
3) David C Lay, Linear Algebra and its applications, Addison-Wesley Publishers, Fourth Edition, 2012, ISBN: 9780321385178

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s
- https://www.youtube.com/watch?v=csgvZol6Wfw
- https://www.youtube.com/watch?v=Atv3IsQsak8
- https://www.youtube.com/watch?v=aEF5PPbv8Oc
- https://www.youtube.com/watch?v=Pwk7p8WiCh0
- https://www.youtube.com/watch?v=LGxE_yZYigI
- https://www.youtube.com/watch?v=RFlAiEXRwoo
- https://www.youtube.com/watch?v=RFlAiEXRwoo&t=128s
- https://www.youtube.com/watch?v=sMYtHaSIXbU

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

DC MACHINES AND TRANSFORMERS

Course Code	**25EEE32**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE32.1	Explain the construction, working principle and performance of DC Machines
25EEE32.2	Analyze the speed control techniques of DC machines for different applications
25EEE32.3	Evaluate the performance parameters of Transformer through relevant testing methods
25EEE32.4	Identify and explain the different types of transformers used in industrial applications
25EEE32.5	Analyze the configurations, parallel operation and phase conversion of three-phase transformers
25EEE32.6	Evaluate the applications of DC machines and transformers in real life problems

MODULE-1	**DC GENERATOR**	**25EEE32.1, 25EEE32.6**	**9 Hours**

Construction, Principle of operation, EMF equation, Types of armature windings, Types of generators, Armature reaction, Commutation, Characteristics, Losses and efficiency, Applications.

Self-study	Losses in DC Generator
Text Book	Text Book 1: 7.1, 7.2, 7.4, 7.5, 7.6,7.9,7.12 Text Book 2: 4.15,4.18

MODULE-2	**DC MOTOR**	**25EEE32.1, 25EEE32.2, 25EEE32.6**	**9 Hours**

Principle of Operation, Significance of Back EMF, Types of Motor, Torque equation, Characteristics, Speed control, Starters and testing, Applications.

Applications	Investigate the different types of applications in industries with motors
Text Book	Text Book 1: 7.15, 7.16, 7.17, 7.19, 7.20 Text Book 2: 4.18

MODULE-3	**SINGLE PHASE TRANSFORMERS**	**25EEE32.3, 25EEE32.6**	**9 Hours**

Principle of operation, Types, EMF equation, Transformer on no-load and load - phasor diagram, Equivalent circuit, Efficiency, Regulation and testing.

Case study	Step down, core type, distribution transformer
Text Book	Text Book 1: 3.2 ,3.3,3.4,3.5,3.6,3.9 Text Book 2: 1.4, 1.7

MODULE-4	**THREE PHASE TRANSFORMERS**	**25EEE32.5, 25EEE32.6**	**9 Hours**

Construction- Configurations- Scott Connection, Auto transformers and tap changers, Applications.

Self-study	Applications using different connection in three phase transformers.
Text Book	Text Book 1: 3.11,3.13,3.16 Text Book 2: 1.12, 1.14

MODULE-5	**PARALLEL OPERATION**	**25EEE32.4, 25EEE32.5**	**9 Hours**

Need of parallel operation, Essential and desirable conditions for parallel operation, Parallel operation and load sharing of single-phase transformer, Grounding transformer, Audio-Frequency transformer, Welding transformer, Pulse transformer.

Self-study	Investigate the different types of transformers used in industry
Text Book	Text Book 1: 3.14, 3.19, 3.20, 3.21 Text Book 2: 1.18

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		**Marks Distribution**		
		Test (s)	**AAT1**	**AAT2**
		25	**15**	**10**
L1	**Remember**	**-**	**-**	**-**
L2	**Understand**	**10**	**-**	**-**

L3	**Apply**	**5**	**5**	**5**
L4	**Analyze**	**5**	**5**	**5**
L5	**Evaluate**	**5**	**5**	**-**
L6	**Create**	**-**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**--**
L2	**Understand**	**20**
L3	**Apply**	**10**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**--**

Suggested Learning Resources:

Text Books:

1) Electric Machines, D. P. Kothari and I. J. Nagrath, Tata McGraw Hill Education, 5th Edition, 2017. ISBN-10: 935260640X, ISBN-13: 978-9352606405
2) Electric Machinery, P. S. Bhimbra, Khanna publications, 7th Edition, 2015. ISBN: 978-81-7409-152-9

Reference Books:

1) Electrical Machines, S.K. Bhattacharya, McGraw Hill Education, 4th Edition, 2017. ISBN-10: 9332902852, ISBN-13: 978-9332902855
2) Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662
3) Electrical Machines, R. K. Rajput, Laxmi Publication, 6th Edition, 2018. ISBN: 9788131804469
4) Electric Machinery, Fitzgerald & Kingsley's, Stephen Umans, McGraw Hill Education; 7th edition, 2014. ISBN10: 0073380466, ISBN13: 9780073380469
5) A Course in Electrical Technology-II, J.B. Gupta, S. K. Kataria and Sons, 14th Edition, 2017. ISBN-10: 9350144158, ISBN-13: 978-9350144152

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee13/preview
- https://electrical-engineering-portal.com/academy/courses/electrical-machines-dc-synchronous-induction-transformers
- https://www.beeindia.gov.in/sites/default/files/3Ch2.pdf
- https://www.electricaltechnology.org/2020/04/dc-machine-types-working-applications.html
- https://standards.ieee.org/ieee/1349/10559/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to any electrical machines manufacturing industry or any power plant
- Demonstration of working of DC machines and transformers
- Video demonstration of latest trends in industry applications
- Efficiency and regulation calculation activity
- Organizing Group wise discussions on applications of DC generators in renewable energy systems
- Seminars on applications of DC motors in electric traction systems

DC MACHINES AND TRANSFORMERS LABORATORY

Course Code	**25EEL32**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEL32.1	Develop the winding diagram for DC machines using AutoCAD
25EEL32.2	Estimate the performance of a DC machines by conducting appropriate tests
25EEL32.3	Examine the operation of Scott connection with two single-phase transformers
25EEL32.4	Evaluate the performance of Transformers by conducting various tests and load sharing

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Introduction to Basic electrical engineering	2	NA
PART-A			
1	Develop a winding diagram for DC machines in AutoCAD	2	25EEL32.2
2	Experimental and Simulation Analysis of DC Shunt Motor Speed Control	2	25EEL32.2
3	Load Performance Analysis of a DC Shunt Motor	2	25EEL32.2
4	Retardation Test on DC shunt machine	2	25EEL32.2
5	Field's test on series motor	2	25EEL32.1
6	Determination of magnetization, internal & load characteristics of DC shunt generator	2	25EEL32.4
PART-B			
7	Swinburne's Test on DC shunt machine	2	25EEL32.2
8	Calculation of efficiency and regulation by open circuit and short circuit test on single phase transformer	2	25EEL32.2
9	Polarity Test and connection of three single phase transformer in star Delta	2	25EEL32.2
10	Sumpner's test on similar transformer and determination of combined and individual transformer	2	25EEL32.2
11	Scott connection with balanced and unbalanced resistive loads	2	25EEL32.3
12	Parallel operation of two dissimilar single-phase transformer	2	25EEL32.3

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Familiarization of the electrical machine laboratory apparatus.
   https://ems-iitr.vlabs.ac.in/exp/lab-equipment-familiarization/
2. To study the Load Characteristics of DC shunt generator
   https://ems-iitr.vlabs.ac.in/exp/load-characteristics-dc-shunt/
3. Speed Control of DC motor by field resistance control
   https://ems-iitr.vlabs.ac.in/exp/dcmotor-field-resistance-control/
4. Speed Control of DC motor by Armature Resistance Control
   https://ems-iitr.vlabs.ac.in/exp/dcshunt-motor-armature-control/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test(s)	Weekly Assessments
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	15
L4	Analyze	15
L5	Evaluate	20
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Electric Machines, D. P. Kothari and I. J. Nagrath, Tata McGraw Hill Education, 5th Edition, 2017. ISBN-10: 935260640X, ISBN-13: 978-9352606405
2) Electric Machinery, P. S. Bhimbra, Khanna publications, 7th Edition, 2015. ISBN: 978-81-7409-152-9
3) Electrical Machines, S.K. Bhattacharya, McGraw Hill Education, 4th Edition, 2017. ISBN-10: 9332902852, ISBN-13: 978-9332902855
4) Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662
5) Electrical Machines, R. K. Rajput, Laxmi Publication, 6th Edition, 2018. ISBN: 9788131804469
6) Electric Machinery, Fitzgerald & Kingsley's, Stephen Umans, McGraw Hill Education; 7th edition, 2014. ISBN10: 0073380466, ISBN13: 9780073380469
7) A Course in Electrical Technology-II, J.B. Gupta, S. K. Kataria and Sons, 14th Edition, 2017. ISBN-1: 9350144158, ISBN-13: 978-9350144152
8) http://www.nptel.ac.in/

ELECTRIC CIRCUIT THEORY			
Course Code	**25EEE33**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE33.1	Apply suitable network reduction techniques to simplify electrical circuits
25EEE33.2	Examine the electrical circuits using network theorems
25EEE33.3	Analyze the frequency response of RLC circuits
25EEE33.4	Investigate the transient response of RLC circuits with DC and AC excitation
25EEE33.5	Evaluate balanced three phase circuits and two port networks for the electrical systems
25EEE33.6	Design an electrical system for practical engineering problem

MODULE-1	**BASIC CIRCUITS ANALYSIS**	**25EEE33.1, 25EEE33.6**	**9 Hours**

DC Circuits: Practical and ideal sources, Active and passive elements, Dependent and independent sources, Mesh Analysis and Nodal Analysis of DC and AC Circuits with dependent and independent sources. Concept of Super-Mesh and Super-Node.AC Fundamentals: Analysis of R-L, R-C, R-L-C Series circuit -Simple Numerical problems.

Self -study	AC Circuit with dependent sources
Text Book	Text Book 2: 1.5, 1.7, 1.10, 1.11, 2.3, 2.4, 2.5, 2.6

MODULE-2	**NETWORK REDUCTIONS AND THEOREMS**	**25EEE33.2, 25EEE33.6**	**9 Hours**

Network reduction using star-delta transformation and Source transformation, Superposition theorem-Thevenin's theorem, Norton's theorem -Maximum power transfer theorem-Reciprocity theorem (problems with independent ac and dc sources)

Application	Superposition theorem in multi-source networks
Text Book	Text Book 2: 3.2, 3.3, 3.4, 3.5,3.6, 6.4, 6.5, 6.6, 6.7

MODULE-3	**RESONANCE AND COUPLED CIRCUITS**	**25EEE33.3, 25EEE33.6**	**9 Hours**

Series resonance, parallel resonance - phasor diagram, effect of power factor, current, voltage, frequency, band width, selectivity and variation of quality factor (Q) on resonance. Problems on resonant frequency, band width, and quality factor at resonance - Self-Inductance, Mutual Inductance, Coefficient of Coupling (k), inductances in series and parallel- cumulative coupling, differential coupling, Analysis of coupled circuits.

Case study	AM/FM radio tuning circuit
Text Book	Text Book 2:5.1, 5.2, 5.3, 5.4, 7.2, 7.3, 7.4, 7.5, 7.6,7.7, 7.8

MODULE-4	**TRANSIENT ANALYSIS**	**25EEE33.4, 25EEE33.6**	**9 Hours**

Behavior of R, L, C under different switching instances, Source Free RL, RC and RLC Circuits, Step Response of RL, RC and RLC Circuits.

Self-study	Voltage /current waveforms of R,L,C during sudden switching
Text Book	Text Book 1:7.2, 7.37.5, 7.6, 8.4, 8.5, 8.6

MODULE-5	**THREE PHASE CIRCUITS**	**25EEE33.5, 25EEE33.6**	**9 Hours**

Balance three phase voltages, Analysis of Balanced and unbalanced three phase systems – wye-wye, wye-delta, delta-wye, and delta-delta. Power measurement in three phase circuits.

Self -study	Delta-delta connection
Text Book	Text Book 1: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels	**Marks Distribution**		
	Test (s)	**AAT1**	**AAT2**
	25	**15**	**10**

L1	**Remember**	**-**	**-**	**-**
L2	**Understand**	**-**	**-**	**-**
L3	**Apply**	**10**	**5**	**5**
L4	**Analyze**	**10**	**5**	**5**
L5	**Evaluate**	**5**	**5**	**-**
L6	**Create**	**-**	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	**-**
L3	**Apply**	**20**
L4	**Analyze**	**20**
L5	**Evaluate**	**10**
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1) Fundamentals of Electric Circuits, Charles Alexander, McGraw Hill; Standard 7th Edition, 2022, ISBN10: 9355320167; ISBN-13: 978-9355320162
2) Network Analysis and Synthesis, Ravish R Singh, McGraw Hill Education (India) Private Limited, ISBN (13): 978-1-25-906295-7, ISBN (10): 1-25-906295-3

Reference Books:

1) Circuit theory: Analysis and Synthesis, A Chakrabharti, Shree Hari Publications, 2021,ISBN: 978B092TL82DM
2) Electric Circuits (Schaum's Outline Series),McGraw Hill Education; 5th edition ,2017, ISBN-10: 0070151431; ISBN-13: 978-0070151437
3) Engineering circuit analysis, Hayt and Kemmerly, McGraw Hill, 7th edition, 2022. ISBN-13 9781259098635; ISBN-10 1259098635

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=uyE_UhLwIXc
- https://www.youtube.com/watch?v=BNK4gxqWaV0
- https://nptel.ac.in/courses/108105159
- https://www.youtube.com/watch?v=7Nh7ISeqn6E&list=PLbRMhDVUMngfNnABo5mre45ZbHqJE2sUn
- https://www.youtube.com/watch?v=Eknlx7zHBVo&list=PL1D46B10238154408

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experiential learning approach through lab sessions (Hardware/Software)
- Learning to solve real life problems using PSPICE
  Concept Quiz on Network theorems
- Seminars on balanced Vs Unbalance three phase loads in industrial applications

ELECTRIC CIRCUIT THEORY LABORATORY

Course Code	**25EEL33**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEL33.1	Deduce the given network using different network reduction techniques
25EEL33.2	Analyze various network using mesh and nodal methods
25EEL33.3	Apply different network theorems for the given circuit
25EEL36.4	Design transient circuits, analyze the frequency and steady-state response of mutually coupled circuits, and measure three-phase power using the two-wattmeter method

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Resistance colour coding. • Familiarization of breadboards and PSPICE.	2	NA
	PART-A		
1	Simulation of Network Reduction using Series-Parallel Combination	2	25EEL33.1
2	Network Reduction and Analysis using Source Transformation	2	25EEL33.1
3	Network Analysis using Mesh-Current Method	2	25EEL33.2
4	Network Analysis using Node-Voltage Method	2	25EEL33.2
5	Verification of Superposition Theorem	2	25EEL33.3
6	Verification of Thevenin's Theorem & Norton's Theorem	2	25EEL33.3
	PART-B		
7	Verification of Reciprocity Theorem	2	25EEL33.3
8	Verification of Maximum Power Transfer Theorem	2	25EEL33.3
9	Determination of Resonant Frequency, Bandwidth and Quality Factor of a RLC Circuit	2	25EEL33.4
10	Transient and steady state analysis of RL, RC and RLC Circuits	2	25EEL33.4
11	Measurement of Three phase power using two wattmeter method	2	25EEL33.4
12	Steady State Analysis of Mutually Coupled Circuits	2	25EEL33.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Verification of Thevenin Theorem
   https://asnm-iitkgp.vlabs.ac.in/exp/verification-thevenin-theorem/simulation.html
2. Verification of Maximum Power Transfer Theorem
   https://asnm-iitkgp.vlabs.ac.in/exp/maximum-power-transfer-theorem/
3. R-L-C Circuit Analysis
   https://asnm-iitkgp.vlabs.ac.in/exp/rlc-circuit-analysis/
4. Verification of Superposition Theorem
   https://asnm-iitkgp.vlabs.ac.in/exp/verification-superposition-theorem/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	**Remember**	-	-
L2	**Understand**	-	-
L3	**Apply**	15	10
L4	**Analyze**	10	5
L5	**Evaluate**	5	5

L6	**Create**	-	-	

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	15
L5	**Evaluate**	15
L6	**Create**	-

Suggested Learning Resources:

Reference Books:

1) Electric Circuits Laboratory Manual, Asadi, Farzin, Publisher: Springer Cham, 2023, ISBN-9783031245510

MEASUREMENTS AND INSTRUMENTATION			
Course Code	**25EEE34**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE34.1	Understand the fundamentals of measurement system, errors and its characteristics
25EEE34.2	Evaluate the electrical parameter such as power, energy consumed, frequency using measuring instruments
25EEE34.3	Demonstrate the working principle and industrial applications of potentiometers and instrument transformers
25EEE34.4	Analyze of D.C and A.C bridges used in measuring instruments
25EEE34.5	Demonstrate the different types of electronic instruments, display devices and waveform analyzers, their construction and operation
25EEE34.6	Illustrate the working of recording, bio medical instruments and smart sensors

MODULE-1	**INTRODUCTION TO MEASURING INSTRUMENTS**	**25EEE34.1 25EEE34.2**	**9 Hours**

Fundamentals of measurement systems, Static and dynamic characteristics of measuring instruments, errors in measurements, Classification of instruments, loading effect due to shunt and series connected instruments, Measurement of power, energy and frequency, Extension of instrument ranges and multipliers.

Case Study	Investigate the Challenges of analog instruments and compare with digital instruments
Text Book	Text Book 1: 1.1, 1.2,1.6, 2.3, 2.30,3.1,8.1,10.1,11.1,12.1

MODULE-2	**POTENTIOMETERS AND INSTRUMENT TRANSFORMERS**	**25EEE34.3 25EEE34.2**	**9 Hours**

DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, AC potentiometers: polar and coordinate type, applications; Instrument transformer: CT and PT, ratio and phase angle error.

Applications	Working of CT and PT in substations and industries
Text Book	Text Book 1: 14.1 to 14.35, 9.1 to 9.33

MODULE-3	**DC AND AC BRIDGES**	**25EEE34.4, 25EEE34.2**	**9 Hours**

Measurement of Resistance: Methods of measuring low, medium, high resistance, Wheatstone bridge, Kelvin's double bridge, Measurement of Inductance: Maxwell's bridge, hay's bridge, Anderson's bridge, Measurement of Capacitance: Desauty's bridge, Wein's bridge, Schering bridge.

Self-study	Earth resistance measurement using Megger
Text Book	Text Book 1:13.1 to 13.33, Text Book 1:16.1-16.15

MODULE-4	**ELECTRONIC AND DIGITAL INSTRUMENTS:**	**25EEE34.5**	**9 Hours**

Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter, electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, integrating type DVM, Continuous –balance DVM and Successive - approximation DVM, Q meter Principle of working of electronic energy meter (block diagram)

Self-study	Digital Energy meter
Text Book	Text Book 1: 20.1-20.16, Text Book 2:6.1-2,8.9

MODULE-5	**DISPLAY AND RECORDING DEVICES**	**25EEE34.6**	**9 Hours**

Introduction, Character formats, Segment displays, Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Strip chart recorders, LVDT type recorders, Circular chart and X – Y recorders. Magnetic tape recorders, Digital tape recording, Biomedical recorders, Electro Cardio Graph (ECG), Electroencephalograph, Smart sensors.

Applications	Explore the applications of sensors in real world in various fields and its development
Text Book	Text Book 1: 28.75 to 28.95, Text book 1:28.100 to 28.150

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	-	-	-
L3	Apply	10	10	5
L4	Analyze	10	5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	15
L3	Apply	20
L4	Analyze	10
L5	Evaluate	5
L6	Create	--

Suggested Learning Resources:

Text Books:

1) A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation" , Publisher: Dhanpatrai and Sons, New Delhi, 19th revised Edition, 2015, ISBN-10 : 8177001000.
2) David A. Bell," Electronic Instrumentation and Measurement", oxford Publication, 3rd Edition, 2013, ISBN-10: 019569614X.

Reference Books:

1) Golding and Widdies, "Electrical Measurements and Measuring Instruments", Pitman, 5th 2011, ISBN-10 : 8190630725
2) Cooper D. and A.D. Heifrick "Modern Electronic Instrumentation and Measuring Techniques", , Pearson's, 2nd Edition, 2015, ISBN-10 :8120307526

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc19_ee44/preview
- https://idemi.org/training/professional-courses
- https://archive.nptel.ac.in/courses/108/105/108105153/
- https://ieee-ims.org/publication/imm
- https://www.satishkashyap.com/2012/01/video-lectures-from-iit-professors_09.html

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of CRO and Function Generator, Analog and Digital meter
- Seminars
- Video demonstration of latest trends in instruments
- Organizing Group wise discussions on issues

DIGITAL LOGIC DESIGN

Course Code	**25EEE35**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE35.1	Apply Boolean reduction technique to simplify digital logic circuits
25EEE35.2	Recommend combinational logic circuits for specific applications
25EEE35.3	Analyze synchronous and asynchronous digital logic circuits
25EEE35.4	Design sequential logic systems using appropriate state models and flip-flop- based configuration
25EEE35.5	Construct optimized digital circuits for the desired specification using counters and shift registers
25EEE35.6	Develop Verilog HDL code for combinational and sequential circuit implementations

MODULE-1	**COMBINATIONAL LOGIC CIRCUITS**	**25EEE35.1**	**9 Hours**
Definition of digital system, combinational logic circuits, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables, incompletely specified functions (Don't Care terms), Simplifying Max term equations. Design of combination circuits using NAND and NOR gates. Quine-McCluskey minimization technique, Quine-McCluskey using Don't care terms, Map entered variable.			
Self-study	Recall the concepts of Boolean algebra and logic gates		
Text Book	Text Book 1: 2.1 to 2.5 Text book 2: 5.1 to 5.7		
MODULE-2	**ANALYSIS AND DESIGN OF COMBINATIONAL LOGIC CIRCUITS**	**25EEE35.2**	**9 Hours**
Adders and subtractors, cascading full adders, Look ahead carry, Binary comparators, Decoders-Encoders, Priority encoders. Digital multiplexers, Using multiplexers as Boolean function generators, Demultiplexers.			
Applications	Investigate combinational logic circuit applications.		
Text Book	Text Book 1: 4.3 to 4.6 Ref.Book 3: 4.1,4.2 to 4.8		
MODULE-3	**SEQUENTIAL LOGIC CIRCUITS**	**25EEE35.3, 25EEE35.4**	**9 Hours**
Basic Bistable Element, Latches, SR Latch, gated SR Latch, gated D Latch, Characteristics equations of latches. Flip-flops-SR, JK, D, T, Master-Slave SR Flip-Flops, Master-Slave JK Flip-Flops, Registers, Types of shift – registers			
Application	T-flip flop in frequency divider circuit		
Text Book	Text Book 1: 6.1 to 6.6		
MODULE-4	**DESIGN OF SEQUENTIAL LOGIC CIRCUITS**	**25EEE35.5**	**9 Hours**
Design of asynchronous & synchronous counters, binary counters, Counters based on Shift Registers, Design of a Synchronous Modulo Counter using clocked Flip-Flops. Concept of states, state diagram, state table & state assignment. Mealy & Moore state models.			
Self-study	Investigate sequential logic circuit applications.		
Text Book	Text Book 1: 7.1 to 7.6 Text Book 2: 11.1 to 11.8 Ref.Book 3: 5.1 to 5.9		
MODULE-5	**VERILOG HDL**	**25EEE35.6**	**9 Hours**
Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis. Design of combinational, sequential logic circuits and state machines using Verilog			
Self-study	Types of modeling in verilog		
Text Book	Text Book 2: 10.1 to 10.6		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-

L2	**Understand**	-	-	**-**
L3	**Apply**	10	5	**5**
L4	**Analyze**	10	5	**5**
L5	**Evaluate**	5	5	**-**
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	**-**

Suggested Learning Resources:

Text Books:

1) Digital Design and computer design, M. Morris Mano, Pearson Education, 6th Edition, 2018,ISBN: 978-93-53-06-2019
2) Fundamentals of logic design, Charles H Roth, larry L henny, Raghunandan G. H. Cengage India Private Limited, 1st Edition, 2019, ISBN: 9780-49-54-71-684

Reference Books:

1) Digital electronics, B.R.Gupta, V.Singhal, S.K Kataria& sons, 7thEdition, 2014, ISBN: 978-93-5014-407-7
2) Logic and computer design Fundamentals, Mono and Kim, Prentice Hall, 5th Edition, 2015, ISBN: 978-01-33-760-637
3) Fundamentals of digital logic with Verilog design, S. Brown and Z. Vranesic, McGraw-Hill, Third Edition, 2014, ISBN: 978–0–07–338054–4
4) Digital Logic Applications and Design, John M Yarbrough, Thomson Learning, 8th Edition, reprint 2017,ISBN: 978-9812-400-628
5) Verilog HDL: A Guide to Digital Design and Synthesis, S. Palnitkar, Pearson Education, Second Edition, 2015, ISBN: 978-8177589184

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
- https://www.tutorialspoint.com/digital_electronics/index.asp
- https://onlinecourses.nptel.ac.in/noc20_ee32/preview
- https://www.coursera.org/learn/digital-systems
- https://www.youtube.com/watch?v=X7M3rUxUpOc&list=PLbRMhDVUMngePP5JcezxImF-FzOC9wstz

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstration of logic gates using hardware
- Video demonstration of digital logic circuits
- Industry expert lecture on application of combinational and sequential circuits

25EEE36X-Ability Enhancement Course – III

DIGITAL LOGIC DESIGN LABORATORY			
Course Code	**25EEE361**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE361.1	Apply Boolean Algebra and Simplification tools for solving problems
25EEE361.2	Analyze the operation of combinational and sequential logic circuits
25EEE361.3	Use EDA tool to develop digital logic circuits
25EEE361.4	Evaluate the logic circuits to draw conclusions based on RTL synthesis

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	1. Boolean Laws and Simplification procedures 2. Understanding the operation of combinational and logic circuits	2	NA
	PART-A		
1	Simplification, realization of Boolean expressions using logic gates/Universal gates.	2	25EEE361.1 25EEE361.2
2	Realization of Half/Full adder and Half/Full Subtractors using logic gates.	2	25EEE361.1 25EEE361.2
3	MUX/DEMUX – use of 74153, 74139 for arithmetic circuits	2	25EEE361.1 25EEE361.2
4	Realization of One/Two-bit comparator and study of 7485 magnitude comparator.	2	25EEE361.1 25EEE361.2
5	Truth table verification of Flip-Flops: (i) JK Master slave (ii) T type and (iii) D type.	2	25EEE361.1 25EEE361.2
6	Realization of 3-bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).	2	25EEE361.1 25EEE361.2
	PART-B		
7	Develop a Verilog module for full adder and parallel adder. Test the modules using test bench	2	25EEE361.3 25EEE361.4
8	Develop a Verilog module for 8 to 1 Mux. Test the modules using test bench	2	25EEE361.3 25EEE361.4
9	Develop a Verilog module for 8 to 3 Priority Encoder. Test the modules using test bench	2	25EEE361.3 25EEE361.4
10	Develop a Verilog module for D, SR, JK and T Flip Flops. Test the modules using test bench	2	25EEE361.3 25EEE361.4
11	Develop a Verilog module for counters. Test the modules using test bench	2	25EEE361.3 25EEE361.4
12	Develop a Verilog module for Shift Register. Test the modules	2	25EEE361.3 25EEE361.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Analysis of Boolean equations- https://dec-iitkgp.vlabs.ac.in/exp/basic-logic-gates/
2. Analysis of logic circuits using decoders- https://dec-iitkgp.vlabs.ac.in/exp/functions-using-decoders/
3. Analysis of logic circuits using comparator- https://dec-iitkgp.vlabs.ac.in/exp/digital-comparators/

4. Analysis of sequential circuits using flip flops- https://dec-iitkgp.vlabs.ac.in/exp/sequential-circuits/

CIE Assessment Pattern (50 Marks – Lab)

Table 1

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	10
L4	Analyze	10	10
L5	Evaluate	10	10
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Verilog HDL Design Examples, Joseph Cavanagh, Publisher: CRC Press, Taylor & Francis group, 2018, ISBN- 9781138099951
2) Hardware Description Language Demystified: Explore Digital System Design using Verilog HDL and VLSI Design Tools, Dr. Cherry Bhargava and Dr. Rajkumar Sarma, Publisher: BPB Publications, 2020, ISBN- 9789389898040

MATLAB PROGRAMMING FOR PROBLEM SOLVING			
Course Code	**25EEE362**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE362.1	Make use of the software to perform basic mathematical operations.
25EEE362.2	Explore the utility of computational tools
25EEE362.3	Evaluate power system performance by analyzing three phase circuits
25EEE362.4	Analyze the electrical networks and electronics circuits to interpret system behavior

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic Computational knowledge • Basic knowledge on the application circuits	2	NA
	PART-A		
1	To write a program to perform some basic operation on matrices such as addition, subtraction, multiplication.	2	25EEE362.1
2	To write a program to generate various signals and sequences, such as unit impulse, unit step, unit ramp, sinusoidal, square, saw tooth, triangular, sine signals.	2	25EEE362.2
3	Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, edit window, Shortcuts, Help files.	2	25EEE362.2
4	To write program using Matrix Constructors and Operator, Matrix Bitwise operator, Relational Operators and Logical Operator	2	25EEE362.2
5	To write a program to create 2-D and 3-D plots in MATLAB using the plot function to visualize data	2	25EEE362.3
6	To write and execute programs using control loop statement.	2	25EEE362.2
	PART-B		
7	Analyze a given electrical network by applying Network Theorems using MATLAB.	2	25EEE362.4
8	Analyze the basic electronics circuits using MATLAB.	2	25EEE362.4
9	Design and analysis of measurement of Real Power, Reactive Power and Power Factor in Three Phase Circuits using MATLAB.	2	25EEE362.3
10	Determination of ABCD parameter of transmission network.	2	25EEE362.4
11	To write a MATLAB program to find the impulse response and step response of a system from its difference equation.	2	25EEE362.4
12	Speed control of DC motor using MATLAB.	2	25EEE362.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. MATLAB Fundamentals
   https://in.mathworks.com/matlabcentral/
2. Signals and their properties
   https://ssliitg.vlabs.ac.in/Signals%20and%20their%20properties(objectives).html
3. 2-D and 3-D Plots
   https://in.mathworks.com/help/matlab/learn_matlab/plots.html
4. Electrical Engineering Virtual Electric Machine
   https://www.mathworks.com/matlabcentral/fileexchange/97027-electrical-engineering-virtual-electric-machine-power-labs

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	15
L4	Analyze	20
L5	Evaluate	15
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) MATLAB: An Introduction with applications, Amos Gilat - Wiley India Pvt. Ltd, 4th Ed., 2012, ISBN-8126537205
2) Getting started with MATLAB, Rudra Pratap – Oxford University Press, 2010, ISBN- 0198069197
3) https://www.udemy.com/MATLAB/Online-Course
4) https://nptel.ac.in/courses/103/106/103106118
5) https://www.matlabtutorials.com/mathforum/

VIRTUAL INSTRUMENTATION USING LABVIEW

Course Code	**25EEE363**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE363.1	Select different functions available in Lab VIEW for engineering applications
25EEE363.2	Analyze the concepts of virtual instrumentation and develop basic programs using loops
25EEE363.3	Evaluate user interfaces with charts, graph, and buttons
25EEE363.4	Use the Lab VIEW platform to create and analyze data acquisition systems

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Knowledge of Microsoft Windows Knowledge of writing algorithms in the form of flowcharts or block diagrams. http://www.ni.com/getting-started/labview- basics/environment	2	NA
	PART-A		
1	To perform basic arithmetic operations: addition, subtraction, multiplication, and division using LabVIEW.	2	25EEE363.1
2	To perform Boolean operations: AND, OR, XOR, NOT and NAND using LabVIEW.	2	25EEE363.1
3	To find the Sum of 'n' numbers using 'for' loop and 'while' loop.	2	25EEE363.3
4	To perform the Factorial of a given number using 'for' loop and 'while' loop.	2	25EEE363.3
5	To sort even numbers using 'while' loop in an array.	2	25EEE363.3
6	To find the maximum and minimum variable from an array.	2	25EEE363.2
	PART-B		
7	To create a sine wave using formula node.	2	25EEE363.2
8	Build a Virtual Instrument which adds two sine waves of different frequencies and displays the result in a graph.	2	25EEE363.1
9	To apply filtering technique (median filter) for a given input signal.	2	25EEE363.1
10	To build a Virtual Instrument that converts Celsius to Fahrenheit.	2	25EEE363.4
11	To build a Virtual Instrument for acquiring and continuously displaying a thermocouple signal.	2	25EEE363.4
12	To acquire and analyze an ECG signal using NI ELVIS LabVIEW.	2	25EEE363.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Simulations in LabVIEW
   https://www.youtube.com/watch?v=X6oRczEDao
2. LabVIEW Formula Node
   https://www.youtube.com/watch?v=m5z_5j6iu2M
3. LabVIEW Mathscript
   https://www.youtube.com/watch?v=dQjmzEM8Kc

Reading data from Spreadsheet
https://www.just.edu.jo/FacultiesandDepartments/FacultyofEngineering/Departments/BiomedicalEngineering/Documents/labview%20experiments.pdf

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) Joseph Cavanagh, "Verilog HDL Design Examples", Publisher: CRC Press, Taylor & Francis group, 2018, Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011, ISBN: 978-81-203-4030-5
2) Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011, ISBN: 9781259083815
3) Sensor, transducers and Lab view, Barry Paton, Prentice Hall of India 2000, ISBN: 978-013-08-11-554 LabVIEW Graphical Programming, Richard Jennings, Fabiola De la Cueva,5th edition, McGraw-Hill Publishing 2020,ISBN: 978-1260-135-268

555 IC LABORATORY			
Course Code	**25EEE364**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE364.1	Identify the applications of 555 timers
25EEE364.2	Interpret the multivibrator circuits using IC555
25EEE364.3	Analyze multivibrator circuits using op-amp and 555Timer
25EEE364.4	Design and test LED circuits, Alarm Circuits and generate pulse, frequency shift keying using 555 timer

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• **Basic knowledge of Electronic Devices and Circuits** • **Digital logic circuits basics** • **Use of basic electronic laboratory instruments.**	2	NA
	PART-A		
1	Study of IC 555 Timer	2	25EEE364.1
2	Construct Astable Multivibrator circuit using IC-555 Timer	2	25EEE364.1, 25EEE364.2
3	Construct Mono-stable Multivibrator circuit using IC-555 Timer	2	25EEE364.1, 25EEE364.2
4	Construct bistable multivibrator using 555 timer	2	25EEE364.1
5	Generate Pulse Width Modulator (PWM) signal using IC-555 Timer.	2	25EEE364.1, 25EEE364.2
6	Construct Burglar Alarm circuit using IC-555 Timer.	2	25EEE364.1, 25EEE364.2
	PART-B		
6	Construct and generate Frequency Shift Keying (FSK) signal using IC-555 Timer.	2	25EEE364.3, 25EEE364.4
7	Construct and test Running LED circuit using IC-555 Timer.	2	25EEE364.3, 25EEE364.4
8	Construct water level indicator using IC-555 Timer	2	25EEE364.3, 25EEE364.4
9	Construct continuity tester using IC-555 Timer	2	25EEE364.3, 25EEE364.4
10	Construct and test Sequential timer using IC-555.	2	25EEE364.3, 25EEE364.4
11	Construct and test Advanced Red LED Flasher.	2	25EEE364.3, 25EEE364.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Astable and monostable multivibrator using IC 555
   https://ae-iitr.vlabs.ac.in/exp/astable-monostable-multivibrator/theory.html
2. 555 Timer circuit-
   https://www.multisim.com/content/JGVP34rADPxaJTV2epEsPk/555-timer-circuit/
3. DAC and ADC-
   https://he-coep.vlabs.ac.in/exp/digital-analog-converter/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1)Design of Function Circuits with 555 Timer Integrated Circuit, By K.C. Selvam, 1st Edition, CRC Press, 2023**,** ISBN 9781032391700

2)Op-Amps and Linear Integrated Circuits | Fourth Edition | By Pearson Paperback ,by Ramakant A. Gayakwad, 4th Edition, Pearson, 2018, ISBN-9789332549913

BIO INSPIRED DESIGN AND INNOVATION

Course Code	**25EEE365**	**Credits**	**01**
L:T:P:S	**1:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**50**
TW & SL / Sem	**15**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE365.1	Understand the fundamentals and significance of bio-inspired design and engineering.
25EEE365.2	Apply biomaterials and bio-inspired healthcare systems for engineering applications.
25EEE365.3	Analyze bio-inspired optimization techniques to solve sustainable engineering and environmental management problems.
25EEE365.4	Apply bio-inspired AI innovations in manufacturing, automation, materials, and sustainable product development.

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**25EEE365.1**	**3 Hours**

Bio-Inspired Engineering and design, History, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).

Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	**BIO MATERIALS AND BIO HEALTHCARE DESIGN**	**25EEE365.2**	**3 Hours**

Biomaterials, Design of Forms- (Hexagonal unit cells, Intrinsic disorder, anisotropy), Bio- Mechanics, Applications of Biomaterials and Bio systems in Health care design (Human Prosthetics, Parasitic, Wasp Inspired Needle)

Case Study	Investigate Bio-Compatible and health care applications.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**BIO SUSTAINABLE DEVELOPMENT**	**25EEE365.3**	**3Hours**

Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air purification, filtration), Dew water collection systems, water purification, desalination.

Case Study	Explore the Bio inspired environmental constructions and development.
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	**BIO-OPTIMISATION TECHNIQUES**	**25EEE365.3**	**3 Hours**

No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).

Self-study	Scrutinize the Different types of Optimization techniques, genetic research.
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	**APPLICATIONS OF BIO-INSPIRED AI INNOVATIONS**	**25EEE365.4**	**3 Hours**

Bio-inspired innovations in AI Integrated automotive systems, automation and robotics, AI-driven Bio materials discovery and manufacturing, AI Driven predictive modeling, digital twins, and sustainable product design for addressing environmental and industrial challenges.

Case Study	Survey on Bio inspired Innovations, design, applications and case studies of the same.
Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		**Marks Distribution**		
		Test (s)	**AAT1**	**AAT2**
		25	**15**	**10**
L1	**Remember**	5	-	-
L2	**Understand**	5	5	-
L3	**Apply**	10	5	5
L4	**Analyze**	5	5	5
L5	**Evaluate**	-	-	-

L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**20**
L4	**Analyze**	**10**
L5	**Evaluate**	--
L6	**Create**	--

Suggested Learning Resources:

Text Books:

1) Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10: 366257683X, ISBN-13: 978-3662576830.
2) Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10:1636390471, ISBN-13: 978-1636390475

Reference Books:

1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020, ISBN-13: 978-1108492263.
2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2021, Revised Selected Papers (Vol. 1363). Springer Nature, 2021, ISBN: 978-981-16-1820-1.

Web links and Video Lectures (e-Resources)

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design20Workshop%20Report_2232327_October%202022_Final.508.pdf

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Bio Materials printing using 3D Printing
- Flipped class room
- Organizing Group wise discussions on sub topics
- Student presentations

COMMUNITY PROJECT USING INNOVATION AND DESIGN THINKING

Course Code	**25CPD37**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**-**	**SEE Marks**	**50**
TW & SL / Sem	**30**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25CPD37.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25CPD37.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25CPD37.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25CPD37.4	Formulate feasible environmental problem statements and solutions considering practical constraints and sustainability aspects

Community Project using Innovation and Design Thinking helps students to understand community problems, develop innovative solutions, and create sustainable positive impact through a structured problem-solving approach. Rapid urbanization, population growth, environmental concerns, energy demand, water scarcity, waste management, transportation issues and rural development challenges have created practical problems affecting communities and public welfare. This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:
Community / Societal Projects shall remain academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation.

CIE Assessment Pattern (50 Marks)

RBT Levels		**Periodical Reviews and Evaluation**
		50
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**10**

SEE Assessment Pattern (50 Marks)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	**-**
L2	**Understand**	**05**
L3	**Apply**	**15**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**

L6	**Create**	**10**

Suggested Learning Resources:

Textbooks:

1) Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2) Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3) Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4) Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1) NPTEL courses on Project-Based Learning and Social Innovation.
2) SWAYAM courses on community engagement and sustainability.
3) UN Sustainable Development Goals portal: https://sdgs.un.org
4) MyGov India and local civic body portals for community initiatives.
5) YouTube resources on design thinking, social innovation, and community service learning.
6) NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1) NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2) NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3) Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4) Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5) YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments).
6) American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

BASIC APPLIED MATHEMATICS - I
(Common for All Branches)

Course Code	**25DMAT31**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

Course outcomes:
At the end of the course, the student will be able to:

25DMAT31.1	Understand the concepts of elementary transformations to the rank of a matrix, and apply the consistency and solutions of systems of linear equations
25DMAT31.2	Apply eigenvalues and eigenvectors of square matrices for matrix diagonalization, and compute the powers of matrices for engineering and computational applications
25DMAT31.3	Analyze curves represented in Cartesian, polar coordinate systems, determine tangents, angles between polar curves, and derive pedal equations for scientific modeling.
25DMAT31.4	Apply techniques of partial differentiation, chain rule, Euler's theorem for homogeneous functions, Jacobians of functions to solve multivariable engineering problems
25DMAT31.5	Analyze the motion of particles using velocity and acceleration vectors, and evaluate gradient and directional derivatives to interpret rates of change in scalar fields.
25DMAT31.6	Apply vector differential operators—gradient, divergence, and curl—to investigate scalar and vector fields

MODULE-1	**LINEAR ALGEBRA - 1**	**25DMAT31.1**	**3 Hours**
Elementary transformations, Reduction of the given matrix to echelon form, Rank of a Matrix, Consistency of a system of linear equations, Solution of a system of non-homogeneous linear equations.			
Self-study	Rank of a matrix by normal form, Solution of a system of homogeneous linear equations		
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-2	**LINEAR ALGEBRA - 2**	**25DMAT31.2**	**3 Hours**
Linear transform, Eigen values and Eigen vectors of a square matrix, Diagonalization of a square matrix and Power of matrices using Diagonalization.			
Self-study	Reduction of quadratic expression to canonical form.		
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		
MODULE-3	**DIFFERENTIAL CALCULUS**	**25DMAT31.3**	**3 Hours**
Importance of cartesian and polar coordinate systems, Angle between the radius vector and tangent to a polar curve, angle between two polar curves, Pedal equation of a polar curve.			
Self-study	Radius of curvature in cartesian, parametric, polar forms		
Text Book	Text Book 1: 4.4, 4.7, 4.8		
MODULE-4	**MULTIVARIABLE CALCULUS**	**25DMAT31.4**	**3 Hours**
Introduction to partial differentiation, total differentiation, chain rule, Euler's theorem for Homogeneous functions, Jacobians, Extreme values of the functions with two variables.			
Self-study	Basic problems on partial differentiation		
Text Book	Text Book 1: 5.4, 5.7		
MODULE-5	**VECTOR CALCULUS**	**25DMAT31.5 25DMAT31.6**	**3 Hours**
Velocity and Acceleration of a particle, Gradient of scalar function, directional derivative, Divergence and Curl of vector functions, Solenoidal and Irrotational vector fields.			
Self-study	Vector identities		
Text Book	Text Book 1: 8.3, 8.5, 8.7, 8.18 Text Book 2: 9.7, 9.8, 9.9		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
- https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
- https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
- https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
- https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
- https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
- https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
- https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
- https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
- https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
- https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

FOURTH SEMESTER
SYLLABUS

COMPLEX ANALYSIS, OPTIMIZATION AND PROBABILITY DISTRIBUTIONS
(Common for ECE, EEE & ME)

Course Code	**25MAE41**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25MAE41.1	Analyze two-dimensional potential flow problems using velocity potential, stream functions, and complex potential functions in engineering applications.
25MAE41.2	Apply Operations Research techniques to analyze and optimize engineering systems involving production planning, scheduling, logistics, network optimization, and resource management.
25MAE41.3	Analyze engineering problems involving uncertainty and random processes and select appropriate probability distributions.
25MAE41.4	Analyze sample data by selecting appropriate statistical tests, interpreting hypothesis test results, evaluating confidence limits, and applying the Central Limit Theorem for engineering applications.
25MAE41.5	Apply Markov chain models to solve engineering problems involving state transitions and compute higher transition probabilities using matrix methods
25MAE41.6	Apply the queueing models to determine key performance measures such as system utilization, average queue length, average waiting time, and probability of system states

MODULE-1	**COMPLEX ANALYSIS**	**25MAE41.1**	**9 Hours**
Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions using Milne-Thompson's method. Applications of Flow Problems-Velocity potential, Stream functions and complex potential functions. Conformal Transformations of $W = z^2$ and $W = e^z$. Cauchy's Theorem, Generalized Cauchy's integral formula			
Self-study	Bilinear transformation, conformal transformation of $w = z + \frac{1}{z}$, complex line integration.		
Text Book	Text Book 1: 20.3, 20.4, 20.5, 20.6, 20.9, 20.13, 20.14. Text Book 2: 13.3, 13.4, 14.2, 14.3		
MODULE-2	**OPTIMIZATION TECHNIQUES**	**25MAE41.2**	**9 Hours**
Introduction to optimization techniques, Objectives and Characteristics of Operation Research. Introduction to Linear programming, solution by simplex and Big M methods. Formulation of transportation problem, Initial Basic feasible solution by North-West Corner method, least cost method, Vogel's approximation method. Optimal solutions-Problems. Formulation of assignment problems, Hungarian method.			
Self-study	Linear programming, solution by graphical method, two phase simplex method		
Text Book	Text Book 1: 34.1, 34.2, 34.7, 34.8, 34.9, 34.14, 34.15, 34.17, 34.18 Text Book 2: 22.3, 22.4		
MODULE-3	**PROBABILITY DISTRIBUTIONS**	**25MAE41.3**	**9 Hours**
Random variables, discrete and continuous random variables, probability density functions, Expectation and Standard deviation. Discrete Probability distribution, Binomial and Poisson Distributions. Continuous Probability distribution, Normal distribution. Joint probability distribution - dependent and independent Random variables, Covariance, Correlation coefficient.			
Self-study	Basic probability theory, Baye's theorem, Bernoulli distribution, uniform distribution, exponential distribution		
Text Book	Text Book 1: 25.12, 25.13, 26.8, 26.9, 26.10, 26.11, 26.12, 26.14, 26.15, 26.16.		
MODULE-4	**SAMPLING THEORY**	**25MAE41.4**	**9 Hours**
Sampling, Sampling distributions, Level of significance, Type-I & Type-II errors, one tail and two tail tests, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem, confidence limits for means, Student's t-distribution, F-distribution and Chi-square distribution for test of goodness of fit for small samples.			
Self-study	Confidence limits problems.		
Text Book	Text Book 1: 27.2, 27.4, 27.6, 27.8, 27.10, 27.12, 27.14, 27.16, 27.18, 27.20,		
MODULE-5	**MARKOV CHAIN AND QUEUEING THEORY**	**25MAE41.5 25MAE41.6**	**9 Hours**
Stochastic Process: Stochastic processes, probability vector, stochastic matrices, fixed probability vector, regular stochastic matrices, Markov chains, higher transition probability problems.			

Queueing Theory: Problems on Queueing model with M/M/1 and M/M/C	
Self-study	Queueing model with M/G/1 and M/D/1
Text Book	Text Book 3: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	10	5	5
L5	Evaluate	-	5	-
L6	Create			-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	20
L4	Analyze	20
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.
3) William J. Stewart, Probability, Markov Chains, Queues, and Simulation: The Mathematical Basis of Performance Modeling, Princeton University Press, ISBN 9780691140629

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=f_EqOpgRwRM&t=16s
- https://www.youtube.com/watch?v=Xb9Ypn77LBo&t=16s
- https://www.youtube.com/watch?v=csgvZol6Wfw
- https://www.youtube.com/watch?v=Atv3IsQsak8
- https://www.youtube.com/watch?v=aEF5PPbv8Oc
- https://www.youtube.com/watch?v=Pwk7p8WiCh0
- https://www.youtube.com/watch?v=LGxE_yZYigI
- https://www.youtube.com/watch?v=RFlAiEXRwoo
- https://www.youtube.com/watch?v=RFlAiEXRwoo&t=128s
- https://www.youtube.com/watch?v=sMYtHaSlXbU

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

ANALOG ELECTRONICS AND INTEGRATED CIRCUITS			
Course Code	**25EEE42**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE42.1	Understand the characteristics and application of semiconductor devices.
25EEE42.2	Analyze transistor amplifier performance through mathematical modeling and circuit analysis.
25EEE42.3	Evaluate the performance of power amplifiers and oscillator circuits for various operating conditions and frequency ranges.
25EEE42.4	Analyze the characteristics of operational amplifiers and build basic Op-Amp application circuits.
25EEE42.5	Implement comparator circuits, waveform generators, active filters, and timer circuits using operational amplifiers and IC 555.
25EEE42.6	Design analog and integrated electronic circuits to satisfy given functional and performance requirements.

MODULE-1	**DIODE CIRCUITS AND TRANSISTOR DC BIASING**	**25EEE42.1 25EEE42.2**	**9 Hours**

PN Junction Diode, Diode equivalent circuits, Diode Clipping and Clamping circuits. BJT – Operating point, Analysis and design of Fixed bias circuit, Emitter stabilized bias circuit, Voltage divider bias circuit, Stability factor.

Self-study	V-I characteristics of CB, CC, CE configuration.
Text Book	Text Book 1: 1.6, 1.9, 2.8, 2.9, 3.3, 4.3,4.4,4.5

MODULE-2	**TRANSISTOR MODELING AND MULTI STAGE AMPLIFIER**	**25EEE42.2 25EEE42.6**	**9 Hours**

BJT transistor modeling- hybrid equivalent model, analysis using h – parameter model for CE configuration, CB and CC configuration using approximate hybrid model, Frequency Response of CE single stage amplifier, Need for cascading, Cascade and Cascade connection, Darlington connection.

Case Study	Analyzing the CE amplifier stage using re model.
Text Book	Text Book 1: 5.4, 5.5, 5.6,5.8,5.19

MODULE-3	**POWER AMPLIFIERS, FEEDBACK AMPLIFIER AND OSCILLATOR**	**25EEE42.3, 25EEE42.6**	**9 Hours**

Definitions and amplifier types - Transformer coupled Class A amplifiers, Class B amplifier circuits, Feedback concept, Effects of Negative Feedback, Feedback connection types, Barkhausen criterion, analysis and working of Phase shift Oscillator, Tuned Oscillator circuits, Crystal Oscillator.

Applications	Use of Crystal Oscillators and Power Amplifiers in Mobile Communication Systems
Text Book	Text Book 2: 13.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	**OPERATIONAL AMPLIFIERS**	**25EEE42.4 25EEE42.6**	**9 Hours**

Introduction, Block diagram and characteristics of an Op-amp. Inverting & non –inverting amplifier General Linear Applications: A.C. amplifier, summing, scaling & averaging amplifier, Instrumentation amplifier.

Self-study	Precision Rectifier.
Text Book	Text Book 3: 2.1, 2.7, 3.3-3.8

MODULE-5	**COMPARATORS & ACTIVE FILTERS**	**25EEE42.5 25EEE42.6**	**9 Hours**

Basic comparator, zero crossing detector, inverting Schmitt trigger circuit, Triangular Wave Generator, First order high pass & low pass filter.
Timer: Internal architecture of 555 timers, Mono stable multivibrator, Astable Multivibrator.

Case Study	Phase Locked Loop (PLL).
Text Book	Text Book 3: 8.2-8.4

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	5	5
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Robert L. Boylestad and Louis Nashelsky," Electronic Devices and Circuit Theory", PHI, 11th Edition, 2015. ISBN: 9332542600
2) David A.Bell "Electronics Devices and Circuits", , PHI, 5thEdition, 2008. ISBN: 019569340X
3) David A Bell, "Operational amplifiers and linear IC's", Oxford University Press, 2014, ISBN: 9780195696134

Reference Books:

1) Jacob Millman & Christos, C. Halkias, "Integrated Electronics", Tata-McGraw Hill, 2nd edition, 2010. ISBN:9780070151420
2) Thomas L Floyd, "Fundamentals of Analog Circuits", Pearson, 2nd edition, 2012, ISBN: 0130606197
3) S.Salivahanan, N.Suresh , "Electronic Devices and Circuits", McGrawHill, 3rdedition, 2013 ISBN: 978-0070660847
4) Christopher Siu, "Electronic Devices, Circuits, and Applications", Springer, 1st Edition, 2023. ISBN: 9783030805401.
5) S.Salivahanan, V S Kanchana, Bhasskaran, " Linear Integrated Circuits ", Mc Graw Hill, August 2018. ISBN: 9789351342885
6) James M. Fiore, "Operational Amplifiers & Linear Integrated Circuits Theory and Application", 3rd edition, 2024, ISBN: 0314908935

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106084
- https://nptel.ac.in/courses/108102112
- https://onlinecourses.nptel.ac.in/noc24_ee73
- https://edurev.in/electrical-engineering-exam/videos/analog-and-digital-electronics-9205
- https://www.ee.iitm.ac.in/vlsi/courses/ee5325_2018/start

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Studies
- Practical orientation on Design Thinking, Creativity & Innovation
- Practical activities / problem solving exercises

ANALOG ELECTRONICS AND INTEGRATED CIRCUITS LABORATORY

Course Code	**25EEL42**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEL42.1	Analyze rectifier, regulator, clipper and clamper circuits, and voltage regulators using semiconductor devices.
25EEL42.2	Evaluate performance of oscillator and amplifier circuits.
25EEL42.3	Implementation of operational amplifier circuits for specified applications.
25EEL42.4	Analyze the frequency response and gain characteristics of amplifier and filter circuits, and interpret the experimental results with theoretical concepts.

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Understanding of semiconductor devices, diode and transistor characteristics, operational amplifiers, and basic analog electronic circuits. • Use of laboratory instruments such as DC power supplies, function generators, digital multimeters, and Cathode Ray Oscilloscopes (CRO) along with basic circuit assembly and safety practices.	2	NA
	PART-A		
1	Implementation of Half-wave rectifiers with and without capacitor filter	2	25EEL42.1
2	Implementation of Full-wave rectifiers with and without capacitor filter	2	25EEL42.1
3	Implementation of clipper and clamper circuits	2	25EEL42.1
4	Implementation of series voltage regulator	2	25EEL42.1
5	Implementation of crystal oscillator	2	25EEL42.2
6	Implementation of RC coupled amplifier	2	25EEL42.2
	PART-B		
7	Implementation of Class B Push-Pull amplifier	2	25EEL42.2
8	Implementation of RC Phase Shift Oscillator	2	25EEL42.2
9	Implementation of op-amp as an (a) adder (b) subtractor	2	25EEL42.3
10	Analyze the frequency response of an op-amp amplifier under inverting and non-inverting configuration for a given gain	2	25EEL42.4
11	Schmitt trigger using an op-amp for desired Upper Trip Point (UTP) and Lower Trip Point (LTP)	2	25EEL42.3
12	Op-amp based first order Butterworth (a) low pass (b) band pass filters for a given cut off frequency/frequencies to verify the frequency response characteristics	2	25EEL42.3 25EEL42.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

5. Familiarisation with Oscilloscope and Function Generator
   https://aec-iitkgp.vlabs.ac.in/exp/oscilloscope/
6. Zener Diode-Voltage Regulator
   https://be-iitkgp.vlabs.ac.in/exp/voltage-regulator/
7. Studies on BJT CE Amplifier
   https://be-iitkgp.vlabs.ac.in/exp/ce-amplifier/
8. Study of Differentiator and Integrator using Operational Amplifier
   https://be-iitkgp.vlabs.ac.in/exp/operational-amplifier/
9. Characteristic parameters of Op-Amp
   https://ade2-iitr.vlabs.ac.in/exp/characteristic-parameters/

10. Monostable Multivibrator using IC 555
https://aec-iitkgp.vlabs.ac.in/exp/monostable-multivibrator/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	**-**	**-**
L2	**Understand**	-	-
L3	**Apply**	15	10
L4	**Analyze**	10	5
L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1) Robert Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Publisher: Pearson, Taylor & Francis group, 2013, ISBN978-0-13-262226-4

2) David A. Bell, "Electronic Devices and Circuits", Publisher: Oxford University Press, 2017, ISBN- 13:978-0-19-569340-9

3) D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuits", Publisher: New Age International (P) Limited, ISBN: 81-224-1470-2

MICROCONTROLLER AND EMBEDDED SYSTEMS			
Course Code	**25EEE43**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE43.1	Explain the philosophy, design process, and applications of embedded systems, and differentiate between microcontrollers and microprocessors with reference to 8051 architecture.
25EEE43.2	Apply addressing modes and the 8051-instruction set to develop assembly language programs for basic data transfer, arithmetic, logical, and control operations.
25EEE43.3	Implement Embedded C programs using timers, counters, serial communication, and interrupts for real-time applications.
25EEE43.4	Demonstrate microcontroller interfacing techniques with input/output devices and programmable peripheral interfaces for practical embedded applications.
25EEE43.5	Evaluate embedded system concepts withATMEGA328P for engineering applications.
25EEE43.6	Analyze and compare ARM architecture with 8051, and develop basic programs using ARM registers and instruction sets for modern embedded systems.

MODULE-1	**FUNDAMENTALS OF EMBEDDED SYSTEM AND INTRODUCTION TO MICROCONTROLLER 8051**	**25EEE43.1**	**9 Hours**

Introduction to Embedded Systems - Philosophy, Embedded Systems, Embedded Design and Development Process – Applications – Microcontroller - Microprocessor - Von-Neumann and Harvard Architecture – RISC & CISC - 8051 Block Diagram-Pin Diagram- Internal Data Memory, External Memory Access.

Applications	Create a table of at least 10 diverse embedded applications and for each, note the microcontroller/ microprocessor family commonly used.
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	**8051 ASSEMBLY LANGUAGE PROGRAMMING**	**25EEE43.2**	**9 Hours**

Assembly Language Programming – Addressing Modes, Instruction set: Data Transfer, Arithmetic and Logical Instructions, Branching and Looping Instructions- Programming.

Self-study	Program to toggle an LED connected to a port pin.
Text Book	Text Book 1: 3.1,3.2,3.3 Text Book 2: 3,4,5

MODULE-3	**EMBEDDED C PROGRAMMING**	**25EEE43.3**	**9 Hours**

Introduction to Embedded C Programming – Timer/Counter Registers-Modes of operation-Timer/Counter Programming, Basics of serial communication- Serial Communication Registers Programming-Types of Interrupts – Programming.

Case study	UART based serial communication
Text Book	Text Book 1: 4.1,4.2 Text Book 2:6,7

MODULE-4	**MICROCONTROLLER INTERFACING**	**25EEE43.4, 25EEE43.5**	**9 Hours**

Input Device Interfacing- Output Device Interfacing - Communication Interfacing - 8255 Programmable Peripheral Interface -Programming.

Self-study	Interfacing of 8051 is commonly uses in academic and hobbyist robotics projects for motor control and sensor integration.
Text Book	Text Book 1: 12.1, 12.2, 13.1,13.2,13.3, 15.1,15.2 Text Book 2: 8,9

MODULE-5	**ARM ARCHITECTURE AND PROGRAMMING FUNDAMENTALS**	**25EEE43.6**	**9 Hours**

Introduction to ARM Architecture – History and evolution of ARM Processors, Application in embedded systems, ARM Cortex Family – Registers and Instruction Set basics

Self-study	Compare 8051 vs ARM Cortex-M in terms of speed, power, and applications
Text Book	Text Book 3: 1.6, 2.4

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	5	-	-
L3	Apply	10	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) The 8051 Microcontroller and Embedded Systems – using assembly and C, Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, 2nd Edition, 2007, Pearson Education. ISBN: 9788131710265.
2) The 8051 Microcontroller & Embedded Systems Using Assembly and C with CD, Kenneth Ayala, 1st Edition, 2010, Cengage Learning, India. ISBN: 9788131511053 39.
3) Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 8)

Reference Books:

1) Microprocessors Principles and Applications, Ajit Pal, Kindle Edition, 30 August 2011, Tata McGraw Hill. ISBN: 9788120343924.
2) Microprocessors and interfacing: Programming and Hardware, Douglas V. Hall, Second Edition 2006, McGraw Hill Inc. ISBN: 9780070601673.
3) 8051 Microcontroller: An Application Based Introduction, David Calcutt, Fred Hassan, Newness, 2008. ISBN: 9780750657594
4) The 8051 Microcontroller, Dr. K. Uma Rao, 1 January 2010, Pearson Education. ISBN: 9788131732526.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/117104072
- https://sripc.edu.in/data/uploads/eee/Notes/5%20Sem/5%20MC.pdf
- https://www.researchgate.net/publication/359502443_Study_of_arduino_microcontroller_board
- https://universe.bits-pilani.ac.in/uploads/EEE_G512_324.pdf
- https://ieeexplore.ieee.org/document/6402096

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Design-Based Learning Projects
- Design Count button presses and displays them via Serial Monitor or LEDs.
- Pairing activities with mini-reports or demo presentations
- Video demonstration of latest trends in industry applications

MICROCONTROLLER AND EMBEDDED SYSTEMS LABORATORY			
Course Code	**25EEL43**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEL43.1	Apply 8051 microcontroller assembly language programs for basic operations on the memories
25EEL43.2	Use SFRs, delay subroutine to write 8051 microcontroller assembly language programs for data processing
25EEL43.3	Analyze embedded C program to the 8051 microcontroller to an external world
25EEL43.4	Provide solution for 8051 to work with external devices for DAC, Stepper motor control, DC motor control, LCD and Keyboard

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to 8051 Microcontroller architecture (Block diagram, pin diagram, memory organization, I/O Ports, Registers, instruction set etc.)	2	NA
	PART-A		
1	Study of data transfer and data manipulation instructions, loop operation (block data movement, sorting, exchanging, finding largest element in an array)	2	25EEL43.1
2	To write an ALP for Arithmetic instructions: Addition, subtraction, multiplication and division. Square and cubeoperationsfor16-bitnumbers.	2	25EEL43.1 25EEL43.2
3	To write an ALP for Boolean and logical instructions(bit manipulation)	2	25EEL43.1 25EEL43.2
4	To write an ALP for Conditional call and return instructions	2	25EEL43.1
5	To write an ALP for code conversion programs: ASCII to decimal, Decimal to ASCII, Hexa to decimal and Decimal to Hexa	2	25EEL43.1 25EEL43.2
6	To write an ALP for delay operations	2	25EEL43.1 25EEL43.2
	PART-B		
7	To write an ALP and C Program using serial port and on-chip timer	2	25EEE351.3, 25EEE351.4
8	To write an ALP and C Program: 8051Interfacing with DC motor	2	25EEE351.3, 25EEE351.4
9	To write an ALP and C Program: 8051Interfacing with stepper Motor	2	25EEE351.3, 25EEE351.4
10	To write an ALP and C Program: 8051 Interfacing: LCD	2	25EEE351.3, 25EEE351.4
11	To write an ALP and C program to interface a 16×2 LCD with the 8051 microcontroller and display messages or data	2	25EEE351.3, 25EEE351.4
12	To study and implement a traffic light control system using an 8051 microcontroller	2	25EEE351.3, 25EEE351.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

http://ebootathon.com/labs/beta/ec/MicroprocessorAndMicrocontrollerLab/exp1/simulation.html

https://esd-iitr.vlabs.ac.in/Objective.html4

http://vlabs.iitkgp.ac.in/rtes/

https://esd-coep.vlabs.ac.in/exp/delay-generation-effect/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	**-**	**-**
L2	**Understand**	**-**	-
L3	**Apply**	**15**	10
L4	**Analyze**	**10**	5
L5	**Evaluate**	**5**	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1) The 8051 Microcontroller and Embedded Systems – using assembly and C, Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D.McKinlay, 2nd Edition, 2007, Pearson Education. ISBN: 9788131710265.

2) The 8051 Microcontroller & Embedded Systems Using Assembly and C with CD, Kenneth Ayala, 1st Edition, 2010, Cengage Learning, India. ISBN: 9788131511053.

SYNCHRONOUS AND INDUCTION MACHINES			
Course Code	**25EEE44**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE44.1	Explain the operating principles and performance characteristics of three phase induction motor.
25EEE44.2	Identify appropriate starting and speed control technique(s) for three phase induction motors.
25EEE44.3	Analyze the starting mechanisms of single-phase induction motors for practical applications.
25EEE44.4	Design the winding layout and predetermine the regulation of synchronous generators using standard methods
25EEE44.5	Analyze the behaviour of synchronous motors and power factor correction techniques
25EEE44.6	Choose appropriate AC machines for real time applications.

MODULE-1	**THREE PHASE INDUCTION MACHINES**	**25EEE44.1, 25EEE44.6**	**9 Hours**

Concept of rotating magnetic field – Principle of operation – Construction – Types of rotors – Torque-Slip characteristics – Losses – Efficiency.

Self-study	Principal of a rotating magnetic field
Text Book	Text Book 1: 9.1, 9.2, 9.3, 9.4, 9.5 Text Book 2: 6.1, 6.2, 6.3

MODULE-2	**STARTING AND TESTING OF THREE-PHASE INDUCTION MOTOR**	**25EEE44.2, 25EEE44.6**	**9 Hours**

Necessity of starter - Types of starters- Speed control methods- No load and blocked rotor tests - brake test- Circle diagram - Cogging and Crawling.

Self- Study	Speed control methods
Text Book	Text Book 1: 9.6, 9.7, 9.8, 9.9, 9.10 Text Book 2: 6.4, 6.5, 6.6

MODULE-3	**SINGLE-PHASE INDUCTION MOTOR**	**25EEE44.3, 25EEE44.6**	**9 Hours**

Double revolving field theory - Principle of operation – Types - Split phase induction motors- Capacitor start motor - Capacitor start and run motor - Shaded pole motor - AC series motor - Applications.

Case study	Use of capacitor in series with the auxiliary winding to improve starting torque
Text Book	Text Book 1: 10.2 Text Book 2: 6.7, 6.8, 6.9

MODULE-4	**SYNCHRONOUS GENERATOR**	**25EEE44.4, 25EEE44.6**	**9 Hours**

Principle of operation- Construction - EMF equation - Armature reaction - Phasor diagram - Voltage regulation - EMF, MMF and ZPF methods - Parallel operation.

Self-study	Effect of armature current on main flux
Text Book	Text Book 1: 8.13, 8.14, 8.15, 8.16, 8.17 Text Book 2: 5.11, 5.12, 5.13

MODULE-5	**SYNCHRONOUS MOTOR**	**25EEE44.5, 25EEE44.6**	**9 Hours**

Principle of operation - Phasor diagram - V and inverted V curves - Starting Methods – Applications.

Self -Study	Applications of synchronous motor
Text Book	Text Book 1: 8.1, 8.2, 8.3, 8.4, 8.5 Text Book 2: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		**Marks Distribution**		
		Test (s)	**AAT1**	**AAT2**
		25	**15**	**10**
L1	**Remember**	-	-	-
L2	**Understand**	10	5	-

L3	**Apply**	5	5	5
L4	**Analyze**	5	5	5
L5	**Evaluate**	5	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	20
L2	**Understand**	-
L3	**Apply**	10
L4	**Analyze**	10
L5	**Evaluate**	10
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1) Electric Machines, D. P. Kothari and I. J. Nagrath, Tata McGraw Hill Education, 5th Edition, 2017. ISBN-10: 935260640X, ISBN-13: 978-9352606405
2) Electric Machinery, P. S. Bhimbra, Khanna publications, 7th Edition, 2015. ISBN: 978-81-7409-152-9

Reference Books:

1) Electrical Machines, S.K. Bhattacharya, McGraw Hill Education, 4th Edition, 2017. ISBN-10: 9332902852, ISBN-13: 978-9332902855
2) Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662
3) Electrical Machines, R. K. Rajput, Laxmi Publication, 6th Edition, 2018. ISBN: 9788131804469
4) Electric Machinery, Fitzgerald & Kingsley's, Stephen Umans, McGraw Hill Education; 7th edition, 2014. ISBN10: 0073380466, ISBN13: 9780073380469
5) A Course in Electrical Technology-II, J.B. Gupta, S. K. Kataria and Sons, 14th Edition, 2017. ISBN-10 : 9350144158, ISBN-13: 978-9350144152

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_ee13/preview
- https://electrical-engineering-portal.com/academy/courses/electrical-machines-dc-synchronous-induction-transformers
- https://www.beeindia.gov.in/sites/default/files/3Ch2.pdf
- https://electrical-engineering-portal.com/resources/knowledge/induction-machines
- https://standards.ieee.org/ieee/1349/10559/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to any electrical machines manufacturing industry or any power plant
- Demonstration of working of induction machines
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Seminars on applications of AC motors in industry

SYNCHRONOUS AND INDUCTION MACHINES LABORATORY

Course Code	**25EEL44**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEL44.1	Investigate various speed control techniques of induction motors
25EEL44.2	Evaluate the performance of induction and synchronous machines
25EEL44.3	Analyze load sharing among different alternators
25EEL44.4	Choose a suitable starter for various applications

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to Synchronous and Induction Machines	2	NA
	PART-A		
1	Load test on single phase induction motor	2	25EEL44.2
2	No load and Blocked rotor tests on single phase Induction motor	2	25EEL44.2
3	Load test on three phase induction motor	2	25EEL44.2
4	No load and Blocked rotor tests on three phase squirrel cage Induction motor	2	25EEL44.2
5	Speed control of three phase slip-ring induction motor	2	25EEL44.1
6	Study of starters: DOL and Star-Delta starters	2	25EEL44.4
	PART-B		
7	Regulation of three phase alternator by EMF Method	2	25EEL44.2
8	Regulation of three phase alternator by MMF Method	2	25EEL44.2
9	Regulation of three phase alternator by ZPF Method	2	25EEL44.2
10	Slip test and determination of regulation on Salient pole synchronous machine	2	25EEL44.2
11	Parallel operation of alternators	2	25EEL44.3
12	V and Inverted V curves of a synchronous motor	2	25EEL44.3

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Speed control slip-ring induction motor
   https://ems-iitr.vlabs.ac.in/exp/speed-control-slip-ring/
2. Familiarization of Lab Equipments
   https://ems-iitr.vlabs.ac.in/exp/lab-equipment-familiarization/
3. Synchronous motor
   https://em-coep.vlabs.ac.in/exp/synchronous-motor/
4. Blocked rotor test on induction motor
   https://em-coep.vlabs.ac.in/exp/blocked-rotor-test-induction-motor/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	-	-
L2	**Understand**	-	-
L3	**Apply**	15	10
L4	**Analyze**	10	5

L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	15
L4	**Analyze**	15
L5	**Evaluate**	20
L6	**Create**	-

Suggested Learning Resources:

Reference Books:

1) Electric Machines, D. P. Kothari and I. J. Nagrath, Tata McGraw Hill Education, 5th Edition, 2017. ISBN-10: 935260640X, ISBN-13: 978-9352606405
2) Electric Machinery, P. S. Bhimbra, Khanna publications, 7th Edition, 2015. ISBN: 978-81-7409-152-9
3) Electrical Machines, S.K. Bhattacharya, McGraw Hill Education, 4th Edition, 2017. ISBN-10: 9332902852, ISBN-13: 978-9332902855
4) Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662
5) Electrical Machines, R. K. Rajput, Laxmi Publication, 6th Edition, 2018. ISBN: 9788131804469
6) Electric Machinery, Fitzgerald & Kingsley's, Stephen Umans, McGraw Hill Education; 7th edition, 2014. ISBN10: 0073380466, ISBN13: 9780073380469
7) A Course in Electrical Technology-II, J.B. Gupta, S. K. Kataria and Sons, 14th Edition, 2017. ISBN-10 : 9350144158, ISBN-13: 978-9350144152
8) http://www.nptel.ac.in/

25EEE45X- PROFESSIONAL ELECTIVE COURSE-I

ELECTROMAGNETIC FIELD THEORY			
Course Code	**25EEE451**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE451.1	Understand the basic concepts of electrostatics and magneto statics
25EEE451.2	Analyze electric potential, energy density and boundary condition in conductors and dielectrics
25EEE451.3	Apply Poisson's, Laplace Equations and integral theorems in evaluating steady magnetic fields
25EEE451.4	Evaluate the behaviour of magnetic materials under different conditions
25EEE451.5	Interpret the Faraday's law, Displacement current, Maxwell's equations
25EEE451.6	Examine the basic concepts of electromagnetic waves and characterizing parameters

MODULE-1	**VECTOR ANALYSIS AND ELECTROSTATICS**	**25EEE451.1**	**9 Hours**

Scalars and Vectors, Vector algebra, Cartesian co-ordinate system, Vector Components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems. Numerical.
Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Numerical.

Self-study	Numerical on vector analysis
Text Book	Text Book 1: Chapter 1, 2, 3 Text book 2: Chapter 4,5,6(part –2)

MODULE-2	**ENERGY AND POTENTIAL, CONDUCTOR AND DIELECTRICS**	**25EEE451.2**	**9 Hours**

Energy expended in moving a point charge in an electric field. The line integral. Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient. The dipole. Energy density in the electrostatic field. Numerical. Current and current density. Continuity of current. Metallic conductors, conductor's properties and boundary conditions. Perfect dielectric materials, capacitance calculations. Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates. Numerical.

Self-study	Numerical problems related to energy and potential difference in electric field
Text Book	Text Book 1: Chapter 4, 5

MODULE-3	**POISSON'S AND LAPLACE EQUATIONS AND STEADY MAGNETIC FIELDS**	**25EEE451.3**	**9 Hours**

Derivations and problems, Uniqueness theorem. Laplacian Operator Poisson's and Laplace's equations Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Numerical.

Self-study	Review derivations of magnetic field due to simple current distributions
Text Book	Text Book 1: Chapter 7, 8

MODULE-4	**MAGNETIC FORCES AND MAGNETIC MATERIALS AND MAGNETISM**	**25EEE451.4**	**9 Hours**

Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Numerical. Nature of magnetic materials, magnetization and permeability. Magnetic boundary conditions. Magnetic circuit, inductance and mutual inductance. Numerical.

Case study	Study of magnetic materials

Text Book	Text Book 1: Chapter 9		
MODULE-5	**TIME VARYING FIELDS AND MAXWELL'S EQUATIONS AND UNIFORM PLANE WAVE**	**25EEE451.5, 25EEE451.6**	**9 Hours**
Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Numerical. Electromagnetic radiation: near field—non-radiative and radiative, far field. Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect. Numerical.			
Self- study	Numerical problems involving displacement currents		
Text Book	Text Book 1: Chapter 10, 11 Text book 2: Chapter 9,10(part –4)		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Engineering Electromagnetics William H Hayt et al McGraw Hill 8th Edition, 2017, ISBN:978-007-33-80-667
2) Principles of Electromagnetics Matthew N. O. Sadiku Oxford 6th Edition, 2015, ISBN: 978-01-99-46-18-51

Reference books:

1) Fundamentals of Engineering Electromagnetics David K. Cheng Pearson 2014 , ISBN**:** 978-9332535138
2) Electromagnetism -Theory (Volume -1) -Applications (Volume-2) Ashutosh Pramanik PHI Learning 2014, ISBN: 978-8120348882
3) Electromagnetic Field Theory Fundamentals, Bhag Guru et al, Cambridge, 2009, ISBN: 978-0521116022 Electromagnetic Field Theory Rohit Khurana Vikas Publishing 1st Edition,2014 , ISBN:978-9325978584

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/104/108104087/
- https://archive.nptel.ac.in/courses/108/106/108106073/
- https://nptel.ac.in/courses/115101005

- **Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning**
  Simulation of Field Patterns (Using MATLAB/COMSOL/Ansys Maxwell)
- Vector Field Mapping Activity (Whiteboard/Chart)
- Seminars on magnetic materials

PRINCIPLES OF COMMUNICATION SYSTEMS			
Course Code	**25EEE452**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE452.1	Compare the Generation and Detection of Analog modulation techniques
25EEE452.2	Evaluate the Power consumption and Bandwidth utilization in Analog modulation techniques
25EEE452.3	Examine the statistical averages associated with random processes
25EEE452.4	Apply the fundamentals of digital Communication for baseband signal processing and coding
25EEE452.5	Categorize digital modulation techniques based on Bit Error Rate performance
25EEE452.6	Estimate the signal in presence of noise by appropriate receiver design

MODULE-1	**ANALOG MODULATION**	**25EEE452.1, 25EEE452.2**	**9 Hours**
Introduction, Amplitude Modulation, Double side band-suppressed carrier modulation, Quadrature Carrier Multiplexing, Single-sideband modulation, VSB Modulation, Theme Example: VSB Transmission of Analog and Digital Television, Frequency Translation, Frequency- Division Multiplexing. Phase and Frequency modulation: Basic definitions, Frequency Modulation, Phase–Locked Loop.			
Applications	Investigate the applications of AM and FM in today's Communication scenario		
Text Book	Text Book 1: 3.1-3.8, 4.1 – 4.4		
MODULE-2	**RANDOM VARIABLES AND PROCESSES**	**25EEE452.3**	**9 Hours**
Introduction, Probability, Random variables, Statistical averages, Random processes, Mean, correlation, and Covariance functions. Power spectral density, Gaussian process, Noise, Narrowband noise.			
Self-study	Investigate the effect of noise in Communication Systems and methods to tackle it.		
Text Book	Text Book 1: 5.1 – 5.6, 5.8 – 5.11		
MODULE-3	**SAMPLING PROCESS AND WAVEFORM CODING TECHNIQUES**	**25EEE452.4**	**9 Hours**
Sampling Theorem, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, Practical aspects of sampling and signal recovery, Pulse Amplitude Modulation, Time Division Multiplexing. Pulse code modulation, Quantization noise and Signal-to-noise ratio, Robust quantization, Differential PCM, Delta modulation.			
Self-study	Explore the uses of analog-to-digital conversion in current Digital Systems.		
Text Book	Text Book 2: 4.1 – 4.3,4.5-4.7, 5.1,5.3-5.6		
MODULE-4	**DIGITAL MODULATION TECHNIQUES**	**25EEE452.5**	**9 Hours**
Digital Modulation formats, Coherent binary modulation techniques- Coherent Binary PSK, Coherent Binary FSK, Coherent quadrature modulation techniques-Quadri phase-shift keying, Noncoherent binary modulation techniques-Differential PSK.			
Self-study	Explore the applications of digital modulation techniques in today's Communication scenario.		
Text Book	Text Book 2: 7.1 – 7.2, 7.3 (1), 7.4 (2)		
MODULE-5	**DETECTION AND ESTIMATION**	**25EEE452.6**	**9 Hours**
Model of Digital Communication System, Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input, Detection of known signals in noise, correlation receiver, matched filter receiver. Estimation: concepts and criteria, Maximum Likelihood Estimation.			
Case Study	Survey on the different detection techniques used in existing Communication Systems.		
Text Book	Text Book 2: 3.1–3.5,3.7-3.8, 3.10 ,3.11		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	20
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Communications Systems, 5th Edition, Simon Haykin, Michael Moher, Publisher: WILEY India Pvt. Ltd, 2019 ISBN: 978-81-265-2151-7
2) Digital Communications, Simon Haykin, Publisher: WILEY India Pvt. Ltd, 2006, ISBN-10 : 8126508248, ISBN- 13 : 978-8126508242

Reference Books:

1) Digital Communication System, Simon Haykin, 2021, John Wiley India Pvt. Ltd., ISBN: 978-9354242465
2) Modern digital and analog Communication systems, B. P. Lathi, 3rd edition, 2015, Oxford University Press, ISBN:978-0195110098 Electronic communication systems, Kennedy and Davis, 5th edition, 2011, TMH, ISBN:978-0071077828

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc25_ee68/preview
- https://www.tutorialspoint.com/principles_of_communication/index.htm
- https://www.eeeguide.com/principles-of-communication-systems/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to any communication-based company/public sector enterprise.
- Simulation demonstration on modulation processes.
- Video demonstration of latest trends in communication sector.
- Seminar on applications of digital modulation techniques in today's Communication scenario.

UTILIZATION OF ELECTRICAL ENERGY			
Course Code	**25EEE453**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE453.1	Understand the working of electric heating and welding systems
25EEE453.2	Identify the different lighting system for various requirement
25EEE453.3	Analyze the concept of Electric Drives and Traction systems
25EEE453.4	Examine the performance of refrigeration and air conditioning systems and propose improvements for efficiency.
25EEE453.5	Analyze the impact of energy conservation strategies and evaluate effective energy management practices.
25EEE453.6	Evaluate energy storage technologies and recommend appropriate solutions for industrial energy conservation and efficient energy utilization.

MODULE-1	**ELECTRIC HEATING & WELDING**	**25EEE453.1**	**9 Hours**
Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding			
Self-study	Importance of electric heating in industrial processes		
Text Book	Text Book 1: 7.1, 7.2, 7.4, 7.5, 7.6,7.9,7.12 Text Book 2: 4.15,4.18		
MODULE-2	**ILLUMINATION**	**25EEE452.2**	**9 Hours**
Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED			
Applications	Applications in industries		
Text Book	Text Book 1: , 1.1, 1.2, 1.3,1.4,1.5,1.5,1.6,1.7		
MODULE-3	**ELECTRIC DRIVES AND TRACTION**	**25EEE453.3**	**9 Hours**
Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear			
Case study	Selection, performance and control of electric traction motors in metro rail systems		
Text Book	Text Book 1: 6.1 ,6.2,6.3,6.4,6.5,6.6 Text Book 2: 1.4, 1.7		
MODULE-4	**REFRIGERATION AND AIR CONDITIONING**	**25EEE452.4**	**9 Hours**
Refrigeration Systems – Refrigerants – Types of Refrigeration Systems – Electrical Circuit of a Domestic Refrigerator – Trouble shooting of Refrigerator. Air Conditioning Systems – Types - Electrical circuit of window and Central Air Conditioning Systems			
Self-Study	Applications using different connection in three phase transformers.		
Text Book	Text Book 1: 4.1,4.2,4.3,4.4,4.5 Text Book 2: 1.12, 1.14		
MODULE-5	**ENERGY CONSERVATION AND STORAGE**	**25EEE452.5, 25EEE452.6**	**9 Hours**
Importance of energy conservation, Energy management techniques, General Comparison of Private Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses, Choice of Voltage, Power Factor Improvement, Improvement of Load Factor, Energy storage systems – batteries, flywheels, supercapacitors.			
Self-study	Industrial energy conservation Techniques.		
Text Book	Text Book 1: 9.1, 9.2, 9.3, 9.4. Text Book 2: 1.18		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels	**Marks Distribution**		
	Test (s)	**AAT1**	**AAT2**
	25	**15**	**10**

L1	**Remember**	-	**-**	**-**
L2	**Understand**	5	**-**	**-**
L3	**Apply**	10	5	5
L4	**Analyze**	5	5	5
L5	**Evaluate**	5	5	**-**
L6	**Create**	-	**-**	**-**

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	--
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	10
L5	**Evaluate**	10
L6	**Create**	--

Suggested Learning Resources:

Text Books:

1) Utilization of Electrical Power, R.K.Rajput, Laxmi Publications Pvt. Ltd., Kolkata , 3rd Edition, 2023, ISBN: 978-81-318-0829-0
2) Generation, Distribution and Utilization of Electrical Energy, C. L. Wadhwa, New Age International, 4th Edition, 2017. ISBN-13: 978-9386418395

Reference Books:

1) Utilization of Electric Power : Including Electric Drives and Electric Traction, N.V. Suryanarayana, New Age International Publishers, Second Edition, 2014 , ISBN : 978-8122405460
2) Utilization of Electric Power and Electric Traction, J.B. Gupta, S.K.Kataria and Sons, Eleventh Edition 2015, ISBN :978-9350142589.
3) Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009, ISBN :978-817371700

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc25_ee68/preview
- https://www.tutorialspoint.com/principles_of_communication/index.htm
- https://www.eeeguide.com/principles-of-communication-systems/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Compare electric heating methods (resistance, arc, induction) using simulation tools like MATLAB/Simulink or real components.
- Choose suitable motors and control methods for speed/torque control
- Encourage Students to prepare a presentation on energy efficiency, speed control, and braking in traction systems.

OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code	**25EEE454**	**Credits**	**03**
L:T:P:S	**2:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30 + 30**	**SEE Marks**	**50**
TW & SL / Sem	**30**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE454.1	Apply object-oriented concepts including classes, objects, methods, and I/O operations in Java, to develop programs that produce correct outputs under given problem specifications.
25EEE454.2	Analyze and implement inheritance, polymorphism, interfaces, and packages, to build modular Java programs for different programming scenarios.
25EEE454.3	Construct programs using control structures, arrays, and file handling in Java, to achieve efficient data processing and storage operations.
25EEE454.4	Evaluate object-oriented features, to enhance program structure, reusability, and maintainability in software development.
25EEE454.5	Utilize exception handling mechanisms in Java, to ensure reliable program execution under various runtime conditions.
25EEE454.6	Implement graphical user interface applications using Java Swing, to generate interactive applications with functional user interfaces under given requirements.

MODULE-1	**INTRODUCTION TO JAVA**	**25EEE454.1 25EEE454.3**	**(6 + 6) Hours**

Introduction to Java:

Basics and Overview of Java programming, - "Hello, World" Program, Compiling and Running a Java Program, Data types, Variables, Operators, Control structures including selection, Looping, Math class, Arrays in Java.

Laboratory Component:

1. Develop a JAVA program to demonstrate selection statements.
2. Develop a JAVA program to demonstrate looping statement.
3. Develop a JAVA program to demonstrate math class.

Applications	Develop a menu-driven calculator using control structures and looping statements to perform basic arithmetic operations.
Text Book	Text Book 1: 1.1–1.11, 2.1–2.8, 3.1–3.10, 7.2 Text Book 2: 1.1–1.7, 3.1–3.8, 4.2

MODULE-2	**OBJECTS, CLASSES AND CONTRUCTORS**	**25EEE454.1**	**(6 + 6) Hours**

Working with Objects, Implementing Classes, Object Construction, Static Variables and Methods, Overloading, Constructors: Visibility modifiers, Methods and Objects, Inbuilt classes like String, Character, String Buffer, 'this' reference, nested classes.

Laboratory Component:

1. Develop a JAVA program to demonstrate static variables and methods.
2. Develop a JAVA program to demonstrate method overloading.
3. Develop a JAVA program to demonstrate class and constructors.

Applications	Develop a student class to demonstrate object creation, constructors, static members, and method implementation for managing student details.
Text Book	Text Book 1: 6.1–6.14, 7.1–7.4 Text Book 2: 4.1–4.9, 5.1, 3.6–3.8, 6.9

MODULE-3	**INHERITANCE, INTERFACE AND PACKAGES**	**25EEE454.2 25EEE454.4**	**(6 + 6) Hours**

Inheritance, Interface and Package:

Inheritance and types, Base and Derived classes, Overriding, Polymorphism, Dynamic Binding, Casting objects, super(), final-keyword and method, finalize, Abstract class, Interface, Package.

Laboratory Component:

1. Develop a JAVA program to implement single inheritance.
2. Develop a JAVA program to demonstrate use of method overriding.
3. Develop a JAVA program to demonstrate the use of implementing interfaces.

Case Study	Design and Implementation of a Student Management System using Inheritance and Interface-Based Architecture.		
Text Book	Text Book 1: 8.1–8.10, 9.1–9.10, 10.7 Text Book 2: 5.1–5.10, 6.1–6.5		
MODULE-4	**EXCEPTION HANDLING AND FILES**	**25EEE454.3 25EEE454.5**	**(6 + 6) Hours**
Exception Handling: Exception Types, Uncaught Exceptions, Using try and catch block, Multiple catch clauses, Nested try statements, throw, throws, finally, Java's Built-in Exceptions and User defined Exceptions. I/O Basics &Files: Reading input, Writing output - Reading and Writing files.			
Laboratory Component: 1. Develop a JAVA program to implement the concept of Exception Handling using predefined exception. 2. Develop a JAVA program to implement the concept of Exception Handling by creating user defined exceptions 3. Develop a JAVA program to demonstrate File I/O Operations.			
Self-study	Study of File-Based Student Record Management System with Exception Handling mechanisms.		
Text Book	Text Book 1: 10.1–10.11, 13.1–13.10 Text Book 2: 7.1–7.8, 11.1–11.5		
MODULE-5	**MULTITHREADING AND JAVA SWING**	**25EEE454.2, 25EEE454.6**	**(6 + 6) Hours**
Threads: Java Thread Model, Main Thread, Thread Life Cycle- Creating a Thread, Running, Suspending, Resuming and Stopping Threads, Creating Multiple Threads, Thread Priorities, Synchronization. Java Swing: JFrame, JButton, JLabel, JTextField, JRadioButton, JTable, Jlist, JOptionPane, JScrollBar, JCheckBox.			
Laboratory Component: 1. Develop a JAVA program to implement multithreading. 2. Develop a JAVA program to add a label and button in a frame. 3. Develop a JAVA program to create a table and show some data.			
Applications	Develop a simple GUI-based button counter using Java Swing and basic thread execution.		
Text Book	Text Book 1: 11.1–11.13, 14.1–14.11 Text Book 2: 14.1–14.7, 9.1–9.9		

CIE Assessment Pattern (50 Marks – Theory and Lab) –

RBT Levels		Marks Distribution		
		Test (s)	AAT	Lab
		25	05	20
L1	Remember	-	-	-
L2	Understand	5	-	5
L3	Apply	10	2.5	5
L4	Analyze	5	2.5	5
L5	Evaluate	5	-	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Text Books:

1) Herbert Schildt, "Java: The Complete Reference", McGraw Hill Education, 12th Edition, 2021, ISBN: 978-1260463416.
2) Cay S. Horstmann, "Core Java Volume I – Fundamentals", Pearson Education, 12th Edition, 2021, ISBN: 978-0135166301.

Reference Books:

1) Paul Deitel, Harvey Deitel, "Java: How to Program", Pearson Education, 12th Edition, 2021, ISBN: 978-0134743350.
2) Y. Daniel Liang, "Introduction to Java Programming and Data Structures", Pearson, 12th Edition, 2022, ISBN: 978-0136520232.
3) Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java", O'Reilly Media, 3rd Edition, 2022, ISBN: 978-1491910771.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs36
- https://java-programming.mooc.fi/part-1
- https://www.coursera.org/specializations/programming-python-java
- https://www.youtube.com/watch?v=yRpLlJmRo2w&t=18s
- https://www.coursera.org/learn/java-for-programming-beginners

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Experiential learning approach through lab sessions
- Code Debugging and Review Activity
- Code Completion (Fill-in-the-Blanks)
- Error Prediction Before Execution
- GUI Enhancement Activity

MACHINE LEARNING FUNDAMENTALS			
Course Code	**25EEE455**	**Credits**	**03**
L:T:P:S	**3:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**45**	**SEE Marks**	**50**
TW & SL / Sem	**45**	**Total Marks**	**100**
Total Hours /Sem	**90**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE455.1	Understand the basics of machine learning
25EEE455.2	Apply the different learning algorithms for prediction
25EEE455.3	Develop skills to analyze and evaluate the performance of machine learning models using appropriate metrics and techniques.
25EEE455.4	Analyse a model to solve classification /clustering problems using supervised or unsupervised machine learning algorithms.
25EEE455.5	Evaluate the performance of various machine learning algorithms using different real world data sets.
25EEE455.6	Apply ML algorithms for solving practical applications related to electrical and electronics engineering

MODULE-1	**INTRODUCTION TO MACHINE LEARNING**	**25EEE455.1**	**9 Hours**

Introductions to Machine Learning: Terminologies in machine learning, Applications, Types of machine learning: supervised, unsupervised, semi-supervised learning, Reinforcement Learning. Features: Types of Data (Qualitative and Quantitative), Scales of Measurement (Nominal, Ordinal, Interval, Ratio), Concept of Feature, Feature construction, Feature Selection and Transformation, Curse of Dimensionality. Linear discriminate Analysis (LDA).

case-study	ML applications in real world
Text Book	Text Book 1: 1.1, 1.2, 1.6

MODULE-2	**SUPERVISED LEARNING**	**25EEE455.2 25EEE455.3**	**9 Hours**

Binary Classification: Linear Classification model, Performance Evaluation-Confusion Matrix, Accuracy, Precision, Recall, ROC Curves, F-Measure. Support Vector Machines-Large margin classifiers, Nonlinear SVM, kernel Functions. Multi-class Classification: Model, Performance Evaluation Metrics – Multiclass Classification Techniques-One vs. One, One vs. Rest, Decision Trees: Concept sand Terminologies, Classification and Regression Tree (CART). Regression: Introduction, Univariate Regression – Least-Square Method, Model Representation, Cost Functions: MSE, MAE, R-Square, Performance Evaluation, Estimating the values of the regression coefficients.

Self-Study	Understand the Linear Algebra and Calculus: concepts like vectors, matrices, derivatives, and gradients.
Text Book	Text Book 1: Ch 2, Text Book 2: 3.1,3.2,3.3,6.3,8.2

MODULE-3	**UNSUPERVISED LEARNING**	**25EEE455.3 25EEE455.5**	**9 Hours**

Distance Based Models: Distance Metrics (Euclidean, Manhattan, Hamming, Minkowski Distance Metric), Clustering as Learning task: K-means clustering Algorithm-with example, k-medoid algorithm with example. Principal Component analysis (PCA).

Self-study	Implement K-means on Iris data set
Text Book	Text Book 2: 6.12

MODULE-4	**TRENDS IN MACHINE LEARNING**	**25EEE455.4**	**9 Hours**

Ensemble Learning- Combining Multiple models, bagging, boosting, stacking-Algorithms-Random Forest, ada-boost. Introduction to Reinforcement Learning –Exploration, exploitation, rewards, penalties

Self-study	Recent trends in machine learning
Text Book	Text Book 1: 17, Text book 2: Ch 13

MODULE-5	**APPLICATIONS OF MACHINE LEARNING**	**25EEE455.5 25EEE455.6**	**9 Hours**

. Machine learning applications to electrical engineering: Electrical load forecasting, wind and solar energy forecasting, fault identification and classification, reinforcement learning for control, Image classification and segmentation, smart grid applications.

Applications	Discuss how machine learning can contribute to energy efficiency and conservation efforts.
Text Book	Text book 3: 15

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	AAT1	AAT2
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	5	-
L3	Apply	5	5	10
L4	Analyze	5	5	-
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Introduction to Machine Learning, E. Alpaydin, PHI, 2005, ISBN: 978-8120350786
2) Machine Learning, Tom Mitchell, New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072
3) Machine Learning Algorithms and Applications in Engineering, P. Chaterjee, M.Yazdani, F F Navarro, JP Rodriguez, ISBN: 9780367569129

Reference Books:

1) Machine Learning, T. Mitchell, McGraw Hill, ISBN: 978-1259096952
2) Introduction to Machine Learning, Alex Smola, S.V.N. Vishwanathan, Cambridge University Press 2008, ISBN: 978-0521825830
3) Pattern Recognition and Machine Learning, Christopher Bishop, Springer, ISBN: 978-1493938438

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=dGNJ-feQLC4
- https://onlinecourses.nptel.ac.in/noc21_cs24/preview
- https://www.youtube.com/watch?v=NVUpLo1AFs8
- https://www.youtube.com/watch?v=My1_-ttLsfg&list=PLNZMKGYv14qLjeZyyoFIjvTZtEYZU0BVq

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- For active participation of students, instruct the students to read research topics on Machine Learning, Class Presentation.
- Seminar on applications of machine learning

25EEE46X -Ability Enhancement Course–IV

AUTOCAD FOR ELECTRICAL ENGINEERING			
Course Code	**25EEE461**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:
At the end of the course, the student will be able to:

25EEE461.1	Use various symbols and notations in electrical and electronics engineering drawings.
25EEE461.2	Analyze simple electrical circuits using Simulation software
25EEE461.3	Evaluate electronics circuits using Simulation software
25EEE461.4	Design a PCB layout for different electronic circuits

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	• Starting AUTOCAD for windows • Exploring workspace	2	NA
PART-A			
1	Basic procedure to be adopted for computer aided drawings of electrical circuits: R-L series, parallel circuit, R-C series, parallel circuit, R-L-C series, parallel circuit	2	25EEE461.1
2	Basic procedure to be adopted for computer aided drawings of electrical machines: Electrical machines – AC and DC, motor	2	25EEE461.1
3	Basic procedure to be adopted for computer aided drawings of windings: A.C. and D.C. winding diagrams	2	25EEE461.1
4	Basic procedure to be adopted for computer aided drawings of electronic components I: Resistor, Inductor, transformer and Capacitor	2	25EEE461.1
5	Basic procedure to be adopted for computer aided drawings of electronic components II: Semiconductor device Diodes, Zener diode, Transistors PNP/ NPN, MOSFET, IGBT, UJT.	2	25EEE461.1
6	Basic procedure to be adopted for computer aided drawings of electronic circuits: Half-wave, full-wave and bridge rectifier, Power amplifier and voltage amplifier	2	25EEE461.1
PART-B			
7	Simulation of electrical circuits - Series and parallel R-L circuit, Series and parallel R-C circuit, Series and parallel R-L-C circuit, Resonance in AC Circuit	2	25EEE461.2
8	Simulation of electrical machines - Electrical machines circuits: Graphics, Plot, sub plot, label, legend	2	25EEE461.2
9	Simulation of electronic circuit - Half wave, full wave and bridge rectifier, Power amplifier and voltage amplifier	2	25EEE461.3
10	Simulation of electronic circuits - Different types of oscillators circuits	2	25EEE461.3
11	Overview of software for PCB design, PCB layout of rectifier circuit	2	25EEE461.4
12	PCB layout of amplifier circuit	2	25EEE461.4

PART-C
Beyond Syllabus Virtual Lab Content (4 Hours)
(To be done during Lab but not to be included for CIE or SEE)

1. Electronics system Packing
   https://nptel.ac.in/courses/108108031
2. Sensor and sensor Design

https://www.classcentral.com/course/sensors-circuit-interface-12049

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	15	10
L4	Analyze	10	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) AutoCAD Electrical 2023 for Engineers and Designers by Sham Tickoo, Dream tech press, New Delhi, Latest edition, ISBN:987-9355513144
2) Mastering AutoCAD 2013 and AutoCAD LT 2013 by George Omura, Sybex, New Delhi, Latest edition, ISBN:978-1118174074

ADVANCED ARDUINO PROGRAMMING			
Course Code	**25EEE462**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE462.1	Understand and implement interfacing of basic input/output devices (digital and analog) with Arduino Mega, including LEDs, push buttons, buzzers, and potentiometers.
25EEE462.2	Develop programs for serial communication and control of actuators such as DC motors, servo motors using appropriate control techniques (PWM, H-bridge, etc.).
25EEE462.3	Analyze and interface various sensors (IR/LDR, smoke, DHT11, color sensor, ultrasonic) with Arduino to acquire real-world data and perform corresponding actions.
25EEE462.4	Design and implement complete embedded systems integrating sensors, actuators, and display devices (LCD, serial monitor) for real-time monitoring and control applications.

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	• Knowing basic programming concepts such as variables, data types, loops, and conditionals helps with learning Arduino programming. • Basic math skills, including arithmetic and algebra, aid in tasks like calculating resistor values and working with sensor data. • Developing logical thinking and problem-solving skills will aid in troubleshooting and writing efficient code.	2	NA
PART-A			
1	Interfacing digital input (pushbutton) and digital output devices (LED and buzzer) with the Arduino Mega and control the output based on input.	2	25EEE462.1
2	To read analog input from a potentiometer and generate analog output using PWM to vary LED brightness on the Arduino Mega.	2	25EEE462.1
3	Implementation of serial communication for sending and receiving characters between the Arduino Mega and a PC, and to read analog voltage and display it via serial monitor.	2	25EEE462.2
4	Speed and direction control of a DC motor using PWM signals and H-Bridge motor driver with the Arduino Mega.	2	25EEE462.2
5	To rotate a servo motor to specific angles using PWM signals generated by the Arduino Mega.	2	25EEE462.2
6	To design and implement automatic street light system	2	25EEE462.4
PART-B			
7	To interface Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED at sensor detection.	2	25EEE462.4
8	To interface smoke sensor with Arduino and write a program to turn on alarm when smoke is detected.	2	25EEE462.3
9	To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings.	2	25EEE462.3
10	To interface TCS3200 Color Sensor with Arduino to detect the colors and display the same.	2	25EEE462.3
11	Interfacing of an ultrasonic sensor (HC-SR04) with Arduino to measure the distance of an object and display the result on the serial monitor.	2	25EEE462.3
12	Interfacing a 16x2 character LCD with Arduino and display custom text or sensor data in real- time.	2	25EEE462.4
PART-C **Beyond Syllabus Virtual Lab Content (4 Hours)**			

(To be done during Lab but not to be included for CIE or SEE)

1. Ambient Light Sensor- https://docs.simuli.co/components/bh1721
2. Barometric Pressure and temperature sensor- https://docs.simuli.co/components/bmp180
3. Stepper motor driver- https://docs.simuli.co/components/drv8834
4. Real time weather and data collection- https://docs.simuli.co/arduino-projects/weather-data-thingspeak

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	Remember	-	-
L2	Understand	-	-
L3	Apply	10	15
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Reference Books:

1) "Programming Arduino: Getting Started with Sketches", Simon Monk, McGraw-Hill Education, Second Edition, 2016, ISBN-10: 1259641635; ISBN-13: 978-1259641633.
2) Arduino For Dummies, John Nussey, 1st Edition, Publisher: John Wiley & Sons; ISBN-10: 1118446372; ISBN-13: 978-1118446379.

PROGRAMMING USING RoboDK

Course Code	**25EEE463**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE463.1	Analyse the fundamentals of industrial robots and simulation environments.
25EEE463.2	Navigate and utilize the RoboDK interface for robot simulation.
25EEE463.3	Develop and simulate robot programs using RoboDK's built-in tools.
25EEE463.4	Assess robot programming skills to solve real-world industrial automation problems.

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Basic understanding of robotics concepts and potentially some programming experience with Python or C++	2	NA
	PART-A		
1	Introduction to RoboDK - Understand GUI, create new station, import robots and tools.	2	25EEE463.1
2	Practice on various I/O instructions	2	25EEE463.1, 25EEE463.2
3	Practice on Set/Wait, Branching Instructions and movement conversion	2	25EEE463.1, 25EEE463.2
4	Program to Pick and Place application	2	25EEE463.3
5	Program on Palletizing and depalletizing	2	25EEE463.3
6	Program on Collision Detection	2	25EEE463.3
	PART-B		
7	Program on testing, editing & touch up.	2	25EEE463.2
8	Program on using and setting up of User and tool frame.	2	25EEE463.2
9	Program on automated welding and spot welding.	2	25EEE463.4
10	Program on Deburring and Cutting	2	25EEE463.4
11	Robotic CNC or 3D printing simulation	2	25EEE463.4
12	Exporting & Testing Programs on Real Robots (if available).	2	25EEE463.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Laser Cutting
   https://robodk.com/doc/en/Example-Laser-Cutting.html#MET1Featex
2. Robot Machining
   https://robodk.com/doc/en/Example-3-Axis-Robot-Machining.html#PM3xSim

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	20
L1	**Remember**	-	-
L2	**Understand**	-	-
L3	**Apply**	15	10
L4	**Analyze**	10	5
L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

Suggested Learning Resources:

Reference Books:

1) RoboDK User Manual.
2) Robotics Technology and flexible automation, Deb S.R, Tata McGraw-Hill Education, 2nd Edition, 2017, ISBN-13: 978-1259004732.

Industrial Robotics, Technology Programming and Applications, Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, McGraw Hill, 2012, ISBN-13: 978-0071282118

PCB DESIGN LABORATORY

Course Code	**25EEE464**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE464.1	Understand the characteristics of electronic components and basic electronic instruments.
25EEE464.2	Analyze the circuits with PCB design and identify the various processes involved
25EEE464.3	Explain the fabrication of Printed Circuit Boards
25EEE464.4	Perform assembling and testing of the PCB based electronic circuits

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic concepts of Electronics	2	NA
	PART-A		
1	Study of Electronic Components	2	25EEE464.1
2	Study of Instruments and Equipment (DMM, Power supply, CRO, FG)	2	25EEE464.1
3	Introduction to Orcad Schematic entry / drawing, net listing, layering, component foot print library selection & designing, design rules,	2	25EEE464.2
4	Component placing: Manual & automatic, track routing: automatic & manual, rules: track length, angle, joint & size, Auto router setup. Design Rules.	2	25EEE464.2
5	Single side PCB Fabrication	2	25EEE464.2
	PART-B		
6	Design PCB Layout using ORCAD, PCB Design - Full wave Rectifier	2	25EEE464.3
7	Assembly and Testing - Full wave Rectifier	2	25EEE464.3
8	PCB Designing Practice: PCB Designing of Basic and Analog Electronic Circuits, PCB Designing of Power Supplies.	2	25EEE464.4
9	Post Designing & PCB Fabrication Process: Printing the Design, Etching, Drilling,	2	25EEE464.4
10	Interconnecting and Packaging electronic Circuits, Gerber Generation, Soldering and Desoldering, Component Mounting, PCB and Hardware Testing.	2	25EEE464.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. PCB design laboratory- https://fab-coep.vlabs.ac.in/exp/pcb-design-fabrication/
2. PCB design- https://www.rs-online.com/designspark/virtual-lab-project-pcb-design
3. Remote flying fish – https://www.rs-online.com/designspark/ch-7-diy-series-of-remote-flying-fish-pcb-design-schematic

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		30	**20**
L1	**Remember**	-	-
L2	**Understand**	-	-
L3	**Apply**	15	10

L4	**Analyze**	10	5
L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	**Remember**	-
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	-

Suggested Learning Resources:

Text Books:

1) Printed circuit board design, fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006, ISBN-10: 0070588147; ISBN-13: 978-0070588141
2) PCB: Design, Fabrication & Te: sting, R.S. Khandpur, McGraw Hill Education 2017, ISBN-13: 978-0070588141

Reference Books:

1) Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016, ISBN:978-0071467346
2) Printed Circuit Boards: Design and Technology, Walter C. Bosshart, McGraw Hill Education, ISBN-13: 978-0074515495
3) Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner, Bob Doe, Academic Press (imprint of Elsevier), 2019, ISBN: 978-0-12-817684-9

SCILAB FOR DC MACHINES AND TRANSFORMERS

Course Code	**25EEE465**	**Credits**	**01**
L:T:P:S	**0:0:1:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**30**	**SEE Marks**	**50**
TW & SL / Sem	**-**	**Total Marks**	**100**
Total Hours /Sem	**30**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

25EEE465.1	Examine the efficiencies and regulation of DC machines using different tests
25EEE465.2	Design various winding for DC Machines
25EEE465.3	Evaluate the losses of a transformer and test performance of the transformer
25EEE465.4	Apply the software to simulate single phase transformer and Induction Motor

Exp. No. / Pgm. No.	**List of Experiments / Programs**	**Hours**	**COs**
	Prerequisite Experiments / Programs / Demo		
	• Introduction to Electrical Machines	2	NA
	PART-A		
1	Open Circuit and Short circuit tests on single phase step up or step-down transformer and predetermination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit.	2	25EEE465.1
2	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.	2	25EEE465.1
3	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the short circuit test data	2	25EEE465.1
4	Voltage regulation of an alternator by ZPF method.	2	25EEE465.2
5	Voltage regulation of an alternator by EMF methods	2	25EEE465.2
6	Voltage regulation of an alternator by MMF methods	2	25EEE465.2
	PART-B		
7	Air gap MMF calculation for magnetic circuits using SCILAB	2	25EEE465.3
8	A SCILAB program for design of electromagnet	2	25EEE465.3
9	Design of an iron cored choke coil using SCILAB coding	2	25EEE465.3
10	Core Loss Calculations in magnetic materials using SCILAB programming	2	25EEE465.3
11	Design of a small single-phase transformer using SCILAB coding	2	25EEE465.4
12	Efficiency Analysis of Induction Motor using SCILAB	2	25EEE465.4

PART-C

Beyond Syllabus Virtual Lab Content (4 Hours)

(To be done during Lab but not to be included for CIE or SEE)

1. Electrical System modelling
   https://www.scilab.org/software/xcos/electronics
2. DC Motor Simulation and Code Generation using ScicosLab and E4Code
   https://youtu.be/AOV7YxOUNrI?si=ifHjS_4TejVqPzMy
3. Single Phase Transformer
   https://asnm-iitkgp.vlabs.ac.in/exp/single-phase-transformer/theory.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Test (s)**	**Weekly Assessment**
		30	**20**
L1	**Remember**	**-**	**-**
L2	**Understand**	-	-

L3	**Apply**	15	10
L4	**Analyze**	10	5
L5	**Evaluate**	5	5
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		**Exam Marks Distribution (50)**
L1	**Remember**	**-**
L2	**Understand**	-
L3	**Apply**	20
L4	**Analyze**	20
L5	**Evaluate**	10
L6	**Create**	**-**

Suggested Learning Resources:

Reference Books:

1)Electrical Machines, S.K. Bhattacharya, McGraw Hill Education, 4th Edition, 2017. ISBN-10: 9332902852, ISBN-13: 978-9332902855

2) Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662

ENVIRONMENTAL SCIENCE PROJECT			
Course Code	**25EPP47**	**Credits**	**02**
L:T:P:S	**0:0:2:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**-**	**SEE Marks**	**50**
TW & SL / Sem	**60**	**Total Marks**	**100**
Total Hours /Sem	**60**	**Exam Hours**	**03**

Course outcomes: At the end of the course, the student will be able to:

25EPP47.1	Identify environmental issues and their impact on ecosystems, natural resources, and sustainable development.
25EPP47.2	Evaluate environmental conditions using data obtained through field surveys, case studies, environmental audits, and related investigations
25EPP47.3	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
25EPP47.4	Design sustainable solutions to mitigate identified environmental problems using scientific and engineering principles.

The Environmental Science Project is a practical, applied-learning course that builds students' environmental awareness and responsibility. It focuses on real issues such as climate change, pollution, biodiversity, resource use, soil erosion, and thermal comfort, using field surveys, case studies, data collection, audits, and analysis to develop feasible and sustainable solutions. Students are encouraged to propose feasible, sustainable, and technically sound solutions based on scientific principles and engineering practices.

The project may be undertaken **individually or in groups of up to four students**, including interdisciplinary teams wherever appropriate. Student performance shall be evaluated based on the prescribed project assessment rubrics.

Methods for project identification: Students may identify the project topic using one or more of the following methods: interaction with local rural or urban stakeholders such as local leaders, corporation/municipality personnel, NGOs, panchayat representatives, etc.; review of issues highlighted in print and electronic media, and social networks; and, after selecting a broad topic, collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and define the problem statement and objectives clearly.

Restrictions and professional conduct:

Environmental Science Projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stakeholders, and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, environmental impact, and stakeholder cooperation

CIE Assessment Pattern (50 Marks)

RBT Levels		Periodical Reviews and Evaluation
		50
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

SEE Assessment Pattern (50 Marks)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	05
L3	Apply	15
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books:

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org
4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Web links and Video Lectures (e-Resources):

1. NPTEL courses on Engineering Geology (IIT Roorkee, IIT Kharagpur).
2. NPTEL courses on Soil Mechanics and Foundation Engineering (IIT Delhi, IIT Bombay).
3. Virtual Labs – Geotechnical Engineering Virtual Lab (IIT Kanpur): https://vlab.co.in
4. Geological Survey of India (GSI) – Maps, reports, and publications: https://www.gsi.gov.in
5. YouTube channels: Civil Engineering Essentials, The Engineering Classroom (soil mechanics experiments). 6.
6. American Society of Civil Engineers (ASCE) – Geotechnical resources and standards

BASIC APPLIED MATHEMATICS - II
(Common for All Branches)

Course Code	**25DMAT41**	**Credits**	**0**
L:T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50**
Total Hours /Sem	**30**	**Exam Hours**	**--**

Course outcomes:
At the end of the course, the student will be able to:

25DMAT41.1	Understand the least squares method to fit linear, quadratic, and exponential curves to experimental data.
25DMAT41.2	Solve first-order and first-degree differential equations and interpret their solutions in engineering and scientific applications.
25DMAT41.3	Analyze higher-order linear differential equations solutions encountered in engineering systems.
25DMAT41.4	Apply the double and triple integrals concepts to compute the areas and volumes of engineering domains.
25DMAT41.5	Analyze the Laplace transforms and apply their properties to simplify mathematical models of engineering systems.
25DMAT41.6	Apply Laplace transform techniques to solve linear differential equations arising in the engineering applications.

MODULE-1	**STATISTICAL ANALYSIS**	**25DMAT41.1**	**3 Hours**
Fitting of the linear curves, quadratic curves and exponential curves by least square method. Correlation, Coefficient of correlation and Lines of Regression.			
Self-study	Fitting of the geometric curves.		
Text Book	Text Book 1: 24.5, 25.12, 25.13, 25.14		
MODULE-2	**ORDINARY DIFFERENTIAL EQUATIONS**	**25DMAT41.2 25DMAT41.3**	**3 Hours**
Solution of first order and first-degree differential equations – Exact differential equations. Solution of second and higher order homogeneous and non-homogeneous (e^{ax}, sin ax, cos ax) linear differential equations.			
Self-study	Solution of first order linear differential equations		
Text Book	Text Book 1: 11.11, 11.12, 13.5		
MODULE-3	**INTEGRAL CALCULUS**	**25DMAT41.4**	**3 Hours**
Evaluation of double integrals, evaluation of double integrals by change of order of integration, double integrals in polar coordinates, Area enclosed by plane curves, Evaluation of triple integrals.			
Self-study	Evaluation of double integrals over the region of integration.		
Text Book	Text Book 1: 7.1, 7.2, 7.3.		
MODULE-4	**LAPLACE TRANSFORMS**	**25DMAT41.5**	**3 Hours**
Definition and Laplace transform of simple functions, Properties of Laplace transforms -Shifting property problems, Laplace transform of Periodic functions problems.			
Self-study	Laplace transform of elementary functions		
Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.		
MODULE-5	**INVERSE LAPLACE TRANSFORMS**	**25DMAT41.6**	**3 Hours**
Inverse Laplace Transform by partial fractions and completing square forms. Solution of linear differential equations using Laplace Transform techniques.			
Self-study	Inverse Laplace transform of simple functions		
Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	**AAT1**	**AAT2**
		25	**15**	**10**
L1	**Remember**	-	**-**	**-**
L2	**Understand**	5	**-**	**-**
L3	**Apply**	10	**5**	5
L4	**Analyze**	10	5	5
L5	**Evaluate**	-	5	-

L6	**Create**			**-**	

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, 9780273719236
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, 4th Edition ISBN: 9780070634190
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018 9789352533831
4) N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., 9th Ed 2014, ISBN: 9788131808320

Web links and Video Lectures (e-Resources):

- https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK
- https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp
- https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIds203os
- https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ
- https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_
- https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih
- https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa
- https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JIZe9LE

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving Approach
- Organizing Group wise discussions on related topics
- Seminars

NATIONAL SERVICE SCHEME			
Course Code	**25NSS30, 25NSS40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each Semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2 = 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25NSS30/40.1	Understand the importance of his / her responsibilities towards society.
25NSS30/40.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
25NSS30/40.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
25NSS30/40.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Semester/ Course Code	CONTENT	COs	HOURS
3RD 25NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Developing Sustainable Water management system for rural areas and implementation approaches. 4. Setting of the information imparting club for women leading to contribution in social and economic issues. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS30.1, 25NSS30.2, 25NSS30.3, 25NSS30.4	26 HRS
4TH 25NSS40	1. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 2. Contribution to any national level initiative of Government of India. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs). 4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure. 6. Participation in Institution NSS Unit Cell campaigns.	25NSS40.1, 25NSS40.2, 25NSS40.3, 25NSS40.4	26 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress -	10

PHASE - 2	
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- Implementation strategies of the project (NSS work).
- The last report should be signed by NSS Officer, the HOD and Principal.
- At last report should be evaluated by the NSS officer of the Institute.
- Finally, the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.

Suggested Learning Resources:

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:

1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:

- In every semester from 3rd semester to 4th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.
- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:

- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
    - Lecture session by NSS Officer
    - Students Presentation on Topics
    - Presentation - 1, Selection of topic, PHASE – 1
    - Commencement of activity and its progress - PHASE – 2
    - Execution of Activity
    - Case study-based Assessment, Individual performance
    - Sector/ Team wise study and its consolidation
    - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic

1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Co ntinuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Developing SustainableWater management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection/prope rconsultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams /College campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionablebusiness proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
1.	Helping local schools toachieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Governm ent Schemes officers	School selection/prope r consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

2.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Organize National integration and socialharmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prope r consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place selection/prope r consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS			
Course Code	**25PED30, 25PED40**	**Credits**	**00**
L:T:P:S	**0:0:0:0**	**CIE Marks (each semester)**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2= 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**

Course outcomes:

At the end of the course, the student will be able to:

25PED30/40.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
25PED30/40.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
25PED30/40.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
25PED30/40.4	Understand the roles and responsibilities of organization and administration of sports and games

Semester	CONTENT	COs	HOURS
3RD 25PED30	**Module 1: Orientation** A. Lifestyle B. Food & Nutrition C. Health & Wellness D. Pre-Fitness test.	25PED30.1, 25PED30.2, 25PED30.3, 25PED30.4	26 HRS
	Module 2: General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash		
	Module 3: **Specific games (Any one to be selected by the student)** 1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.		
4TH 25PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	25PED40.1, 25PED40.2, 25PED40.3, 25PED40.4	26 HRS
	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration		

CIE Assessment Pattern (50 Marks – Practical) –

CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:
Reference Books:

1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA			
Course Code	**25YOG30, 25YOG40**	**Credits**	**00**
L: T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL/sem	**15**	**Total Marks**	**50 x 2 = 100**
Total Hour/sem	**30**	**Exam Hours**	**02**

Course outcomes:
At the end of the course, the student will be able to:

25YOG30/40.1	Understanding the origin, history, aim and objectives of Yoga
25YOG30/40.2	Become familiar with an authentic foundation of Yogic practices
25YOG30/40.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some
25YOG30/40.4	Use the teachings of Patanjali in daily life.

Semester / Course Code	CONTENT	COs	HOURS
3rd 25YOG30	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Kapalabhati:** 40strokes/min 3rounds **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana	25YOG30.1, 25YOG30.2, 25YOG30.3, 25YOG30.4	26 Hrs
4TH 25YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brahmari Pranayama** **Different types of Asanas with Brief introduction and importance:** 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Sarvangasana, Chakraasana 5. Balancing: Sheershasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	25YOG40.1, 25YOG40.2, 25YOG40.3, 25YOG40.4	26 Hrs

	Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati		

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:

Reference Books:

1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
2. Tiwari, O P: Asana Why and How
3. Ajitkumar: Yoga Pravesha (Kannada)
4. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
5. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
6. Nagendra H R: The art and science of Pranayama
7. Tiruka: Shatkriyegalu (Kannada)
8. Iyengar B K S: Yoga Pradipika (Kannada)
9. Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

MUSIC			
Course Code	**25MUS30, 25MUS40**	**Credits**	**00**
L: T:P:S	**0:0:0:0**	**CIE Marks**	**50**
TLP Contact Hours / Sem	**15**	**SEE Marks**	**--**
TW & SL / Sem	**15**	**Total Marks**	**50 x 2 = 100**
Total Hours /Sem	**30**	**Exam Hours**	**02**
Course outcomes: At the end of the course, the student will be able to:			
25MUS30/40.1	Identify and understand the origins and evolution of the Indian music system and its fundamental concepts		
25MUS30/40.2	Analyze and practice various types of compositions in Carnatic music and relate to different musical traditions		
25MUS30/40.3	Demonstrate knowledge of major composers and their contributions to Indian classical music		
25MUS30/40.4	Classify and understand various musical instruments and their construction		

Semester / Course Code	CONTENT	COs	HOURS
3rd 25MUS30	**Origin of Indian Music** - Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Taya, Raga, Tala, and Mla. Study of the fundamental concepts that form the foundation of Carnatic music. **Compositions in Carnatic Music** - Introduction to types of compositions including Geethe, Jathi, Swara, Swarajathi, Varna, Krithi, and Thillana. Understanding of notation systems and their application in musical compositions. **Composers and Their Contributions** - Biography and musical contributions of Purandaradasa (founder of Carnatic music pedagogy), Thyagaraja (prolific composer and saint), and Mysoro Vasudevacharya. Study of their impact on Indian classical music traditions. **Abhyasa Gana - Practical Training**- Singing of Sarale Varase exercises and notation writing. Introduction to Suladi Sapthatala. Singing of 2 Geethe in Malahiri. Foundation for practical music experience.	25MUS30.1, 25MUS30.2, 25MUS30.3, 25MUS30.4	26 Hrs
4TH 25MUS40	**Classification of Musical Instruments** - Classification and construction of string instruments (Veena, Sitar), wind instruments (Flute, Shehnai), percussion instruments (Mridangam, Tabla), and Idiophones (Ghana Vaadya - Gongs, Cymbals). Examples and characteristics of each class of instruments. **Abhyasa Gana - Practical Training**- Continuation of singing exercises including Sarale Varase at varying speeds. Complete notation writing for Sarale Varase and Suladi Sapthatala in Mayamalavagowla Raga. Singing of 2 additional Geethe in Malahiri, one Jathi Swara, and one Krithi in a Mela raga. Advanced practical music training.	25MUS40.1, 25MUS40.2, 25MUS40.3, 25MUS40.4	26 Hrs

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Singing/Playing learnt in the semester and internal tests (MCQ type)

CIE	Marks
Avg of Test 1 and Test 2	20
Practical test on: a. Recite one Sarale Varase mentioned by the examiner in three speeds. b. Sing/Play the Geethe in Malahari. c. Singing/Playing Jathi Swara/Krithi.	30
Total	**50**

Textbooks:

4. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
5. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol.1 (English), Shreenivaas Prakaashana, 2018.

References:

6. Lakshminarayana Subramiam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranqueber 2018.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=ihFDT8ZBPxE
- https://www.youtube.com/watch?v=4XXl5tTXa0I
- **https://www.youtube.com/watch?v=n-60gfzGa1E**
- **https://www.youtube.com/watch?v=Vv_K7J7gx6M**
- **https://www.youtube.com/watch?v=BovAAPumYUo**
- **https://www.youtube.com/watch?v=F_aWPATb8V4**
- **https://www.youtube.com/watch?v=DPPCRWA3hXo**
- **https://www.youtube.com/watch?v=TuP00NK9eTM**
- **https://www.youtube.com/watch?v=LlolyBzZtdg**

APPENDIX A

List of Assessment patterns

1. Assignment
2. Group Discussions
3. Case studies
4. Practical Orientation on design thinking, Creative & Innovation
5. Participatory & Industry-Integrated Learning
6. Practical Activities/Problem Solving Exercises
7. Class Presentations
8. Analysis of Industry/Technical/Business Reports
9. Reports on Industrial Visits
10. Industrial/Social/Rural Projects
11. Participation in External Seminars/Workshops
12. Online/Offline Quizzes

APPENDIX B

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

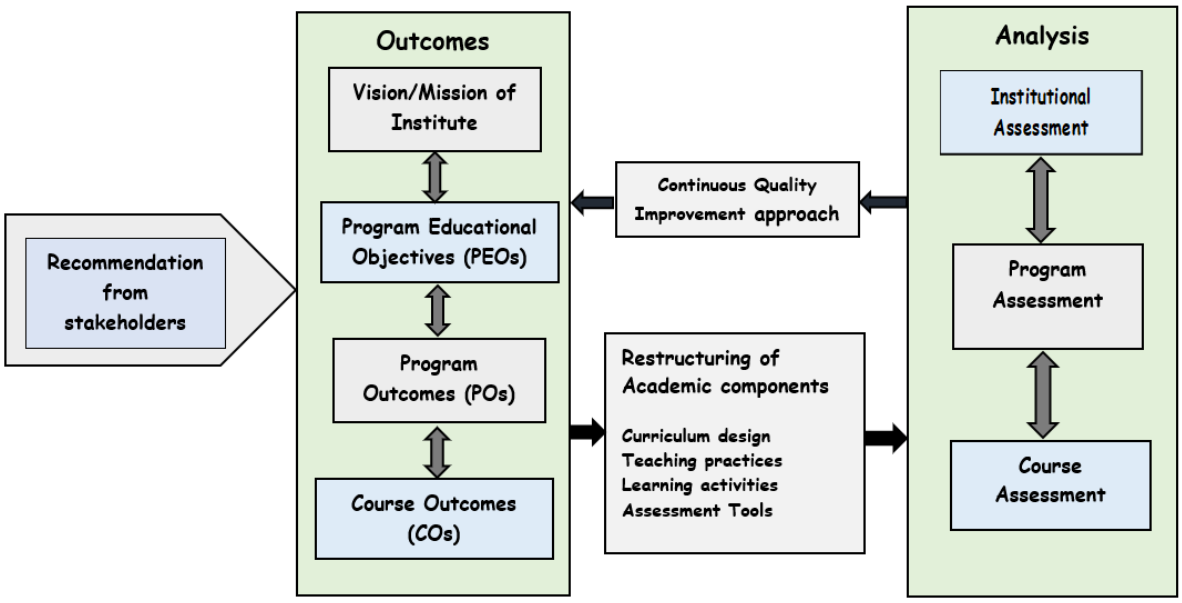
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation.

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX C

The Graduate Attributes of NBA

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

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

Conduct investigations of complex problems: The problems that cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline. * That may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (like: cost, power requirement, durability, product life, etc.).,which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding

of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX D

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.

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