NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electrical and Electronics Engineering

Academic Year 2025-26

3rd and 4th Semester Scheme and Syllabus

BATCH - 2024-2028

CREDITS: 160

NEW HORIZON
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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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
PEO1	3	3	3	3	3	2	2	2	2	2	2	3	3
PEO2	3	3	3	3	3	2	2	2	2	2	2	3	3
PEO3	2	2	2	2	2	3	3	3	3	2	2	2	2

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Graduates will be able to solve real life problems of power system and power Electronics using MiPower, PSPICE and MATLAB software tools and hardware.

PSO 2: Graduates will be able to Develop & support systems based on Renewable and sustainable Energy sources.

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electrical and Electronics Engineering

Scheme of Teaching and Examinations for 2024- 2028 BATCH (2024 Scheme)

III Semester

S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	BSC	24MAE31	Numerical Methods and Transforms	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	24EEE32	DC Machines and Transformers	EE	3	0	0	0	3	3	50	50	**100**
3	PCCL	24EEL32	DC Machines and Transformers Laboratory	EE	0	0	1	0	1	2	50	50	**100**
4	PCC	24EEE33	Electric Circuit Theory	EE	3	0	0	0	3	3	50	50	**100**
5	PCCL	24EEL33	Electric Circuit Theory Laboratory	EE	0	0	1	0	1	2	50	50	**100**
6	PCC	24EEE34	Measurements and Instrumentation	EE	3	0	0	0	3	3	50	50	**100**
7	PCC	24EEE35	Microcontroller and Embedded Systems	EE	3	0	0	0	3	3	50	50	**100**
8	AEC	24EEE36X	Ability Enhancement Course – III	EE	If the course is a Theory						50	50	**100**
					1	0	0	0	1	1			
					If the course is a Laboratory								
					0	0	1	0	1	2			
9	UHV	24DTK37	Design Thinking and Fabrication	Any Dept	1	0	0	0	1	1	50	50	**100**
10	NCMC	24NSS30	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**
		24PED30	Physical Education and Sports	-									
		24YOG30	Yoga	-									
								Total	**19**	**24/25**	**500**	**450**	**950**

11	NCMC*	24DMAT31	Basic Applied Mathematics -I	BS	0	0	0	0	0	2	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, **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation

Ability Enhancement Course – III (0-0-1-0)			
24EEE361	Microcontroller Interfacing and Control	24EEE364	555 IC Laboratory
24EEE362	MATLAB Programming for Problem Solving	24EEE365	Bio Inspired Design and Innovation (1-0-0-0)
24EEE363	Virtual Instrumentation Using LabVIEW		

NCMC*:24DMAT31: This non-credit mandatory course to be offered to Lateral entry students.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education(PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

NEW HORIZON COLLEGE OF ENGINEERING

B. E. in Electrical and Electronics Engineering

Scheme of Teaching and Examinations for 2024- 2028 BATCH (2024 Scheme)

IV Semester

S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	BSC	24MAE41	Numerical, Complex Analysis and Probability Theory	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	24EEE42	Analog Electronics and Integrated Circuits	EE	3	0	0	0	3	3	50	50	**100**
3	PCCL	24EEL42	Analog Electronics and Integrated Circuits Laboratory	EE	0	0	1	0	1	2	50	50	**100**
4	PCC	24EEE43	Digital Logic Design	EE	3	0	0	0	3	3	50	50	**100**
5	PCCL	24EEL43	Digital Logic Design Laboratory	EE	0	0	1	0	1	2	50	50	**100**
6	PCC	24EEE44	Synchronous and Induction Machines	EE	3	0	0	0	3	3	50	50	**100**
7	PCCL	24EEL44	Synchronous and Induction Machines Laboratory	EE	0	0	1	0	1	2	50	50	**100**
8	PEC	24EEE45X	Professional Elective Course-I	EE	3	0	0	0	3	3	50	50	**100**
9	AEC	24EEE46X	Ability Enhancement Course – IV	EE	0	0	1	0	1	2	50	50	**100**
10	UHV	24UHK47	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	**100**
11	PROJ	24EEE48	Mini Project	EE	0	0	1	0	1	0	50	50	**100**
12	NCMC	24NSS40	National Service Scheme	-	0	0	0	0	0	2	50	--	**50**
		24PED40	Physical Education and Sports	-									
		24YOG40	Yoga	-									
Total									**21**	**28**	**600**	**550**	**1150**

13	NCMC*	24DMAT41	Basic Applied Mathematics-II	BS	0	0	0	0	0	2	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**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation.

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Professional Elective Course-I			
24EEE451	Electromagnetic Field Theory	24EEE454	Object Oriented Programming using JAVA
24EEE452	Principles of Communication Systems	24EEE455	Machine Learning Fundamentals
24EEE453	Utilization of Electrical energy		

Ability Enhancement Course – IV			
24EEE461	AutoCAD for Electrical Engineering	24EEE464	PCB Design Laboratory
24EEE462	Advanced Arduino Programming	24EEE465	Scilab for DC Machines and Transformers
24EEE463	Programming Using RoboDK		

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as

(i) A group of 2 if mini project work is single discipline (applicable to all IT allied branches)

(ii) A group of 2- 4 if mini project work is single discipline (applicable to all Core Branches)

(iii) A group of 2 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(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 Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 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, and Yoga 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.

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III SEMESTER
SYLLABUS

NUMERICAL METHODS AND TRANSFORMS
(Common to ECE, EEE and ME)

Course Code	**24MAE31**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24MAE31.1	Use appropriate numerical methods to solve algebraic equations and transcendental equations.
24MAE31.2	Differentiate the physical problems numerically, evaluate a definite integral numerically and use appropriate numerical methods to solve boundary value problems in partial differential equations.
24MAE31.3	Justify Z-transforms method to solve continuous/discrete model problems.
24MAE31.4	Express the periodic functions as Fourier series expansion analytically and numerically.
24MAE31.5	Solve the continuous model problems using Fourier transform and Analyze the Fast Fourier transforms method to solve the discrete model problems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
24MAE31.1	3	3	-	-	-	-	-	-	-	-	-	-
24MAE31.2	3	3	-	-	-	-	-	-	-	-	-	-
24MAE31.3	3	3	-	-	-	-	-	-	-	-	-	-
24MAE31.4	3	3	-	-	-	-	-	-	-	-	-	-
24MAE31.5	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**NUMERICAL SOLUTIONS AND INTERPOLATION**	**24MAE31.1**	**8 Hours**

Numerical solution of algebraic and transcendental equations: Newton-Raphson Method-Problems. Interpolation: Newton's forward and backward formulae for equal intervals, Newton divided difference, Lagrange's formula and Lagrange's inverse interpolation formula for unequal intervals (without proofs)-Problems.

Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.12, 29.13, Text Book 3: 19.2, 19.3.

MODULE-2	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**24MAE31.2**	**8 Hours**

Numerical Differentiation: Derivatives of first order and second order using Newton's forward differences and Newton's backward differences. Numerical solution of one-dimensional wave equation, heat equation and two-dimensional Laplace's equation. Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule and Simpson's 3/8th rule (without proofs)-Problems. Application of numerical integration to velocity of a particle and volume of solids

Text Book	Text Book 1: 30.2, 30.6, 30.7, 30.8, 33.5, 33.8, 33.10, Text Book 3: 19.5.

MODULE-3	**Z-TRANSFORMS**	**24MAE31.3**	**8 Hours**

Definition, Z-transforms of some standard functions, properties, damping rule, shifting rule (without proof), initial and final value theorems. Inverse Z- transforms by partial fractions method. Convolution theorem (Statement only). Solution of difference equations using Z-transform

Text Book	Text Book 1: 23.3, 23.4, 23.5, 23.6, 23.9, 23.15, 23.16. Text Book 2: 6.14.11, 6.14.12

MODULE-4	**FOURIER SERIES**	**24MAE31.4**	**8 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 – problems.

Text Book	Text Book 1: 10.2, 10.4, 10.5, 10.6, 10.7, 10.11, Text Book 3: 11.1

MODULE-5	**FOURIER TRANSFORMS**	**24MAE31.5**	**8 Hours**

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transforms. Convolution theorem (Statement only). Discrete Fourier Transform and Fast Fourier Transform: Definition of N-Point DFT, problems for 4-points and inverse DFT for four points only. FFT algorithm to compute the Fourier transforms 4-point only.

Text Book	Text Book 1: 22.4, 22.5, Text Book 2:8.3, 8.4, 9.2, 9.3, Text Book 3: 11.8, 11.9

List of Tutorial Contents

Sl. No.	Contents	COs
1.	Use Newton's forward formula for equal interval problems.	24MAE31.1
2.	Use Newton's backward formula for equal interval problems.	24MAE31.1
3.	Uses of Simpson's rule	24MAE31.2
4.	Numerical solution of one-dimensional heat equation and two-dimensional Laplace's equation.	24MAE31.2
5.	Solve difference equations using Z-transform.	24MAE31.3
6.	Solve difference equations using inverse Z-transform.	24MAE31.3
7.	Practical harmonic analysis-Problems.	24MAE31.4
8.	Practical harmonic analysis-Problems.	24MAE31.4
9.	Uses of DFT in problems.	24MAE31.5
10.	Uses of FFT in problems.	24MAE31.5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
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	5
L2	Understand	5
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, Wiley-India Publishers, Second impression, 2015, ISBN: 9780198081937.
3) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/IgoJV4g_0LM?si=JO1_bkIvMR8xlC0V
2)https://youtu.be/mIFwzg11uO4?si=Xd13dh0eNlmIswPS
3)https://youtu.be/74g5_3TC-tQ?si=yB2PHVGr4hxllqPo

4)https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
5)https://youtu.be/5817fLmsTGE?si=Y7ORyV2ETSCxZRAZ
6)https://youtu.be/XJRW6jamUHk?si=G_UTgCM622bz9yh4
7)https://youtu.be/QHH50jy8s_A?si=eNUoUXYLEvEZj3KM
8)https://youtu.be/m3mMeXLt2OQ?si=r9QXzwCRo0PC0ewz
9)https://youtu.be/aSu5Yde9Sfk?si=6kZbU3QRXEfEn2ua
10)https://www.youtube.com/live/tjBxcBLBe6I?si=v4RH4oqyttKhfaPd
11)https://youtu.be/-Y_0FY-IDrI?si=-ERIHGln3U2dr54J
12)https://youtu.be/zWRVxWdwXaw?si=Y78g7TogvDZIKhvs
13)https://youtu.be/nl9TZanwbBk?si=LdywSeCJ0EIt5zCx
14)https://youtu.be/E8HeD-MUrjY?si=JWwQzkQWfaTIqVhG

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

DC MACHINES AND TRANSFORMERS

Course Code	**24EEE32**	**CIE Marks**	**50**
L: T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE32.1	Explain the construction, working principle and performance of DC Machines
24EEE32.2	Analyze the speed control techniques of DC machines for different applications
24EEE32.3	Evaluate the performance parameters of Transformer through relevant testing methods
24EEE32.4	Identify and explain the different types of transformers used in industrial applications
24EEE32.5	Analyze the configurations, parallel operation and phase conversion of three-phase transformers
24EEE32.6	Evaluate the applications of DC machines and transformers in real life problems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE32.1	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE32.2	3	2	3	2	1	-	-	-	-	-	1	1	1
24EEE32.3	3	2	3	2	1	-	-	-	-	-	1	1	1
24EEE32.4	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE32.5	3	2	3	2	1	-	-	-	-	-	1	1	1
24EEE32.6	3	2	3	2	1	-	-	-	-	-	1	1	1

MODULE-1	**DC GENERATOR**	**24EEE32.1, 24EEE32.6**	**8 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**	**24EEE32.1, 24EEE32.2, 24EEE32.6**	**8 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**	**24EEE32.3, 24EEE32.6**	**8 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**	**24EEE32.5, 24EEE32.6**	**8 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**	**24EEE32.4, 24EEE32.5**	**8 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	**24EEL32**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEL32.1	Develop the winding diagram for DC machines using AutoCAD
24EEL32.2	Estimate the performance of a DC machines by conducting appropriate tests
24EEL32.3	Examine the operation of Scott connection with two single-phase transformers
24EEL32.4	Evaluate the performance of Transformers by conducting various tests and load sharing

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEL32.1	3	3	2	2	2	-	-	-	-	-	-	1	1
24EEL32.2	3	3	2	2	2	-	-	-	-	-	-	1	1
24EEL32.3	3	3	2	2	2	-	-	-	-	-	-	1	1
24EEL32.4	3	3	2	2	2	-	-	-	-	-	-	1	1

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	Introduction to Basic electrical engineering	2	NA
	PART-A		
1	Develop a winding diagram for DC machines in AutoCAD	2	24EEL32.2
2	Speed control of DC shunt motor by armature voltage control and flux control methods	2	24EEL32.2
3	Brake test on a DC shunt motor –Determination of speed –torque and efficiency characteristic	2	24EEL32.2
4	Retardation Test on DC shunt machine	2	24EEL32.2
5	Field's test on series motor	2	24EEL32.1
6	Determination of magnetization, internal & load characteristics of DC shunt generator	2	24EEL32.4
	PART-B		
7	Swinburne's Test on DC shunt machine	2	24EEL32.2
8	Calculation of efficiency and regulation by open circuit and short circuit test on single phase transformer	2	24EEL32.2
9	Polarity Test and connection of three single phase transformer in star Delta	2	24EEL32.2
10	Sumpner's test on similar transformer and determination of combined and individual transformer	2	24EEL32.2
11	Scott connection with balanced and unbalanced resistive loads	2	24EEL32.3
12	Parallel operation of two dissimilar single-phase transformer	2	24EEL32.3

PART-C

Beyond Syllabus Virtual Lab Content

(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 Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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	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	**24EEE33**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE33.1	Apply suitable network reduction techniques to simplify electrical circuits
24EEE33.2	Examine the electrical circuits using network theorems
24EEE33.3	Analyze the frequency response of RLC circuits
24EEE33.4	Investigate the transient response of RLC circuits with DC and AC excitation
24EEE33.5	Evaluate balanced three phase circuits and two port networks for the electrical systems
24EEE33.6	Design an electrical system for practical engineering problem

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE33.1	3	3	2	2	1	-	-	-	-	-	1	2	2
24EEE33.2	3	3	3	2	1	-	-	-	-	-	1	2	2
24EEE33.3	3	3	2	2	1	-	-	-	-	-	1	2	2
24EEE33.4	3	3	3	2	1	-	-	-	-	-	1	2	2
24EEE33.5	3	3	3	2	1	-	-	-	-	-	1	2	2
24EEE33.6	3	3	3	2	1	-	-	-	-	-	1	2	2

MODULE-1	**Basic concepts and Network Reduction**	**24EEE33.1, 24EEE33.6**	**8 Hours**

DC Circuits: Practical and ideal sources, Active and passive elements, Dependent and independent sources. Network reduction using star-delta transformation and Source transformation, 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 Theorems**	**24EEE33.2, 24EEE33.6**	**8 Hours**

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**	**24EEE33.3, 24EEE33.6**	**8 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**	**24EEE33.4, 24EEE33.6**	**8 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 and Two Port Networks**	**24EEE33.5, 24EEE33.6**	**8 Hours**

Balance three phase voltages, Analysis of Balanced three phase systems – wye-wye, wye-delta, delta-wye, and delta-delta. Two port network concepts, open circuit impedance, short circuit admittance, and transmission parameters and their evaluation for simple 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

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	**24EEL33**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEL33.1	Deduce the given network using different network reduction techniques
24EEL33.2	Analyze various network using mesh and nodal methods
24EEL33.3	Apply different network theorems for the given circuit
24EEL33.4	Design various transient circuits and evaluate the frequency response and steady state response of a mutually coupled circuit

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEL33.1	3	3	3	3	3	-	-	-	1	-	-	1	-
24EEL33.2	3	3	3	3	3	-	-	-	1	-	-	1	-
24EEL33.3	3	3	3	3	3	-	-	-	1	-	-	1	-
24EEL33.4	3	3	3	3	3	-	-	-	1	-	-	1	-

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	• Resistance colour coding. • Familiarization of breadboards and PSPICE.	2	NA
	PART-A		
1	Verification of KCL & KVL	2	24EEL33.1
2	Network Reduction using Series-Parallel Combination	2	24EEL33.1
3	Network Reduction using Star-Delta Transformation	2	24EEL33.1
4	Network Reduction and Analysis using Source Transformation	2	24EEL33.1
5	Network Analysis using Mesh-Current Method	2	24EEL33.2
6	Network Analysis using Node-Voltage Method	2	24EEL33.2
	PART-B		
7	Verification of Superposition Theorem	2	24EEL33.3
8	Verification of Thevenin's Theorem & Norton's Theorem	2	24EEL33.3
9	Verification of Maximum Power Transfer Theorem	2	24EEL33.3
10	Determination of Resonant Frequency, Bandwidth and Quality Factor of a RLC Circuit	2	24EEL33.4
11	Transient and steady state analysis of RL, RC and RLC Circuits	2	24EEL33.4
12	Steady State Analysis of Mutually Coupled Circuits	2	24EEL33.4

PART-C

Beyond Syllabus Virtual Lab Content

(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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	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	**24EEE34**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours /Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE34.1	Understand the principles, characteristics and classification of measuring instruments
24EEE34.2	Demonstrate the working principle and industrial applications of potentiometers and instrument transformers
24EEE34.3	Analyze of D.C and A.C bridges used in measuring instruments
24EEE34.4	Evaluate the performance of digital measuring instruments and its applications in industry
24EEE34.5	Compare and assess different types of display devices used in modern measurement system
24EEE34.6	Illustrate the working of recording and bio medical instruments

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE34.1	3	2	1	1	-	-	-	-	-	-	1	1	1
24EEE34.2	3	2	1	1	-	-	-	-	-	-	1	1	1
24EEE34.3	3	3	2	2	-	-	-	-	-	-	1	1	1
24EEE34.4	3	2	2	2	2	-	-	-	-	-	1	1	1
24EEE34.5	3	2	2	1	2	-	-	-	-	-	1	1	1
24EEE34.6	3	2	2	1	1	-	-	-	-	-	1	1	1

MODULE-1	**INTRODUCTION TO MEASURING INSTRUMENTS**	**24EEE34.1**	**8 Hours**

Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments. General features, Construction, Principle of operation of Electrodynamometer, Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers.

Self Study	Systematic vs random errors with everyday measurement examples
Text Book	Text Book: 2.1,2.2,2.3,2.4,2.7,2.8,2.9,2.10,2.11,2.12

MODULE-2	**POTENTIOMETERS AND INSTRUMENT TRANSFORMERS**	**24EEE34.2**	**8 Hours**

DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, measurement of unknown resistance, current, voltage; AC potentiometers: polar and coordinate type, standardization, 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, Text Book 1: 9.1 to 9.33

MODULE-3	**DC AND AC BRIDGES**	**24EEE34.3**	**8 Hours**

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

Case study	Audio Frequency Filter Design
Text Book	Text Book 1:13.1 to 13.33, Text Book 1:16.1-16.15

MODULE-4	**ELECTRONIC AND DIGITAL INSTRUMENTS:**	**24EEE34.4**	**8 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 treatment)			
Self-Study	Study of Extra features offered by present day meters and their significance in billing		
Text Book	Text Book 1: 28.30 to 28.55		
MODULE-5	**Display and Recording Devices**	**24EEE34.5, 24EEE34.6**	**8 Hours**

Introduction, Character formats, Segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays. Display multiplexing and zero suppression. Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and X – Y recorders. Magnetic tape recorders, Direct recording, Frequency modulation recording, Pulse duration modulation recording, Digital tape recording, Ultraviolet recorders. Biomedical recorders, Electro Cardio Graph (ECG), Electroencephalograph

Application	Hand held calculators
Text Book	Text Book 1:28.75to28.95, 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	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)Electrical and Electronic measurement and instruments, A K Sawhney, DhanpatRai and Sons Publications,19 th Edition 2022, ISBN-10:8177001000, ISBN-13:978-8177001006,

2)Electrical measurements and measuring instruments, E W Golding and F C Widdis, wheeler publishing, 5th Edition,2011, ISBN-10:0273405411, ISBN-13:978-0273405412

Reference Books:

1)Electrical measurements, Buckingham and Price, Prentice Hall. ISBN-10: 0340048484, ISBN-13: 978-0340048481, 2019

2)Transducers and Instrumentation, D V S Murthy, Prentice Hall of India, ISBN-10:8120335694 ISBN-13: 978-8120335691, 2nd Edition, 2009.

3)Principles of measurement of instrumentation, A S Morris, Pearson/Prentice Hall of India, ISBN-10:0134897099, ISBN-13:9780134897097,2nd Edition, 1994.

4)Electronic Instrumentation, H S Kalsi, Tata McGraw Hill Edition, ISBN:0070583706, 9780070583702,1st Edition 1995

Web links and Video Lectures (e-Resources):

- http://www.cl.cam.ac.uk/teaching/1011/SysOnChip/socdam-notes1011.pdf.
- https://www.doc.ic.ac.uk/~wl/teachlocal/cuscomp/notes/cc11.pdf
- https://www.cs.ccu.edu.tw/~chen/arch/SOC-design.pdf
- https://onlinecourses.nptel.ac.in/noc18_ee33/preview
- https://onlinecourses.nptel.ac.in/noc18_ee34/preview

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

- Demonstration of instruments by opening its sections.
- Video demonstration of latest trends in instrumentation.
- Organizing Group wise discussions on measuring instruments.
- Comparison chart related to conventional Vs electronic instruments

MICROCONTROLLER AND EMBEDDED SYSTEMS			
Course Code	**24EEE35**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE35.1	Apply the concepts of embedded systems and addressing modes to develop programs.
24EEE35.2	Develop complex assembly language programs using 8051.
24EEE35.3	Analyze embedded C programs using 8051 special function registers.
24EEE35.4	Examine the interfacing of 8051 with external devices.
24EEE35.5	Evaluate embedded system concepts withATMEGA328P for engineering applications.
24EEE35.6	Design appropriate embedded system for complex engineering tasks.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE35.1	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE35.2	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE35.3	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE35.4	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE35.5	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE35.6	3	2	2	2	1	-	-	-	-	-	1	1	1

MODULE-1	**Introduction**	**24EEE35.1, 24EEE35.2**	**8 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, Addressing Modes.

Application	Temperature controller using microcontroller
Text Book	Text Book 1: 1.1, 2.1,2.2, 2.4, 2.5 Text Book 2: 1.2, 1.3

MODULE-2	**Assembly Language Programming**	**24EEE35.1, 24EEE35.2**	**8 Hours**

Assembly Language Programming Introduction to 8051 assembly programming, Instruction set: Data Transfer, Arithmetic and Logical Instructions, Branching and Looping Instructions- Programming

Self-study	Program to blink an LED at 1sec interval
Text Book	Text Book 1: 3.1,3.2,3.3 Text Book 2: 3,4,5

MODULE-3	**Embedded C Programming**	**24EEE35.2, 24EEE35.3**	**8 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**	**24EEE35.4, 24EEE35.6**	**8 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	**ATMEGA328P Microcontroller**	**24EEE35.5,**	**8 Hours**

		24EEE35.6	

Block/Pin Diagram – Introduction to Arduino IDE, Overview of Arduino platform, Features of Arduino UNO, Pinout and hardware specifications of ATmega328P, Programming environment (Arduino IDE), Arduino programming.

Applications	Investigate the suitability of using an Arduino Uno in a smart home lighting system, IoT projects, Education tools etc.
Text Book	Text Book 3: 2.1, 2.2, 3.3, 3.4, 3.5

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) 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) Programming Arduino: Getting Started with Sketches, Simon Monk, 2nd edition, 2016, McGraw Hill TAB publisher, ISBN: 978-1259641633

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.
5) https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-42735-8-bit-AVR-Microcontroller-ATmega328-328P_datasheet.pdf

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

24EEE36X-Ability Enhancement Course–III

MICROCONTROLLER INTERFACING AND CONTROL			
Course Code	**24EEE361**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE361.1	Apply 8051 microcontroller assembly language programs for basic operations on the memories
24EEE361.2	Use SFRs, delay subroutine to write 8051 microcontroller assembly language programs for data processing
24EEE361.3	Analyze embedded C program and interface the 8051 microcontrollers to the external world.
24EEE361.4	Recommend Automation work-flow in IoT enabled environment.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE361.1	3	3	3	3	2	-	-	-	-	-	-	2	2
24EEE361.2	3	3	3	3	2	-	-	-	-	-	-	2	2
24EEE361.3	3	3	3	3	2	-	-	-	-	-	-	2	2
24EEE361.4	3	3	3	3	2	-	-	-	-	-	-	2	2

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	24EEE361.1
2	To write an ALP for Arithmetic instruction: Addition, subtraction, multiplication and division. Square and cubeoperationsfor16-bitnumbers.	2	24EEE361.1, 24EEE361.2
3	To write an ALP for Boolean and logical instructions (bit manipulation)	2	24EEE361.1, 24EEE361.2
4	To write an ALP for Conditional call and return instructions	2	24EEE361.1
5	To write an ALP for code conversion programs: ASCII to decimal, Decimal to ASCII, Hexa to decimal and Decimal to Hexa	2	24EEE361.1, 24EEE361.2
6	To write an ALP for delay operations	2	24EEE361.1, 24EEE361.2
	PART-B		
7	To write an ALP and C Program using serial port and on-chip timer	2	24EEE361.3, 24EEE361.4
8	To write an ALP and C Program: 8051Interfacing with DC motor	2	24EEE361.3, 24EEE361.4
9	To write an ALP and C Program: 8051Interfacing with stepper Motor	2	24EEE361.3, 24EEE361.4

10	To write an ALP and C Program: 8051 Interfacing: DAC (waveform generation)	2	24EEE361.3, 24EEE361.4
11	To interface LED /Buzzer with Arduino and write a program to turn ON LED/Buzzer for 1sec after every 2seconds.	2	24EEE361.3, 24EEE361.4
12	To design and implement an automatic streetlight system using Arduino.	2	24EEE361.3, 24EEE361.4

PART-C

Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. Flash LED in 8051 Microcontroller
   http://ebootathon.com/labs/beta/ec/MicroprocessorAndMicrocontrollerLab/exp1/simulation.html
2. LCD Interfacing with 8051 Microcontroller
   https://embetronicx.com/tutorials/microcontrollers/8051/lcd-interfacing-with-8051-microcontroller/
3. Real Time Embedded Systems
   http://vlabs.iitkgp.ac.in/rtes/
4. Stepper Motor Control Using ATMEGA-16 Microcontroller
   http://vlabs.iitkgp.ac.in/rtes/exp10/index.html

CIE Assessment Pattern (50 Marks – Lab)

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

MATLAB PROGRAMMING FOR PROBLEM SOLVING

Course Code	**24EEE362**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE362.1	Make use of the software to perform basic mathematical operations.
24EEE362.2	Explore the utility of computational tools
24EEE362.3	Evaluate power system performance by analyzing three phase circuits
24EEE362.4	Analyze the electrical networks and electronics circuits to interpret system behavior

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE362.1	3	2	2	2	2	-	-	-	-	-	-	3	-
24EEE362.2	3	2	2	2	2	-	-	-	-	-	-	3	-
24EEE362.3	3	2	2	2	2	-	-	-	-	-	-	3	-
24EEE362.4	3	2	2	2	2	-	-	-	-	-	-	3	-

Pgm. No.	List of Programs	Hours	COs
	Prerequisite 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	24EEE362.1
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	24EEE362.2
3	Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, edit window, Shortcuts, Help files.	2	24EEE362.2
4	To write program using Matrix Constructors and Operator, Matrix Bitwise operator, Relational Operators and Logical Operator	2	24EEE362.2
5	To write a program to create 2-D and 3-D plots in MATLAB using the plot function to visualize data	2	24EEE362.3
6	To write and execute programs using control loop statement.	2	24EEE362.2
	PART-B		
7	Analyze a given electrical network by applying Network Theorems using MATLAB.	2	24EEE362.4
8	Analyze the basic electronics circuits using MATLAB.	2	24EEE362.4
9	Design and analysis of measurement of Real Power, Reactive Power and Power Factor in Three Phase Circuits using MATLAB.	2	24EEE362.3
10	Determination of ABCD parameter of transmission network.	2	24EEE362.4
11	To write a MATLAB program to find the impulse response and step response of a system from its difference equation.	2	24EEE362.4
12	Speed control of DC motor using MATLAB.	2	24EEE362.4

PART-C

Beyond Syllabus Virtual Lab Content
(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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	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	**24EEE363**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE363.1	Select different functions available in Lab VIEW for engineering applications
24EEE363.2	Analyze the concepts of virtual instrumentation and develop basic programs using loops
24EEE363.3	Evaluate user interfaces with charts, graph, and buttons
24EEE363.4	Use the Lab VIEW platform to create and analyze data acquisition systems

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE363.1	3	-	-	-	2	-	-	-	-	-	-	3	3
24EEE363.2	3	-	-	-	2	-	-	-	-	-	-	3	3
24EEE363.3	3	3	2	-	2	-	-	-	-	-	-	3	3
24EEE363.4	3	3	2	1	2	-	-	-	-	-	-	3	3

Pgm. No.	List of Programs	Hours	COs
	Prerequisite Programs		
	• 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	24EEE363.1
2	To perform Boolean operations: AND, OR, XOR, NOT and NAND using LabVIEW.	2	24EEE363.1
3	To find the Sum of 'n' numbers using 'for' loop and 'while' loop.	2	24EEE363.3
4	To perform the Factorial of a given number using 'for' loop and 'while' loop.	2	24EEE363.3
5	To sort even numbers using 'while' loop in an array.	2	24EEE363.3
6	To find the maximum and minimum variable from an array.	2	24EEE363.2
	PART-B		
7	To create a sine wave using formula node.	2	24EEE363.2
8	Build a Virtual Instrument which adds two sine waves of different frequencies and displays the result in a graph.	2	24EEE363.1
9	To apply filtering technique (median filter) for a given input signal.	2	24EEE363.1
10	To build a Virtual Instrument that converts Celsius to Fahrenheit.	2	24EEE363.4
11	To build a Virtual Instrument for acquiring and continuously displaying a thermocouple signal.	2	24EEE363.4
12	To acquire and analyze an ECG signal using NI ELVIS LabVIEW.	2	24EEE363.4

PART-C

Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. Simulations in LabVIEW
   https://www.youtube.com/watch?v=X6oRczEDOao
2. LabVIEW Formula Node
   https://www.youtube.com/watch?v=m5z_5j6iu2M
3. LabVIEW Mathscript
   https://www.youtube.com/watch?v=dQjmzEM8YKc
4. 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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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) 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
4) 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	**24EEE364**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE364.1	Identify the applications of 555 timers
24EEE364.2	Interpret the multivibrator circuits using IC555
24EEE364.3	Analyze multivibrator circuits using op-amp and 555Timer
24EEE364.4	Design and test LED circuits, Alarm Circuits and generate pulse, frequency shift keying using 555 timer

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE364.1	3	3	3	3	-	-	-	-	-	-	-	3	-
24EEE364.2	3	3	3	3	-	-	-	-	-	-	-	3	-
24EEE364.3	3	3	3	3	-	-	-	-	-	-	-	3	-
24EEE364.4	3	3	3	3	-	-	-	-	-	-	-	3	-

Pgm. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	• **555 IC Architecture, pin diagram and timer applications.** • **Digital logic circuits basics**	2	NA
	PART-A		
1	Construct Astable Multivibrator circuit using IC-555 Timer	2	24EEE364.1, 24EEE364.2
2	Construct Mono-stable Multivibrator circuit using IC-555 Timer	2	24EEE364.1, 24EEE364.2
3	Construct bistable multivibrator using 555 timer	2	24EEE364.1
4	Generate Pulse Width Modulator (PWM) signal using IC-555 Timer.	2	24EEE364.1, 24EEE364.2
5	Construct Burglar Alarm circuit using IC-555 Timer.	2	24EEE364.1, 24EEE364.2
	PART-B		
6	Construct and generate Frequency Shift Keying (FSK) signal using IC-555 Timer.	2	24EEE364.3, 24EEE364.4
7	Construct and test Running LED circuit using IC-555 Timer.	2	24EEE364.3, 24EEE364.4
8	Construct water level indicator using IC-555 Timer	2	24EEE364.3, 24EEE364.4
9	Construct continuity tester using IC-555 Timer	2	24EEE364.3, 24EEE364.4
10	Construct and test Sequential timer using IC-555.	2	24EEE364.3, 24EEE364.4
11	Construct and test Advanced Red LED Flasher.	2	24EEE364.3, 24EEE364.4
	PART-C		

Beyond Syllabus Virtual Lab Content
(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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)Design of Function Circuits with 555 Timer Integrated Circuit, By K.C. Selvam, ISBN 9781032391700
2)Op-Amps and Linear Integrated Circuits | Fourth Edition | By Pearson Paperback ,by Ramakant A. Gayakwad, ISBN-9789332549913

BIO INSPIRED DESIGN AND INNOVATION

Course Code	**24EEE365**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

24EEE365.1	Apply the biomimetics principles for real life challenges
24EEE365.2	Investigate novel bioengineering initiatives by evaluating design and development principles
24EEE365.3	Apply the bio computing optimization through research and experiential learning.
24EEE365.4	Review the fundamental biological ideas through pertinent industrial applications and case studies

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
24EEE365.1	3	3	3	3	2	-	-	-	1	1	-	2	1	-
24EEE365.2	3	3	3	3	2	-	-	-	1	1	-	2	1	-
24EEE365.3	3	3	3	3	2	-	-	-	1	1	-	2	1	-
24EEE365.4	3	3	3	3	2	-	-	-	1	1	-	2	1	-

MODULE-1	**BIO-INSPIRED DESIGN AND ENGINEERING**	**24EEE365.1**	**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**	**24EEE365.2**	**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**	**24EEE365.3, 24EEE365.4**	**3 Hours**

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

Self-study / Case Study / Applications	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 COMPUTING AND OPTIMISATION**	**24EEE365.5**	**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 / Case Study / Applications	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 INNOVATIONS**	**24EEE365.6**	**3 Hours**

Bioinspired innovations in– Automotive, Automation, Materials and Manufacturing, Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), Eco-restorations (Eco-friendly pesticide).	
Self-study / Case Study /Applications	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	-	-
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	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
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

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, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021

3) Wann D, "Bio Logic: Designing with nature to protect the environment", Wiley Publisher, 1994

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%20Design%20Workshop%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

DESIGN THINKING AND FABRICATION

Course Code	**24DTK37/47**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**01**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

24DTK37/47.1	Identify innovation opportunities through real-world problem analysis and observation.
24DTK37/47.2	Propose a product or service idea using technical knowledge and feasibility insights.
24DTK37/47.3	Demonstrate empathy and creative thinking in the ideation and concept generation stages.
24DTK37/47.4	Design, prototype, and test functional models using appropriate tools and fabrication

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24DTK37/47.1	3	-	-	-	-	-	-	-	-	-	-	1	-
24DTK37/47.2	3	3	2	-	-	-	-	-	-	-	-	1	-
24DTK37/47.3	3	3	2	-	-	-	-	-	-	-	-	1	-
24DTK37/47.4	3	3	2	1	2	-	-	-	-	-	2	1	-

MODULE-1	**INTRODUCTION TO DESIGN THINKING**	**24DTK37/47.1 24DTK37/47.3**	**3 Hours**

Definition, origin, and key features of Design Thinking. Role of a Design Thinker in organisations. Core principles and stages of the Design Thinking process. Collaborative design thinking with examples of MVPS or prototyping

Self-study	Smart Agricultural Monitoring System
Text Book:	Text Book 1: 2.1,2.2,2.4,2.5,2.6,2.7 Text Book 2: Page No. 1-90

MODULE-2	**DESIGN THINKING METHODOLOGY**	**24DTK37/47.3**	**3 Hours**

Design Thinking Methodology: The 5 Stages of the Design Thinking Process- Empathise, define (the problem), Ideate, Prototype, and Test.

Self-study	Autonomous Drone for Aerial Surveillance
Text Book	Text Book 1:5.1,5.2,5.3 Text Book 2: Page No.100-124

MODULE-3	**TOOLS FOR DESIGN THINKING**	**24DTK37/47.1**	**3 Hours**

Ideation tools & exercises. Sample Design Challenge, Introduction to the Design Challenge Themes, Storytelling and Tools for Innovation.

Self-study	Smart Home Automation System
Text Book	Text Book 1:4.1,4.2,4.6,4.8,6.1,6.2,6.3 Text Book 2: Page No.125-138

MODULE-4	**EMPATHY MAPS**	**24DTK37/47.3**	**3 Hours**

Empathise-Understand customers, Empathy Maps, Empathise-Step into customers' shoes, Customer Journey Maps, Define- Analysis & Drawing Inferences from Research.

Self-study	Custom Drone with Payload Integration for Search and Rescue
Text Book	Text Book 1: 9.1,9.2,9.3,10.1,10.2,10.3,10.4 Text Book 2:Page No.139-146

MODULE-5	**DESIGN CHALLENGE AND PROTOTYPING**	**24DTK37/47.2 24DTK37/47.4**	**3 Hours**

The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing, Documentation, and the Pitching.

Self-study	Automated PCB Inspection System
Text Book	Text Book 1:3.1,3.2 Text Book 2: Page No.147 and 189

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking. ISBN-13: 978-1790435371
2) John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013. ISBN-13: 978-1111645823

Reference Books:

1) Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009. ISBN-13: 978-1422177808
2) Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve - Apply", Springer, 2011, ISBN-13: 978-3-642-13756-3
3) Yousef Haik and Tamer M. Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011. 48 , ISBN-13: 978-0495668145
4) Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author), ISBN-13: 978-0231163569

Web links and Video Lectures (e-Resources)

- https://www.ibm.com/design/thinking/
- https://www.ideou.com/pages/design-thinking

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

- Ergonomic Kitchen Tool Handle: Reverse Engineering and Redesign
- Customizable Modular Furniture System: From Concept to Prototype
- Rapid PCB Prototyping for Bluetooth Applications
- CNC Milling for Custom Circuit Board Fabrication
- Smart Motion Detection System Using Microprocessor
- IoT-Based Smart Home Automation System Using Microprocessor
- Design and Fabrication of Rotary Milling Fixture
- Design and Fabrication of Milling Vise Attachment on Lathe Machine
- AI-Driven Drone for Search and Rescue Operations
- Autonomous Drone for Wildfire Detection and Monitoring
- Drone-Based Delivery System for Emergency Medical Supplies

BASIC APPLIED MATHEMATICS-I
(Common to all Branches)

Course Code	**24DMAT31**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs. / Week	**2**	**Total Marks**	**50**
Credits	**0**	**Exam Hours**	**--**

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

24DMAT31.1	Know the principles of engineering mathematics through calculus
24DMAT31.2	Determine the power series expansion of a function
24DMAT31.3	Find the definite integrals with standard limits and also develop the ability to solve different types of differential equations
24DMAT31.4	Apply ideas from linear algebra in solving systems of linear equations and determine the Eigen values and Eigen vectors of a matrix

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	-
24DMAT31.1	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT31.2	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT31.3	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT31.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**DIFFERENTIAL CALCULUS**	24DMAT31.1 24DMAT31.2	**8 Hours**
Polar Curves-Problems on angle between the radius vector and tangent, Angle between two curves-Problems, Pedal equation for polar curves-Problems. Maclaurin's theorem for function of one variable (statement only)-Problems.			
Text Book	Text Book 1: 4.4, 4.7, 4.8, Text Book 2: 15.4		
MODULE-2	**PARTIAL DIFFERENTIATION**	24DMAT31.1	**8 Hours**
Definition and Simple problems, Euler's theorem for Homogeneous function (NO Derivation and NO extended theorem)-Problems, Jacobians of order two - definition and problems.			
Text Book	Text Book 1: 5.4, 5.7,		
MODULE-3	**INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS**	24DMAT31.3	**8 Hours**
Problems on evaluation of sin n x and cos n x integrals with standard limits (0 to π/2). Solution of first order and first-degree differential equations-Variable separable, Linear and Exact differential equations.			
Text Book	Text Book 1: 6.2, 11.6, 11.9, 11.11, Text Book 2: 1.3, 1.4, 1.5		
MODULE-4	**LINEAR ALGEBRA-1**	24DMAT31.4	**8 Hours**
Problems on rank of a matrix by elementary transformations, Solution of system of linear equations by Gauss elimination method-Problems.			
Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4		
MODULE-5	**LINEAR ALGEBRA-2**	24DMAT31.4	**8 Hours**
Linear transformation, Eigen values and Eigen Vectors of square matrix-Problems.			
Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.		

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5

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

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
2)https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
3)https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
4)https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
5)https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
6)https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
7)https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
8)https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
9)https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
10)https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
11)https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

FOURTH SEMESTER

SYLLABUS

COMPLEX ANALYSIS AND PROBABILITY
(Common to ECE, EEE & ME)

Course Code	**24MAE41**	**CIE Marks**	**50**
L:T:P:S	**2:1:0:0**	**SEE Marks**	**50**
Hrs. / Week	**4**	**Total Marks**	**100**
Credits	**3**	**Exam Hours**	**3**

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

24MAE41.1	Solve initial value problems using appropriate numerical methods
24MAE41.2	Apply the concepts of Complex variables, Transformations and Complex integration to solve Engineering Problems
24MAE41.3	Demonstrate the idea of Linear Dependence and Independence of sets in the vector space.
24MAE41.4	Gain ability to use probability distributions to analyze and solve real time problems
24MAE41.5	Apply the concept of sampling distribution to solve engineering problems and Use the concepts to analyze the data to make decision about the hypothesis

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	
24MAE41.1	3	3	-	-	-	-	-	-	-	-	-	-
24MAE41.2	3	3	-	-	-	-	-	-	-	-	-	-
24MAE41.3	3	3	-	-	-	-	-	-	-	-	-	-
24MAE41.4	3	3	-	-	-	-	-	-	-	-	-	-
24MAE41.5	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**NUMERICAL SOLUTIONS TO DIFFERENTIAL EQUATIONS**	**24MAE41.1**	**8 Hours**
Numerical solution of ordinary differential equations of first order and of first degree: Taylor's series method, Modified Euler's method and Runge-Kutta method of fourth-order-Problems. Milne's predictor and corrector methods-Problems. Numerical Solution of second order ordinary differential equations by Runge-Kutta method of fourth-order-Problems.			
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 32.12, Text Book 2: 21.1.		
MODULE-2	**COMPLEX ANALYSIS**	**24MAE41.2**	**8 Hours**
Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions-Problems 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 (with proof), Generalized Cauchy's integral formula			
Text Book	Text Book 1: 20.2, 20.4, 20.5, 20.6, 20.10, 20.14, Text Book 2: 13.1, 13.2, 13.3, 13.4.		
MODULE-3	**VECTOR SPACES AND LINEAR TRANSFORMATIONS**	**24MAE41.3**	**8 Hours**
Vector Space definition and examples, Subspaces and Spanning sets, Linear Dependence and Independence, Linear Independence and Spanning Sets, Bases: Orthogonal and Orthonormal bases and Dimension. Introduction to Linear Transformations and its properties.			
Text Book	Text Book 3: 4.1, 4.2, 4.3, 4.4, 4.5.		
MODULE-4	**PROBABILITY DISTRIBUTIONS**	**24MAE41.4**	**8 Hours**
Random variables (discrete and continuous), probability density functions, Discrete Probability distributions: Binomial and Poisson Distributions-Problems. Continuous Probability distributions: Exponential and Normal Distributions-Problems. Joint Probability Distribution-Problems.			
Text Book	Text Book 1: 26.7, 26.8, 26.9, 26.12, 26.14, 26.15, 26.16.		
MODULE-5	**SAMPLING THEORY**	**24MAE41.5**	**8 Hours**
Sampling, Sampling distributions, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem (without proof), Confidence limits for means, Student's t-distribution, F-distribution and Chi-Square test for test of goodness of fit for small samples.			
Text Book	Text Book 1: 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 27.10, 27.11, 27.12, 27.14, 27.15, 27.16, 27.17, 27.19.		

List of Tutorial Contents

Sl. No.	Contents	COs
1.	Use Runge-Kutta method of fourth-order to solve first order and of first-degree ordinary differential equations.	24MAE41.1
2.	Use Runge-Kutta method of fourth-order to solve second order ordinary differential equations.	24MAE41.1
3.	Applications of Flow Problems-Velocity potential, Stream functions	24MAE41.2

4.	Find the images/regions in the w-plane bounded regions under the transformation $W = z^2$. $W = e^z$	24MAE41.2
5.	Use Wronskian to test a set of solutions of a linear homogeneous differential equation for linear independence.	24MAE41.3
6.	Usage of linear transformation for scale rotate and manipulate images	24MAE41.3
7.	Use of Binomial Distribution in real life problems.	24MAE41.4
8.	Use of Normal Distribution in real life problems.	24MAE41.4
9.	Use Student's t-distribution to test goodness of fit for small samples.	24MAE41.5
10.	Use Chi-square distribution to test goodness of fit for small samples.	24MAE41.5

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
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	5
L2	Understand	5
L3	Apply	15
L4	Analyze	15
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, 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, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

1)https://youtu.be/4lCiEnuhbA4?si=My95pvqwAMRDfjid
2)https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
3)https://youtu.be/bI46OqXUtd8?si=_Po-jfjq_94X4p_O
4)https://youtu.be/NqZUHJgitHk?si=Y6viSg1DFA4hgM9u
5)https://youtu.be/oPPJNoKYCro?si=A5zWC_vQQaHY7HlQ
6)https://youtu.be/hll0DAilhoA?si=2dN3KfJMBy9ZGxjD
7)https://youtu.be/x6X1P8rGXXs?si=YcmH8nxx1iQwq8mA
8) https://youtu.be/q3xj16shDuw?si=ewdlKAC8UEc6oRQV
9) https://youtu.be/89Z0tOvHjNU?si=3jT-oriJZaC1kSzx
10) https://youtu.be/dOr0NKyD31Q?si=dMBU-BXGdGL6jIZy
11) https://youtu.be/BR1nN8DW2Vg?si=melzz97SqhK3wr--
12)https://youtu.be/z0Ry_3_qhDw?si=6IG2a65BZgdbaKsn

13)https://youtu.be/36cAE1Ovpq4?si=jfR8gkFmMOCkWNZ_
14)https://youtu.be/vFz2FG65HBc?si=SCHi3Y1XuHWg-pPT
15)https://youtu.be/2Dsz1lZBJ3Y?si=8ATLUE-mkJSMewO3

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

ANALOG ELECTRONICS AND INTEGRATED CIRCUITS

Course Code	**24EEE42**	**CIE Marks**	**50**
L: T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE42.1	Understand the principle of basic semiconductor devices and its performance characteristics.
24EEE42.2	Apply mathematical knowledge to design and compare transistor amplifiers.
24EEE42.3	Analyze the power amplifier circuits and oscillators for different frequencies.
24EEE42.4	Choose proper operational amplifiers depending upon application and technological upgradation.
24EEE42.5	Design different electronics circuits to meet the specified needs.
24EEE42.6	Apply the knowledge of analog and integrated circuits to address the real-life problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE42.1	3	3	-	3	1	-	-	-	-	-	1	1	1
24EEE42.2	3	3	2	3	1	-	-	-	-	-	1	1	1
24EEE42.3	2	3	3	3	1	-	-	-	-	-	1	1	1
24EEE42.4	3	3	3	3	1	-	-	-	-	-	1	1	1
24EEE42.5	3	3	3	3	1	-	-	-	-	-	1	1	1
24EEE42.6	3	2	2	1	1	-	-	-	-	-	1	1	1

MODULE-1	**DIODE CIRCUITS AND TRANSISTOR DC BIASING**	**24EEE42.2, 24EEE42.5**	**8 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**	**24EEE42.1, 24EEE42.3 24EEE42.6**	**8 Hours**

BJT transistor modeling- hybrid equivalent model - emitter follower, analysis using h – parameter model- CB 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 h-parameter hybrid model
Text Book	Text Book 1: 5.4, 5.5, 5.6,5.8,5.19

MODULE-3	**POWER AMPLIFIERS, FEEDBACK AMPLIFIER AND OSCILLATOR**	**24EEE42.3, 24EEE42.6**	**8 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.

Self-study	Design of class B push-pull amplifier using suitable software
Text Book	Text Book 2: 13.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	**OPERATIONAL AMPLIFIERS**	**24EEE42.4, 24EEE42.6**	**8 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	Schmitt Trigger
Text Book	Text Book 3: 2.1, 2.7, 3.3-3.8

MODULE-5	COMPARATORS & ACTIVE FILTERS	24EEE42.5, 24EEE42.6	8 Hours

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

Case study	Design of zero crossing detector circuit using an op-amp
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	10	5	-
L5	Evaluate	-	-	-
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) Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, PHI, 11th Edition, 2015. ISBN: 9332542600
2) Electronics Devices and Circuits, David A.Bell, PHI, 5thEdition, 2008. ISBN: 019569340X
3) Operational amplifiers and linear IC's, David A Bell, Oxford University Press, 2014, ISBN: 9780195696134

Reference Books:

1) Integrated Electronics, Jacob Millman & Christos, C. Halkias, Tata-McGraw Hill, 2ndEdition, 2010. ISBN:9780070151420
2) Fundamentals of Analog Circuits, Thomas L Floyd, Pearson,2ndedition,2012, ISBN: 0130606197
3) Electronic Devices and Circuits, S.Salivahanan, N.Suresh, McGrawHill,3rdedition,2013 ISBN: 978-0070660847
4) Op-Amps, Design, Applications and Trouble Shooting, Elsevier, 2ndEdition, 2015. ISBN: 9780750697026.
5) Linear Integrated Circuits, S.Salivahanan, V S Kanchana, Bhasskaran Mc Graw Hill, August 2018. ISBN: 9789351342885
6) Operational Amplifiers & Linear Integrated Circuits Theory and Application / 3E, James M. Fiore Version 3.2.6, 07 May 2021, 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

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

- Video demonstration of latest trends in analog electronics
- Organizing Group wise discussions on real world project
- Seminars on types of amplifier
- Experiential learning through lab experiments

ANALOG ELECTRONICS AND INTEGRATED CIRCUITS LABORATORY

Course Code	**24EEL42**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEL42.1	Apply the knowledge of different analog electronic components
24EEL42.2	Analyze the characteristics of semiconductor diodes and implement various analog circuits.
24EEL42.3	Choose various analog and integrated circuits according to the applications
24EEL42.4	Compare different filter circuits and its characteristics

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEL42.1	3	3	2	2	-	-	-	-	-	-	1	2	-
24EEL42.2	3	3	2	2	-	-	-	-	-	-	1	2	-
24EEL42.3	3	3	3	3	-	-	-	-	-	-	1	2	-
24EEL42.4	3	3	3	3	-	-	-	-	-	-	1	2	-

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments		
	• Demonstration for measuring instruments-Multimeter, CRO • Basic idea about electronic circuits and its operation • Familiarization of the components and equipment used in the lab, Ex: Resistors, Capacitors	2	NA
	PART-A		
1	Design and implementation of Half-wave rectifiers with and without capacitor filter	2	24EEL42.1, 24EEL42.2,
2	Design and implementation of Full-wave rectifiers with and without Capacitor filter	2	24EEL42.1, 24EEL42.2
3	Design and implementation of Clipper and clamper circuits	2	24EEL42.1, 24EEL42.2
4	Design and implementation of Zener voltage regulator	2	24EEL42.1, 24EEL42.2
5	Design and Implementation of Series Voltage Regulator	2	24EEL42.2
6	Design and Implementation of RC coupled amplifier	2	24EEL42.2
	PART-B		
7	Design and Implementation of Class B Push-Pull amplifier	2	24EEL42.2
8	Design and Implementation of RC Phase Shift Oscillator	2	24EEL42.2
9	Design and verify the operation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator	2	24EEL42.3
10	Design and realize to analyze the frequency response of an op – amp amplifier under inverting and non -inverting configuration for a given gain	2	24EEL42.3
11	Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP)	2	24EEL42.3
12	Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c) band pass filters for a given cut off frequency/frequencies to verify the frequency response characteristic	2	24EEL42.4

PART-C

Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

1. Zener diode voltage regulator- https://be-iitkgp.vlabs.ac.in/exp/voltage-regulator/
2. RC frequency response- https://be-iitkgp.vlabs.ac.in/exp/frequency-response/
3. Inverting and non-inverting op-amp- https://be-iitkgp.vlabs.ac.in/exp/non-inverting-amplifiers/
4. Differentiator and integrator using op-amp- https://be-iitkgp.vlabs.ac.in/exp/operational-amplifier/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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) Integrated Electronics, Jacob Millman &Christos, C.Halkias,Tata-McGrawHill,2nd Edition,2010. ISBN:9780070151420

2)Fundamentals of Analog Circuits, Thomas L Floyd, Pearson,2nd edition,2012, ISBN: 0130606197

3)Electronic Devices and Circuits, S. Salivahanan, N. Suresh, McGrawHill,3rd edition,2013 ISBN: 978-0070660847

4) Op-Amps, Design, Applications and Trouble Shooting, Elsevier, 2ndEdition, 2015. ISBN:9780750697026.

DIGITAL LOGIC DESIGN

Course Code	**24EEE43**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE43.1	Apply Boolean reduction technique to simplify digital logic circuits
24EEE43.2	Recommend combinational logic circuits for specific applications
24EEE43.3	Analyze synchronous and asynchronous digital logic circuits
24EEE43.4	Design sequential logic systems using appropriate state models and flip-flop- based configuration
24EEE43.5	Construct optimized digital circuits for the desired specification using counters and shift registers
24EEE43.6	Develop Verilog HDL code for combinational and sequential circuit implementations

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE43.1	3	3	2	2	1	-	-	-	-	-	1	1	2
24EEE43.2	3	3	3	2	1	-	-	-	-	-	1	1	2
24EEE43.3	3	3	3	3	1	-	-	-	-	-	1	1	3
24EEE43.4	3	3	3	2	1	-	-	-	-	-	1	1	2
24EEE43.5	3	3	3	2	1	-	-	-	-	-	1	1	2
24EEE43.6	3	3	3	2	1	-	-	-	-	-	1	1	2

MODULE-1	**COMBINATIONAL LOGIC CIRCUITS**	**24EEE43.1**	**8 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**	**24EEE43.2**	**8 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**	**24EEE43.3, 24EEE43.4**	**8 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**	**24EEE43.5**	**8 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**	**24EEE43.6**	**8 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

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

DIGITAL LOGIC DESIGN LABORATORY

Course Code	**24EEL43**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEL43.1	Apply Boolean Algebra and Simplification tools for solving problems
24EEL43.2	Analyze the operation of combinational and sequential logic circuits
24EEL43.3	Use EDA tool to develop digital logic circuits
24EEL43.4	Evaluate the logic circuits to draw conclusions based on RTL synthesis

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEL43.1	3	2	2	1	-	-	-	-	-	-	-	-	2
24EEL43.2	2	3	2	1	-	-	-	-	-	-	-	-	2
24EEL43.3	2	2	2	1	3	-	-	-	-	-	-	-	2
24EEL43.4	2	2	2	3	3	-	-	-	-	-	-	-	2

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	24EEL43.1 24EEL43.2
2	Realization of Half/Full adder and Half/Full Subtractors using logic gates.	2	24EEL43.1 24EEL43.2
3	MUX/DEMUX – use of 74153, 74139 for arithmetic circuits and code converter.	2	24EEL43.1 24EEL43.2
4	Realization of One/Two-bit comparator and study of 7485 magnitude comparator.	2	24EEL43.1 24EEL43.2
5	Truth table verification of Flip-Flops: (i) JK Master slave (ii) T type and (iii) D type.	2	24EEL43.1 24EEL43.2
6	Realization of 3-bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).	2	24EEL43.1 24EEL43.2
	PART-B		
7	Develop a Verilog module for full adder and parallel adder. Test the modules using test bench	2	24EEL43.3 24EEL43.4
8	Develop a Verilog module for 8 to 1 Mux. Test the modules using test bench	2	24EEL43.3 24EEL43.4
9	Develop a Verilog module for 8 to 3 Priority Encoder. Test the modules using test bench	2	24EEL43.3 24EEL43.4
10	Develop a Verilog module for D, SR, JK and T Flip Flops. Test the modules using test bench	2	24EEL43.3 24EEL43.4
11	Develop a Verilog module for counters. Test the modules using test bench	2	24EEL43.3 24EEL43.4
12	Develop a Verilog module for Shift Register. Test the modules	2	24EEL43.3 24EEL43.4

PART-C

Beyond Syllabus Virtual Lab Content

(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)

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

SYNCHRONOUS AND INDUCTION MACHINES

Course Code	**24EEE44**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE44.1	Explain the operating principles and performance characteristics of three phase induction motor.
24EEE44.2	Identify appropriate starting and speed control technique(s) for three phase induction motors.
24EEE44.3	Analyze the starting mechanisms of single-phase induction motors for practical applications.
24EEE44.4	Design the winding layout and predetermine the regulation of synchronous generators using standard methods
24EEE44.5	Analyze the behaviour of synchronous motors and power factor correction techniques
24EEE44.6	Choose appropriate AC machines for real time applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE44.1	3	2	1	1	-	-	-	-	-	-	-	-	1
24EEE44.2	3	2	2	1	-	-	-	-	-	-	-	-	1
24EEE44.3	3	2	1	1	-	-	-	-	-	-	-	-	1
24EEE44.4	3	2	2	2	-	-	-	-	-	-	-	-	1
24EEE44.5	3	2	2	2	-	-	-	-	-	-	-	-	1
24EEE44.6	3	2	2	2	-	-	-	-	-	-	-	-	1

MODULE-1	**THREE PHASE INDUCTION MACHINES**	**24EEE44.1, 24EEE44.6**	**8 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**	**24EEE44.2, 24EEE44.6**	**8 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**	**24EEE44.3, 24EEE44.6**	**8 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**	**24EEE44.4, 24EEE44.6**	**8 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**	**24EEE44.4, 24EEE44.6**	**8 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	-
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://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	**24EEL44**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEL44.1	Investigate various speed control techniques of induction motors
24EEL44.2	Evaluate the performance of induction and synchronous machines
24EEL44.3	Analyze load sharing among different alternators
24EEL44.4	Choose a suitable starter for various applications

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEL44.1	3	3	2	2	-	-	-	-	1	-	1	-	1
24EEL44.2	3	3	2	2	-	-	-	-	1	-	1	-	1
24EEL44.3	3	3	2	2	-	-	-	-	1	-	1	-	1
24EEL44.4	3	3	2	2	-	-	-	-	1	-	1	-	1

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	Introduction to Synchronous and Induction Machines	2	NA
	PART-A		
1	Load test on single phase induction motor	2	24EEL44.2
2	No load and Blocked rotor tests on single phase Induction motor	2	24EEL44.2
3	Load test on three phase induction motor	2	24EEL44.2
4	No load and Blocked rotor tests on three phase squirrel cage Induction motor	2	24EEL44.2
5	Speed control of three phase slip-ring induction motor	2	24EEL44.1
6	Study of starters: DOL and Star-Delta starters	2	24EEL44.4
	PART-B		
7	Regulation of three phase alternator by EMF Method	2	24EEL44.2
8	Regulation of three phase alternator by MMF Method	2	24EEL44.2
9	Regulation of three phase alternator by ZPF Method	2	24EEL44.2
10	Slip test and determination of regulation on Salient pole synchronous machine	2	24EEL44.2
11	Parallel operation of alternators	2	24EEL44.3
12	V and Inverted V curves of a synchronous motor	2	24EEL44.3

PART-C

Beyond Syllabus Virtual Lab Content

(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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	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/

24EEE45X-PEC COURSES

ELECTROMAGNETIC FIELD THEORY			
Course Code	**24EEE451**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE451.1	Understand the basic concepts of electrostatics and magneto statics
24EEE451.2	Analyze electric potential, energy density and boundary condition in conductors and dielectrics
24EEE451.3	Apply Poisson's, Laplace Equations and integral theorems in evaluating steady magnetic fields
24EEE451.4	Evaluate the behaviour of magnetic materials under different conditions
24EEE451.5	Interpret the Faraday's law, Displacement current, Maxwell's equations
24EEE451.6	Examine the basic concepts of electromagnetic waves and characterizing parameters

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE451.1	3	2	2	2	-	-	-	-	-	-	1	-	-
24EEE451.2	3	3	3	2	-	-	-	-	-	-	1	-	-
24EEE451.3	3	3	3	3	-	-	-	-	-	-	1	-	-
24EEE451.4	3	3	3	3	-	-	-	-	-	-	1	-	-
24EEE451.5	3	2	2	2	-	-	-	-	-	-	1	-	-
24EEE451.6	3	3	3	3	-	-	-	-	-	-	1	-	-

MODULE-1	**VECTOR ANALYSIS AND ELECTROSTATICS**	**24EEE451.1**	**8 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**	**24EEE451.2**	**8 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**	**24EEE451.3**	**8 Hours**

Derivations and problems, Uniqueness theorem.
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**	**24EEE451.4**	**8 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, magnetisation 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**	**24EEE451.5, 24EEE451.6**	**8 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
4) 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	**24EEE452**	**CIE Marks**	**50**
L: T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE452.1	Compare the Generation and Detection of Analog modulation techniques
24EEE452.2	Evaluate the Power consumption and Bandwidth utilization in Analog modulation techniques
24EEE452.3	Examine the statistical averages associated with random processes
24EEE452.4	Apply the fundamentals of digital Communication for baseband signal processing and coding
24EEE452.5	Categorize digital modulation techniques based on Bit Error Rate performance
24EEE452.6	Estimate the signal in presence of noise by appropriate receiver design

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE452.1	3	2	-	-	2	-	-	-	-	-	-	1	1
24EEE452.2	3	2	1	-	3	-	-	-	-	-	-	1	1
24EEE452.3	3	2	1	-	2	-	-	-	-	-	-	1	1
24EEE452.4	3	2	-	2	2	-	-	-	-	-	-	1	1
24EEE452.5	3	2	1	2	3	1	-	-	-	-	-	1	1
24EEE452.6	3	2	1	2	3	2	1	-	-	-	-	1	1

MODULE-1	**ANALOG MODULATION**	**24EEE452.1, 24EEE452.2**	**8 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**	**24EEE452.3**	**8 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**	**24EEE452.4**	**8 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**	**24EEE452.5**	**8 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	24EEE452.6	8 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
3) 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	**24EEE453**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE453.1	Understand the working of electric heating and welding systems
24EEE453.2	Identify the different lighting system for various requirement
24EEE453.3	Analyze the concept of Electric Drives and Traction systems
24EEE453.4	Examine the performance of refrigeration and air conditioning systems and propose improvements for efficiency.
24EEE453.5	Analyze the impact of energy conservation strategies and evaluate effective energy management practices.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE453.1	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE453.2	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE453.3	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE453.4	3	2	2	2	1	-	-	-	-	-	1	1	1
24EEE453.5	3	2	2	2	1	-	-	-	-	-	1	1	1

MODULE-1	**ELECTRIC HEATING & WELDING**	**24EEE453.1**	**8 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**	**24EEE453.2**	**8 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**	**24EEE453.3**	**8 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**	**24EEE453.4**	**8 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 transformer.
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**	**24EEE453.5**	**8 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://archive.nptel.ac.in/content/storage2/courses/108106022/LECTURE%201.pdf
- https://nptel.ac.in/courses/108105060
- https://archive.nptel.ac.in/content/storage2/courses/108105061/Illumination%20%20Engineering/Lesson-01/pdf

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	**24EEE454**	**CIE Marks**	**50**
L: T:P:S	**2:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2+2**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

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

24EEE454.1	Discuss the concepts of OOP to write special functions and I/O programs
24EEE454.2	Use governing principles of Java for writing advanced programs and troubleshooting mechanisms
24EEE454.3	Analyze the Java control structures, I/O operations and file operations
24EEE454.4	Analyze the Inheritance, Interface and Package to optimize Java program
24EEE454.5	Explain the exception handling mechanisms and its implementations
24EEE454.6	Develop Java frameworks using Java Swing

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE454.1	3	2	2	3	3	-	-	-	-	-	-	-	1
24EEE454.2	3	2	2	3	3	-	-	-	-	-	-	-	1
24EEE454.3	2	3	2	3	3	-	-	-	-	-	-	-	1
24EEE454.4	2	3	2	3	3	-	-	-	-	-	-	-	1
24EEE454.5	2	2	1	3	3	-	-	-	-	-	-	-	1
24EEE454.6	2	2	3	3	3	-	-	-	-	-	-	-	1

MODULE-1	**Introduction to Java**	**24EEE454.1, 24EEE454.3**	**4 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: **3 Hours**

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

Text Book	Text Book 1: 3,4,5

MODULE-2	**Objects, Classes and Constructors**	**24EEE454.1**	**4 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: **3 Hours**

1) Write a JAVA program to demonstrate method overloading.
2) Write a JAVA program to demonstrate Arrays.
3) Write a Java Program to define a class, describe its constructor & overload the Constructors.

Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**Inheritance, Interface and Package**	**24EEE454.2, 24EEE454.4**	**4 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) Write a JAVA program to implement single inheritance. 2) Write a JAVA program to demonstrate use of method overriding. 3) Write a JAVA program to demonstrate the use of implementing interfaces.			**3 Hours**
Text Book	Text Book 2:2.5, 3.1, 3.3, 4.1		
MODULE-4	**Exception Handling and Files**	**24EEE454.3, 24EEE454.5**	**4 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) Write a JAVA program to implement the concept of Exception Handling using predefined exception. 2) Write a JAVA program to implement the concept of Exception Handling by creating user defined exceptions 3) Write a JAVA program to demonstrate File I/O Operations.			**3 Hours**
Text Book	Text Book 2: 5.1, 5.2, 5.3		
MODULE-5	**Multithreading and Java Swing**	**24EEE454.2, 24EEE454.6**	**4 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, JMenu, JSlider			
Laboratory Component: 1) Write a JAVA program to implement multithreading. 2) Write a JAVA program to add a label and button in a frame. 3) Write a JAVA program to create a table and show some data.			**3Hours**
Text Book	Text Book 3: 10,11		

CIE Assessment Pattern (50 Marks – Theory and Lab)

RBT Levels		Marks Distribution		
		Test (s)	AAT1	Lab
		25	05	20
L1	Remember	-	-	-
L2	Understand	10	-	-
L3	Apply	10	5	10
L4	Analyze	5	-	10
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	--
L2	Understand	10
L3	Apply	25
L4	Analyze	15
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Herbert Schildt, Java™: The Complete Reference, McGraw-Hill, 12th edition, November 2021, ISBN: 978-1-260-46341-5
2) Cay S. Horstmann, Core Java® SE 9 for the Impatient, Addison Wesley, Second Edition, 2018, ISBN: 978-013-4694726
3)Debasis Samantha, Object oriented Programming with Java, cse.iitkgp.ac.in/~dsamanta/java/index.htm

Reference Books:

1) SAMS teach yourself Java–2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education. ISBN: 978-0672324550
2) Ken Kousen, Modern Java Recipes, O'Reilly Media, Inc., 2017, ISBN: 9781491973172

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc19_cs84/preview
- https://java-programming.mooc.fi/part-1

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

- Experiential learning approach through lab sessions
- Video demonstration of coding using JAVA
- Collaborative learning through lab sessions
- Seminar on exception handling mechanism in JAVA

MACHINE LEARNING FUNDAMENTALS			
Course Code	**24EEE455**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**3**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

24EEE455.1	Understand the basics of machine learning
24EEE455.2	Apply the different learning algorithms for prediction
24EEE455.3	Develop skills to analyze and evaluate the performance of machine learning models using appropriate metrics and techniques.
24EEE455.4	Analyse a model to solve classification /clustering problems using supervised or unsupervised machine learning algorithms.
24EEE455.5	Evaluate the performance of various machine learning algorithms using different real world data sets.
24EEE455.6	Apply ML algorithms for solving practical applications related to electrical and electronics engineering

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE455.1	3	-	-	-	2	-	-	-	-	-	-	-	-
24EEE455.2	3	-	-	-	2	-	-	-	-	-	-	-	2
24EEE455.3	3	3	-	-	2	-	-	-	-	-	-	-	3
24EEE455.4	3	3	3	-	2	-	-	-	-	-	-	-	3
24EEE455.5	3	3	3	3	2	-	-	-	-	-	-	-	3
24EEE455.6	3	3	3	3	3	-	-	-	-	-	-	-	3

MODULE-1	**INTRODUCTION TO MACHINE LEARNING**	**24EEE455.1 24EEE455.2**	**8 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**	**24EEE455.1 24EEE455.2 24EEE455.3 24EEE455.4**	**8 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**	**24EEE455.1 24EEE455.2 24EEE455.3 24EEE455.4**	**8 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	24EEE455.5	8 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**	**24EEE455.5 24EEE455.6**	**8 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

24EEE46X -Ability Enhancement Course–IV

AUTOCAD FOR ELECTRICAL ENGINEERING			
Course Code	**24EEE461**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE461.1	Use various symbols and notations in electrical and electronics engineering drawings.
24EEE461.2	Analyze simple electrical circuits using Simulation software
24EEE461.3	Evaluate electronics circuits using Simulation software
24EEE461.4	Design a PCB layout for different electronic circuits

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE461.1	3	3	3	3	2	-	-	-	1	-	1	3	1
24EEE461.2	3	3	3	3	2	-	-	-	1	-	1	3	1
24EEE461.3	3	3	3	3	2	-	-	-	1	-	1	3	1
24EEE461.4	3	3	3	3	2	-	-	-	1	-	1	3	1

Pgm. No.	List of Programs	Hours	COs
	Prerequisite 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	24EEE461.1
2	Basic procedure to be adopted for computer aided drawings of electrical machines: Electrical machines – AC and DC, motor	2	24EEE461.1
3	Basic procedure to be adopted for computer aided drawings of windings: A.C. and D.C. winding diagrams	2	24EEE461.1
4	Basic procedure to be adopted for computer aided drawings of electronic components I: Resistor, Inductor, transformer and Capacitor	2	24EEE461.1
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	24EEE461.1
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	24EEE461.1
	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	24EEE461.2
8	Simulation of electrical machines - Electrical machines circuits: Graphics, Plot, sub plot, label, legend	2	24EEE461.2
9	Simulation of electronic circuit - Half wave, full wave and bridge rectifier, Power amplifier and voltage amplifier	2	24EEE461.3
10	Simulation of electronic circuits - Different types of oscillators circuits	2	24EEE461.3

11	Overview of software for PCB design, PCB layout of rectifier circuit	2	24EEE461.4
12	PCB layout of amplifier circuit		24EEE461.4

PART-C

Beyond Syllabus Virtual Lab Content
(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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) 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	**24EEE462**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEE462.1	Understand the basic concept of Arduino development board to perform different tasks
24EEE462.2	Identify the importance of Microcontroller in the functioning of embedded systems
24EEE462.3	Interface Arduino to the cloud, interact with online services, and control devices remotely
24EEE462.4	Analyze different types of actuators, such as servo motors, DC motors, and stepper motors

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE462.1	3	3	3	3	2	-	-	-	1	-	-	-	1
24EEE462.2	3	3	3	3	2	-	-	-	1	-	-	-	1
24EEE462.3	3	3	3	3	2	-	-	-	1	-	-	-	1
24EEE462.4	3	3	3	3	2	-	-	-	1	-	-	-	1

Pgm. No.	List of Programs	Hours	COs
	Prerequisite 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	24EEE462.1
2	To read analog input from a potentiometer and generate analog output using PWM to vary LED brightness on the Arduino Mega.	2	24EEE462.1
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	24EEE462.2
4	Speed and direction control of a DC motor using PWM signals and H-Bridge motor driver with the Arduino Mega.	2	24EEE462.2
5	To rotate a servo motor to specific angles using PWM signals generated by the Arduino Mega.	2	24EEE462.2
6	Movement control of a stepper motor in precise steps and set direction using the Arduino Mega.	2	24EEE462.3
	PART-B		
7	Build a basic circuit using Arduino to blink an LED at regular intervals, demonstrating the use of digital output and basic programming logic.	2	24EEE462.3
8	Interfacing a DHT11 or DHT22 sensor with Arduino to measure and display real-time temperature and humidity readings on the serial monitor.	2	24EEE462.3
9	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	24EEE462.4

10	Interfacing a sensor (e.g., temperature, humidity, or distance sensor) with Arduino and send real-time data to a cloud platform like ThingSpeak or Blynk for remote monitoring.	2	24EEE462.4
11	Interfacing a 16x2 character LCD with Arduino and display custom text or sensor data in real-time.	2	24EEE462.4
12	To read analog input from a potentiometer and use it to control the brightness of an LED (using PWM) or to position a servo motor.	2	24EEE462.4

PART-C

Beyond Syllabus Virtual Lab Content
(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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	**24EEE463**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

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

24EEE463.1	Analyse the fundamentals of industrial robots and simulation environments.
24EEE463.2	Navigate and utilize the RoboDK interface for robot simulation.
24EEE463.3	Develop and simulate robot programs using RoboDK's built-in tools.
24EEE463.4	Assess robot programming skills to solve real-world industrial automation problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE463.1	3	3	3	3	2	-	-	-	-	-	-	-	2
24EEE463.2	3	3	3	3	2	-	-	-	-	-	-	-	2
24EEE463.3	3	3	3	3	2	-	-	-	-	-	-	-	2
24EEE463.4	3	3	3	3	2	-	-	-	-	-	-	-	2

Pgm. No.	List of 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	24EEE463.1
2	Practice on various I/O instructions	2	24EEE463.1, 24EEE463.2
3	Practice on Set/Wait, Branching Instructions and movement conversion	2	24EEE463.1, 24EEE463.2
4	Program to Pick and Place application	2	24EEE463.3
5	Program on Palletizing and depalletizing	2	24EEE463.3
6	Program on Collision Detection	2	24EEE463.3
	PART-B		
7	Program on testing, editing & touch up.	2	24EEE463.2
8	Program on using and setting up of User and tool frame.	2	24EEE463.2
9	Program on automated welding and spot welding.	2	24EEE463.4
10	Program on Deburring and Cutting	2	24EEE463.4
11	Robotic CNC or 3D printing simulation	2	24EEE463.4
12	Exporting & Testing Programs on Real Robots (if available).	2	24EEE463.4

PART-C

Beyond Syllabus Virtual Lab Content
(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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) RoboDK User Manual.
2) Robotics Technology and flexible automation, Deb S.R, Tata McGraw-Hill Education, 2nd Edition, 2017, ISBN-13: 978-1259004732.
3) 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	**24EEE464**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEE464.1	Understand the characteristics of electronic components and basic electronic instruments.
24EEE464.2	Analyze the circuits with PCB design and identify the various processes involved
24EEE464.3	Explain the fabrication of Printed Circuit Boards
24EEE464.4	Perform assembling and testing of the PCB based electronic circuits

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE464.1	3	3	2	2	2	-	-	-	-	-	-	2	2
24EEE464.2	3	3	2	2	2	-	-	-	-	-	-	2	2
24EEE464.3	3	3	2	2	2	-	-	-	-	-	-	2	2
24EEE464.4	3	3	2	2	2	-	-	-	-	-	-	2	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	• Basic concepts of Electronics	2	NA
	PART-A		
1	Study of Electronic Components	2	24EEE464.1
2	Study of Instruments and Equipment (DMM, Power supply, CRO, FG)	2	24EEE464.1
3	Introduction to Orcad Schematic entry / drawing, net listing, layering, component foot print library selection & designing, design rules,	2	24EEE464.2
4	Component placing: Manual & automatic, track routing: automatic & manual, rules: track length, angle, joint & size, Auto router setup. Design Rules.	2	24EEE464.2
5	Single side PCB Fabrication	2	24EEE464.2
	PART-B		
6	Design PCB Layout using ORCAD, PCB Design - Full wave Rectifier	2	24EEE464.3
7	Assembly and Testing - Full wave Rectifier	2	24EEE464.3
8	PCB Designing Practice: PCB Designing of Basic and Analog Electronic Circuits, PCB Designing of Power Supplies.	2	24EEE464.4
9	Post Designing & PCB Fabrication Process: Printing the Design, Etching, Drilling,	2	24EEE464.4
10	Interconnecting and Packaging electronic Circuits, Gerber Generation, Soldering and Desoldering, Component Mounting, PCB and Hardware Testing.	2	24EEE464.4

PART-C

Beyond Syllabus Virtual Lab Content

(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
		20	30
L1	Remember	-	-
L2	Understand	-	5
L3	Apply	10	10
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:

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	**24EEE465**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEE465.1	Examine the efficiencies and regulation of DC machines using different tests
24EEE465.2	Design various winding for DC Machines
24EEE465.3	Evaluate the losses of a transformer and test performance of the transformer
24EEE465.4	Apply the software to simulate single phase transformer

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE465.1	3	3	3	3	2	-	-	-	1	-	-	1	1
24EEE465.2	3	3	3	3	2	-	-	-	1	-	-	1	1
24EEE465.3	3	3	3	3	2	-	-	-	1	-	-	1	1
24EEE465.4	3	3	3	3	2	-	-	-	1	-	-	1	1

Pgm. No.	List of Programs	Hours	COs
	Prerequisite 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	24EEE465.1
2	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.	2	24EEE465.1
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	24EEE465.1
4	Voltage regulation of an alternator by ZPF method.	2	24EEE465.2
5	Voltage regulation of an alternator by EMF and MMF methods	2	24EEE465.2
	PART-B		
6	Air gap MMF calculation for magnetic circuits using SCILAB		
7	A SCILAB program for design of electromagnet	2	24EEE465.3
8	Design of an iron cored choke coil using SCILAB coding	2	24EEE465.3
9	Core Loss Calculations in magnetic materials using SCILAB programming	2	24EEE465.3
10	Design of a small single-phase transformer using SCILAB coding	2	24EEE465.4

PART-C

Beyond Syllabus Virtual Lab Content

(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
		20	**30**
L1	**Remember**	**-**	**-**
L2	**Understand**	**-**	5
L3	**Apply**	10	10
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**	15
L5	**Evaluate**	15
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

UNIVERSAL HUMAN VALUES AND LIFE SKILLS

Course Code	**24UHK37/ 24UHK47**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

24UHK37/47.1	Understand the concept and significance of life skills and universal human values.
24UHK37/47.2	Develop Self-awareness and Self-management skills to promote personal growth.
24UHK37/47.3	Apply Critical and Creative thinking and ethical decision-making skills in various contexts.
24UHK37/47.4	Promote teamwork and collaboration while respecting diversity and inclusivity.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24UHK37/47.1	-	-	-	-	-	3	1	2	-	2	2	-	-
24UHK37/47.2	-	-	-	-	-	1	2	3	1	2	3	-	-
24UHK37/47.3	-	-	-	-	-	3	1	2	1	3	2	-	-
24UHK37/47.4	-	-	-	-	-	2	2	3	2	2	1	-	-

MODULE-1	**Self-Awareness and Self-Management**	**24UHK37/47.1, 24UHK37/47.2**	**3 Hours**

Emotional Intelligence, Techniques of self-awareness: SWOT and JOHARI WINDOWS, Stress management and coming out of comfort zone, managing failure, Time Management to recalibrate priorities.
Self-Exploration as a process of Value Education, the basic human Aspirations: Prosperity and Happiness, understanding infatuation.

Self-study / Role play	Understand qualities of Role Models, explore self and do SWOT analysis for growth; participate in role play and presentations to come out of comfort zone

MODULE-2	**Towards Yourself**	**24UHK37/47.1, 24UHK37/47.3**	**3 Hours**

Exploring opportunities, understanding expectations and self for right fitment in profession, Goal Setting - Personal and Professional, aligning Personal and Professional goals for greater achievement, Mind-Maps as a tool for Goal Setting

Self-study / Mind Maps	Understand industry expectations to set professional goals; realizing connection between personal and professional goals for peaceful living

MODULE-3	**Leading self to lead others**	**24UHK37/47.3, 24UHK37/47.4**	**3 Hours**

Quality analysis of leader and self-evaluation, Critical thinking, Creative thinking and Ethical decision making, Critical thinking and Creative thinking for contribution to technical world, Six thinking hats, Exploring ethical decision-making frameworks and principles.

Case study	Case studies for Critical thinking and activities for Creative thinking

MODULE-4	**Ownership towards Family and Society**	**24UHK37/47.2, 24UHK37/47.3 24UHK37/47.4**	**3 Hours**

Responsibility, Diversity and Inclusivity:
Understanding personal and social responsibility; Appreciating diversity and managing inclusivity, promoting teamwork and collaboration while respecting differences.

Self-study / Interview with corporate people	Working on Task bar; team building activities; Interviewing Corporate experts to understand expectations

MODULE-5	**Towards Nature and Industry**	**24UHK37/47.3, 24UHK37/47.4**	**3 Hours**

Personal code of conduct for harmony between self and nature, resisting external pressures, negotiation and conflict resolution, assertiveness and empathy, change management

Role play	Role play to understand contributions to nature and industry.

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels	Marks Distribution		
	Test (s)	AAT1	AAT2

		25	15	10
L1	**Remember**	-	-	-
L2	**Understand**	5	-	5
L3	**Apply**	10	5	5
L4	**Analyze**	10	5	-
L5	**Evaluate**	-	5	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Group Discussion)

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:

REFERENCE BOOKS:

1. The 7 Habits of Highly Effective People, Stephen R Covey, Neha publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to win friends and influence people, Dale Carnegie.
5. BHAGAVADGITA for college students, Sandeepa Guntreddy.

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

- Conduct interviews with HR personnel of corporates to understand expectations in terms of Soft Skills and Values
- Participate in role plays and presentations to come out of comfort zone
- Talk to industry people to understand opportunities available
- Make a short movie to display creativity
- Use Mind maps to plan successful completion of semester
- Actively participate in Group Discussions and JAM sessions

MINIPROJECT

Course Code	**24EEE48**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**0**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

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

24EEE48.1	Apply the knowledge learned via several courses to practical issues
24EEE48.2	Evaluate small hardware systems by using modern tools and technologies
24EEE48.3	Able to work in teams and manage the conduct of the research study
24EEE48.4	Communicate and comprehend the work through articles
24EEE48.5	Articulate the project related activities and findings
24EEE48.6	Extend or use the idea in mini project for Major project

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
24EEE48.1	3	3	3	2	3	2	2	2	3	3	3	2	2
24EEE48.2	3	3	3	2	3	2	2	2	3	3	3	2	2
24EEE48.3	3	3	3	2	3	2	2	2	3	3	3	2	2
24EEE48.4	3	3	3	2	3	2	2	2	3	3	3	2	2
24EEE48.5	3	3	3	2	3	2	2	2	3	3	3	2	2
24EEE48.6	3	3	3	2	3	2	2	2	3	3	3	2	2

Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. The student shall be capable to recognize a problem in the area of Electrical and Electronics Engineering and solve it using latest technologies in a mini-project. Based on the ability/abilities of the student/s and recommendations of the guide, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. The mini-project work will be reviewed by a panel of experts throughout the semester. The CIE marks awarded for the Mini-project work shall be based on the work accomplishment, project presentation skill, and question and answer session. The Plagiarized projects will automatically result an F grade and the student will be liable for further disciplinary action. At the completion of a mini project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution	
		Review 1 (25 Marks)	Review 2 (25 Marks)
		25	25
L1	**Remember**	-	-
L2	**Understand**	5	5
L3	**Apply**	5	5
L4	**Analyze**	5	5
L5	**Evaluate**	5	5
L6	**Create**	5	5

SEE Assessment Pattern (50 Marks – Theory)

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

BASIC APPLIED MATHEMATICS-II
(Common to all Branches)

Course Code	**24DMAT41**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs. / Week	**2**	**Total Marks**	**50**
Credits	**00**	**Exam Hours**	**--**

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

24DMAT41.1	Gain knowledge of basic operations of vectors
24DMAT41.2	Use curl and divergence of a vector function in three dimensions
24DMAT41.3	Develop the ability to solve higher order Linear differential equations
24DMAT41.4	Know the basic concepts of Laplace transform to solve the Periodic functions and also solve initial and boundary value problems using Laplace transform method.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	-
24DMAT41.1	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT41.2	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT41.3	3	3	-	-	-	-	-	-	-	-	-	-
24DMAT41.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**VECTORS**	24DMAT31.1	**8 Hours**

Definition of scalar and vector, Vector addition, Subtraction and Multiplication-Dot product, Cross product, Scalar triple product. Orthogonal, Co-planar and Angle between vectors-Problems.

Text Book	Text Book 1: 3.1, 3.5, 3.6, 3.9, Text Book 2: 7.1, 9.2, 9.3, 9.4.

MODULE-2	**VECTOR DIFFERENTIATION**	24DMAT31.2	**8 Hours**

Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of vector functior Problems. Solenoidal and irrotational vector fields-Problems.

Text Book	Text Book 1: 8.5, 8.6, 8.7, Text Book 2: 9.7, 9.8, 9.9.

MODULE-3	**LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS**	24DMAT31.3	**8 Hours**

Solution of initial and boundary value problems, Inverse differential operator techniques for the functions-e^{ax}, $\sin(ax+b)$ and $\cos(ax+b)$.

Text Book	Text Book 1: 13.3, 13.4, 13.5, 13.6,

MODULE-4	**LAPLACE TRANSFORM**	24DMAT31.4	**8 Hours**

Definition and Laplace transforms of elementary functions-Problems. Properties of Laplace transforms (Shifting property-without proof), Periodic functions (without proof)-problems.

Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.

MODULE-5	**INVERSE LAPLACE TRANSFORM**	24DMAT31.4	**8 Hours**

Inverse Laplace Transform by partial fractions-Problems. Solution of linear differential equations using Laplace Transforms-Problems.

Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

RBT Levels		Marks Distribution		
		Theory Tests	AAT1	AAT2
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

Suggested Learning Resources:

Text Books:

1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:

1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):

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

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

- Contents related activities (Activity-based discussions)
  - Problem solving Approach
  - Organizing Group wise discussions on related topics
  - Seminars

NATIONAL SERVICE SCHEME

Course Code	**24NSS30/24NSS40**	**CIE Marks (each Semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

24NSS30/40.1	Understand the importance of his / her responsibilities towards society.
24NSS30/40.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
24NSS30/40.3	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.
24NSS30/40.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24NSS30/40.1	-	-	-	-	-	3	3	2	-	-	1
24NSS30/40.2	-	-	-	-	-	3	3	2	-	-	1
24NSS30/40.3	-	-	-	-	-	3	3	2	-	-	1
24NSS30/40.4	-	-	-	-	-	3	3	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 24NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	24NSS30.1, 24NSS30.2, 24NSS30.3, 24NSS30.4	30 HRS
4TH 24NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	24NSS40.1, 24NSS40.2, 24NSS40.3, 24NSS40.4	30 HRS
5TH 24NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs).	24NSS50.1, 24NSS50.2, 24NSS50.3, 24NSS50.4	30 HRS
6TH 24NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	24NSS60.1, 24NSS60.2, 24NSS60.3, 24NSS60.4	30 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 - PHASE - 2	10
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 6th 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.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- 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 byindividual to the concerned 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/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	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 byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus	site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionable business 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 byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
6.	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/Govern ment Schemes officers	School selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

7.	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/proper consultation/ Continuous monitoring/ Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
8.	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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
9.	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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
10.	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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
11.	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/proper consultation/ Continuous monitoring / Information board	Report should be submitted byindividual to the concerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION AND SPORTS

Course Code	**24PED30, 24PED40**	**CIE Marks (each semester)**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4= 200**
Credits	**00**	**Exam Hours**	**02**

Course outcomes:

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

24PED30/40.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
24PED30/40.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
24PED30/40.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
24PED30/40.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
24PED30/40.1	-	-	-	-	-	2	-	3	3	-	-	2
24PED30/40.2	-	-	-	-	-	2	-	3	3	-	-	2
24PED30/40.3	-	-	-	-	-	2	-	3	3	-	-	2
24PED30/40.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 24PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	24PED30.1, 24PED30.2	5 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 D. Agility – Shuttle Run E. Flexibility – Sit and Reach F. Cardiovascular Endurance – Harvard step Test	24PED30.2, 24PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	24PED30.3, 24PED30.4	10 HRS
4TH 24PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	24PED40.1, 24PED40.2	5 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. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw. C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up. E. Table Tennis – Service (Fore Hand & Back Hand), Receive	24PED40.3	20 HRS

	(Fore Hand & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.		
	Module 3: Role of Organization and administration	24PED40.4	5 HRS
5TH 24PED50	**Fitness Components:** Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips. **Practical Components:** Speed, Strength, Endurance, Flexibility, and Agility **Athletics**: 1. Track -Sprints: • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block. • Acceleration with proper running techniques. • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug. 2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing 3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) **Handball OR Ball Badminton** **Handball:** A. Fundamental Skills 1. Catching, Throwing and Ball control, 2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot. 3. Dribbling: High and low. 4. Attack and counter attack, simple counter attack, counter attack from two wings and center. 5. Blocking, Goal Keeping and Defensive skills. 6. Game practice with application of Rules and Regulations. B. Rules and their interpretations and duties of officials **Ball badminton:** A. Fundamental Skills 1. Basic Knowledge: Various parts of the Racket and Grip. 2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.	24PED50.1, 24PED50.2, 24PED50.3, 24PED50.4	Total 30 Hrs/ Semester 2 Hrs/week
6TH 24PED60	**Athletics**: 1. Track -110 Mtrs and 400Mtrs: • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles • Crouch start (its variations) use of Starting Block. • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing. 2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing. 3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). **Football OR Hockey** **Football:** A. Fundamental Skills 1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot	24PED60.1, 24PED60.2, 24PED60.3, 24PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

	and Lofted Kick. 2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot. 3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. 4. Heading: In standing, running and jumping condition. 5. Throw-in: Standing throw-in and Running throw-in. 6. Feinting: With the lower limb and upper part of the body. 7. Tackling: Simple Tackling, Slide Tackling. 8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting. 9. Game practice with application of Rules and Regulations. A. Rules and their interpretation and duties of officials. **Hockey:** A. Fundamental Skills 1. Passing: Short pass, Longpass, pushpass, hit 2. Trapping. 3. Dribbling and Dozing 4. Penalty stroke practice. 5. Penalty corner practice. 6. Tackling: Simple Tackling, Slide Tackling. 7. Goal Keeping, Ball clearance- kicking, and deflecting. 8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

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	**24YOG30, 24YOG40**	**CIE Marks**	**50**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs / Week	**2**	**Total Marks**	**50 x 4 = 200**
Credits	**00**	**Exam Hours**	**02**

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

24YOG30/40.1	Understanding the origin, history, aim and objectives of Yoga
24YOG30/40.2	Become familiar with an authentic foundation of Yogic practices
24YOG30/40.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
24YOG30/40.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
24YOG30/40.1	-	-	-	-	-	3	-	-	-	-	1
24YOG30/40.2	-	-	-	-	-	3	-	-	-	-	1
24YOG30/40.3	-	-	-	-	-	3	-	-	-	-	1
24YOG30/40.4	-	-	-	-	-	3	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd 24YOG30	**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 b of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	24YOG30.1, 24YOG30.2, 24YOG30.3, 24YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week
4TH 24YOG40	**Suryanamaskara:** Suryanamaskar 12 count,4rounds **Brief introduction and importance of:** **Kapalabhati:** Revision of Kapalabhati -40strokes/min3rounds **Different types of Asanas**: 1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana 2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana 3. Prone line: Dhanurasana 4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana **Patanjali's Ashtanga Yoga**: Asana, Pranayama **Pranayama:** Chandra Bhedana, Nadishodhana, Surya Bhedana	24YOG40.1, 24YOG40.2, 24YOG40.3, 24YOG40.4	Total 32 Hrs/ Semester 2 Hrs/week

5TH 24YOG50	**Kapalabhati:** Revision of Kapalabhati - 60strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana 4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga **Patanjali's Ashtanga Yoga**: Pratyahara, Dharana **Pranayama:** Ujjayi, Sheetali, Sheektari	24YOG50.1, 24YOG50.2, 24YOG50.3, 24YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 24YOG60	**Kapalabhati:** Revision of Kapalabhati – 80 strokes/min3rounds **Brief introduction and importance of:** **Different types of Asanas**: 1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana 2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana 3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture) 4. Balancing: Sheershasana **Patanjali's AshtangaYoga**: Dhyana (Meditation), Samadhi **Pranayama:** Bhastrika, Bhramari, Ujjai **Shat Kriyas:** Jalaneti and sutraneti, Sheetkarma Kapalabhati	24YOG60.1, 24YOG60.2, 24YOG60.3, 24YOG60.4	Total 32 Hrs/ Semester 2 Hrs/week

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:

4. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
5. Tiwari, O P: Asana Why and How
6. Ajitkumar: Yoga Pravesha (Kannada)
7. Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
8. Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)
9. Nagendra H R: The art and science of Pranayama
10. Tiruka: Shatkriyegalu (Kannada)
11. Iyengar B K S: Yoga Pradipika (Kannada)
12. 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

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.

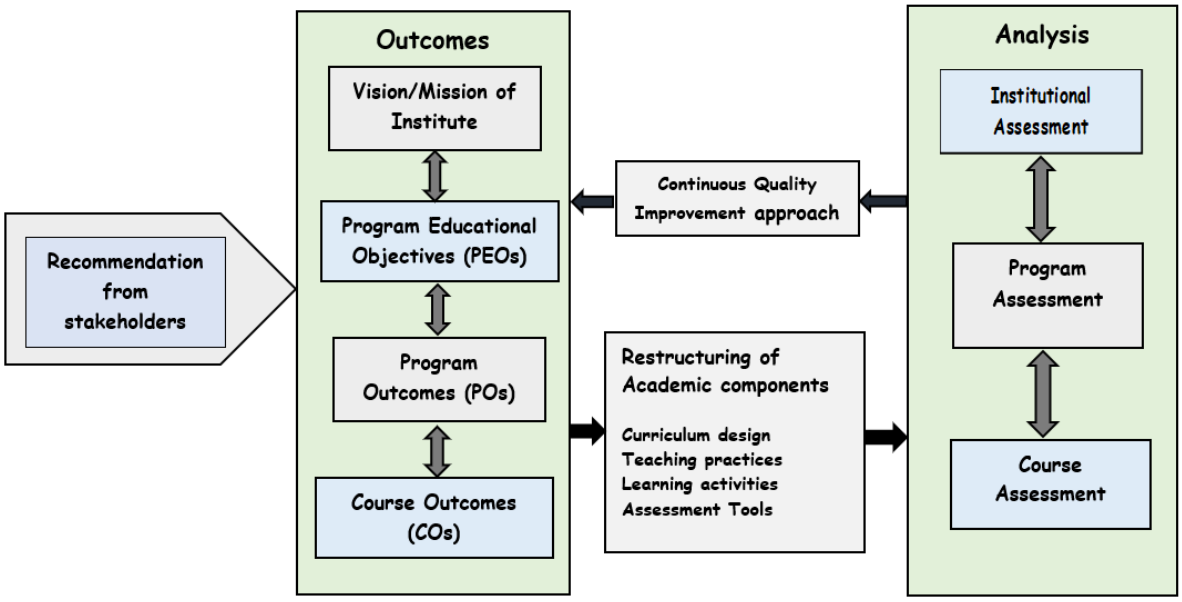
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of engineering degree programarethe 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. [nbaindia.org]

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

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

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

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

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

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

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

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

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

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

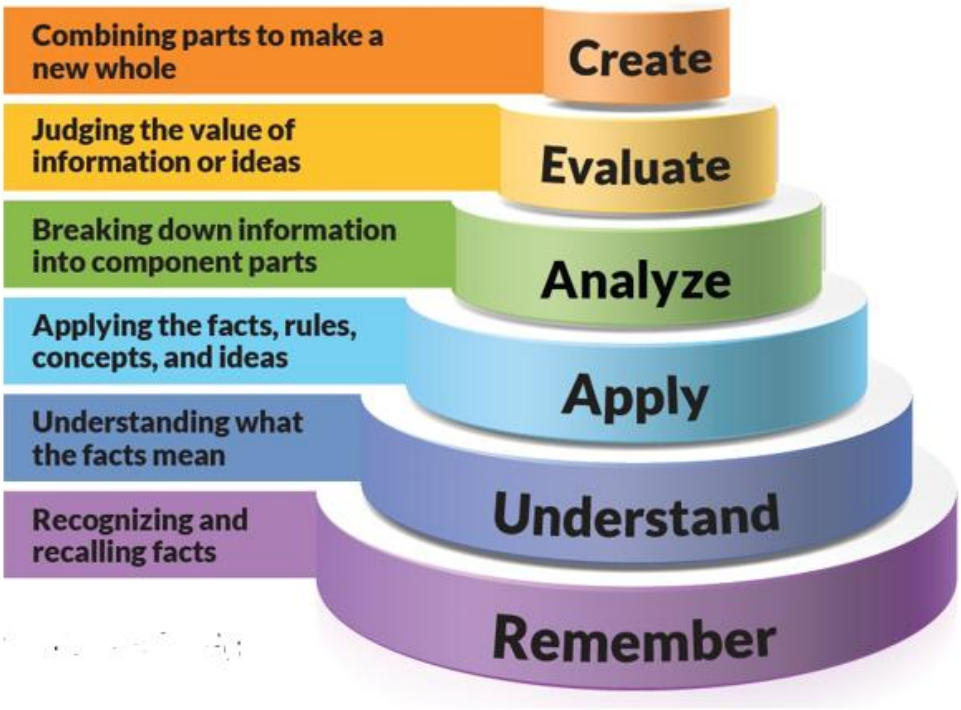
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

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

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.



www.newhorizonindia.edu
Ring Road, Bellandur Post,
Near Marathahalli, Bengaluru,
Karnataka 560103, India.

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