NEW HORIZON
COLLEGE OF ENGINEERING

Department of Electrical and Electronics Engineering

Academic Year 2025-26

5th and 6th Semester Scheme and Syllabus

BATCH - 2023-2027

CREDITS: 160

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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

PROGRAM OUTCOMES (POs)

S.No	Graduate Attributes	Program Outcomes (POs)
1	Engineering Knowledge	PO1: Able to understand the fundamentals of mathematics, science, Electrical and Electronics Engineering and apply them to the solution of complex engineering problems.
2	Problem Analysis	PO2: Ability to identify, formulate and analyse real time problems in Electrical and Electronics Engineering.
3	Design and Development of Solutions	PO3: Design solutions for complex engineering problems, that meet the specified needs and to interpret the data.
4	Investigation of Problem	PO4: Use research-based knowledge and research methods to provide valid solutions for complex problems in Electrical and Electronics Engineering.
5	Modern Tool usage	PO5: Apply appropriate tools techniques for modeling, analyzing and solving Electrical and Electronics Engineering devices & systems.
6	Engineer and society	PO6: To give basic knowledge of social, economic, safety and cultural issues relevant to professional engineering.
7	Environment and sustainability	PO7: To impart knowledge related to the design and development of modern systems which are environmentally sensitive and to understand the importance of sustainable development.

8	Ethics	PO8: Apply ethical principles and professional responsibilities in engineering practice.
9	Individual & team work	PO9: Ability to visualize and function as an individual and as a member in a team of a multi-disciplinary environment.
10	Communication	PO10: Ability to communicate effectively complex engineering ideas to the engineering community & the society at large.
11	Lifelong learning	PO11: To impart education to learn and to engage in independent and life – long learning in the technological change.
12	Project management and finance	PO12: Ability to handle administrative responsibilities, manage projects & handle finance related issues in a multi-disciplinary environment.

PEOs to POs mapping

	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
PEO 1	3	3	3	3	3	2	2	2	2	2	2	2	3	3
PEO 2	3	3	3	3	3	2	2	2	2	2	2	2	3	3
PEO 3	2	2	2	2	2	3	3	3	3	2	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 2023- 2027 BATCH (2022 Scheme)

V 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	HSMS	22EEE51	Operations Research and Management	EE	3	0	0	0	3	3	50	50	**100**
2	PCC	22EEE52	CMOS VLSI Design	EE	3	0	0	0	3	3	50	50	**100**
3	PCCL	22EEL52	CMOS VLSI Design Laboratory	EE	0	0	1	0	1	2	50	50	**100**
4	PCC	22EEE53	Control Systems	EE	3	0	0	0	3	3	50	50	**100**
5	PCCL	22EEL53	Control Systems Laboratory	EE	0	0	1	0	1	2	50	50	**100**
6	PEC	22EEE54X	Professional Elective Course-I	EE	3	0	0	0	3	3	50	50	**100**
7	AEC	22RMK55	Research Methodology and IPR	EE	1	1	0	0	2	3	50	50	**100**
8	AEC	22SDK56	Critical and Creative Thinking Skills	EE	0	0	1	0	1	2	50	--	**50**
9	UHV	22ESK57	Environmental Studies	Any Dept	1	0	0	0	1	1	50	50	**100**
10	PROJ	22EEE58	Mini Project-II	EE	0	0	1	0	1	0	50	50	**100**
11	NCMC	22NSS50	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED50	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG50	Yoga	Yoga Teacher									
Total									**19**	**24**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC**: Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **PROJ**: Mini Project work **L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation

Professional Elective Course-I			
22EEE541	Introduction to Cyber Security	22EEE544	Special Electrical Machines
22EEE542	Energy Storage Systems	22EEE545	Competitive Coding
22EEE543	Electrical Machine Design		

22EEE51 (HSMS)- This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.
For IT allied Branches: Software Product Management
For Core Branches: Engineering Economics and Management / Industrial Management and Entrepreneurship

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) Inter disciplinary: 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.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering.

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-hours 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 2023- 2027 BATCH (2022 Scheme)

VI 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	PCC	22EEE61	Power Electronics	EE	3	0	0	0	3	3	50	50	**100**
2	PCCL	22EEL61	Power Electronics Laboratory	EE	0	0	1	0	1	2	50	50	**100**
3	PCC	22EEE62	Electric Vehicles	EE	3	0	0	0	3	3	50	50	**100**
4	PCCL	22EEL62	Electric Vehicles Laboratory	EE	0	0	1	0	1	2	50	50	**100**
5	PCC	22EEE63	Generation, Transmission and Protection	EE	2	1	0	0	3	4	50	50	**100**
6	PEC	22EEE64X	Professional Elective Course-II	EE	3	0	0	0	3	3	50	50	**100**
7	PROJ	22EEE65	Project Phase-I	EE	0	0	2	0	2	0	50	50	**100**
8	AEC	22SDK66	Problem Solving Skills	EE	0	0	1	0	1	2	50	--	**50**
9	AEC	22EEE67X	Ability Enhancement Course – V	EE	0	0	1	0	1	2	50	50	**100**
10	OEC	23NHOP6XX	Industrial Open Elective Course-I	Offering Dept.	3	0	0	0	3	3	50	50	**100**
11	NCMC	22NSS60	National Service Scheme (NSS)	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED60	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YOG60	Yoga	Yoga Teacher									
Total									**21**	**26**	**550**	**450**	**1000**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **NCMC**: Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **PEC**: Professional Elective Course, **OEC**: Open Elective Course, **PROJ**: Project work**, L:** Lecture, **T**: Tutorial, **P**: Practical **S: SDA**: Self Study for Skill Development, C**IE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Professional Elective Course-II			
22EEE641	High Voltage Engineering	22EEE644	Advanced Control Systems
22EEE642	Introduction to Communication Systems	22EEE645	Machine learning for Electrical Engineering
22EEE643	Digital Signal Processing		

Ability Enhancement Course–V (For EEE, all are Laboratory Courses 0-0-1-0)			
22EEE671	Power System Protection, ETAP and DIALUX	22EEE674	LATex for Technical Writing
22EEE672	Multisim for Electrical design	22EEE675	Electronics Circuit Design Using Proteus
22EEE673	LAB View for Electrical Applications		

Industrial Open Elective Courses-I:

Credit for OEC is 03 (L: T: P: S) can be considered as (3: 0: 0 : 0). The teaching and learning of these Courses will be based on hands-on. The Course Assessment will be based on CIE and SEE in practical mode. This Courses will be offered by Centre of Excellence to students of all the branches. Registration to Industrial open electives shall be documented and monitored on college level.

Project Phase-I: Students have to discuss with the mentor/guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering.

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-hours 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

FIFTH SEMESTER
SYLLABUS

OPERATIONS RESEARCH AND MANAGEMENT

Course Code	**22EEE51**	**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:

22EEE51.1	Apply basic principles of project management for real time projects.
22EEE51.2	Create awareness on entrepreneurship needs and roles with respect to growth of economic development.
22EEE51.3	Develop solutions for barriers in small scale industries.
22EEE51.4	Estimate the interest rates, cash flows and costing materials, production and overheads.
22EEE51.5	Analyze the sequence of jobs on various machines.
22EEE51.6	Evaluate the significance of game theory and determine the optimal solution.

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
22EEE51.1	3	-	-	-	3	-	-	-	-	-	3	3	-	1
22EEE51.2	3	-	-	-	-	-	-	-	-	-	2	3	-	1
22EEE51.3	3	-	-	-	-	-	-	-	-	-	2	2	-	2
22EEE51.4	3	3	3	3	3	-	-	-	-	-	3	2	2	-
22EEE51.5	3	3	3	-	3	-	-	-	-	-	2	2	3	-
22EEE51.6	3	3	3	-	3	-	-	-	-	-	2	2	1	-

MODULE-1	**BASICS OF PROJECT MANAGEMENT**	**22EEE51.1**	**8 Hours**

Introduction, Definition of project, characteristics of projects, types of projects, need for project management, phases of project life cycle management, impact of delays in project completions, roles and responsibilities of project leader.

Self-study	Create project management plan by taking any real time project as example.
Text Book	Text Book 3: 1.1, 1.1, 1.8, 1.9, 1.10, 1.18, 1.16.

MODULE-2	**ENTREPRENEUR AND SSI**	**22EEE51.2 22EEE51.3**	**8 Hours**

Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Stages in entrepreneurial process; Role of entrepreneurs in Economic Development. Entrepreneurship in India; women entrepreneurs, Entrepreneurship - its Barriers,

SSI Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT Supporting Agencies of Government for SSI, Meaning, Nature of support. Objectives; Functions; Types of Help.

Applications	List out some of the Small-Scale Industries which are mainly focused on women empowerment.
Text Book	Text Book 4: 2.2, 2.3, 2.4 to 2.15

MODULE-3	**INTEREST, CASH FLOW, ESTIMATION AND COSTING**	**22EEE51.4**	**8 Hours**

Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion. Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

Text Book	Text Book 5: 2.1 to 2.10

MODULE-4	**SEQUENCING**	**22EEE51.5**	**8 Hours**

Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule- 'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

Case Study	Case study on sequencing by taking any real time examples.
Text Book	Text Book 2: Chapter 11

MODULE-5	**GAME THEORY**	**22EEE51.6**	**8 Hours**
Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), and dominance property.			
Case Study	Case study on game theory by taking any real time examples.		
Text Book	Text Book 2: Chapter 14		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		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) Operation Research, S D Sharma, KedarNath RamNath publication, 2014 edition, ISBN-13: 1234567142552
2) Contemporary Project Management, Timothy J Kloppenborg, Cengage Learning, 2nd Edition, ISBN: 97881315187
3) Project Management a System approach to Planning Scheduling & Controlling, Harold Kerzner, CBS Publishers and Distributors.2nd Ed., 2004, ISBN: 9788123908670
4) Engineering Economy, Riggs J.L., 4 TH ed., McGraw Hill, 2002 . ISBN: 978-0070586703
5) Engineering Economy, Thuesen H.G. PHI, 2002, ISBN: 978-0132774918

Reference Books:

1) Operations Research: An Introduction, H A Taha,Pearson; 10th edition (17 January2017), ISBN-13: 978-1292165547

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://projectmanagement.berkeley.edu/project-managemenet-course/
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA
- 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

- Discussion of project management by taking any real time examples using a software tool
- Implementation of game theory in industries using a software tool.

- Demonstration of application of sequencing in industries
- Motivational videos from a women entrepreneur.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

CMOS VLSI DESIGN

Course Code	**22EEE52**	**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:

22EEE52.1	Analyze the MOSFET characteristics and delay models.
22EEE52.2	Apply physical design process for designing digital logic circuits.
22EEE52.3	Evaluate the types of MOSFET and select an appropriate processing technology for physical design process.
22EEE52.4	Examine CMOS digital circuits to optimize the design parameters.
22EEE52.5	Use delay models to perform timing analysis on MOSFET based design.
22EEE52.6	Solve the digital logic problems using circuit families.

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
22EEE52.1	2	3	2	-	-	-	-	-	-	-	-	1	-	1
22EEE52.2	3	2	2	-	-	-	-	-	-	-	-	1	-	1
22EEE52.3	2	2	2	2	-	-	-	-	-	-	-	1	-	1
22EEE52.4	2	3	2	-	-	-	-	-	-	-	-	1	-	1
22EEE52.5	3	2	2	-	-	-	-	-	-	-	-	1	-	1
22EEE52.6	3	2	2	-	-	-	-	-	-	-	-	1	-	1

MODULE-1	**MOS TRANSISTOR THEORY**	**22EEE52.1, 22EEE52.3**	**8 Hours**

Introduction, MOS transistors, CMOS Logic, Design portioning -Introduction, Long-Channel I-V characteristics, C-V Characteristics - Simple MOS Capacitance Models, Non-ideal I-V effects, DC transfer characteristics

Self-study	Investigate the trends in MOORE's law on MOSFET
Text Book	Text Book 1: 1.3, 1.4, 1.6, 2.1, 2.2, 2.3 (up to 2.3.1), 2.4, 2.5

MODULE-2	**CMOS PROCESSING TECHNOLOGY**	**22EEE52.2, 22EEE52.3, 22EEE52.6**	**8 Hours**

CMOS Fabrication and Layout, Exercises for stick diagram and layout, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, FinFET technology and GateAll around technology.

Case Study	Draw stick diagrams and layouts for developing circuits for given Boolean expressions.
Text Book	Text Book 1: 1.5, 3.1, 3.2, 3.3, 3.4

MODULE-3	**DELAY AND COMBINATIONAL CIRCUIT BASICS**	**22EEE52.1, 22EEE52.2, 22EEE52.5**	**8 Hours**

Introduction, Transient Response, RC Delay Model - Effective Resistance, Gate and Diffusion Capacitance, Equivalent RC Circuits, Transient Response, Elmore Delay, Layout Dependence of Capacitance, Linear Delay Model - Logical Effort, Parasitic Delay, Delay in a Logic Gate, Drive Introduction, Circuit Families - Static CMOS.

Text Book	Text Book 1: 4.1, 4.2, 4.3 (excluding 4.3.7), 4.4 (up to 4.4.4) & Text Book 1: 9.1, 9.2 (up to 9.2.1)

MODULE-4	**COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN**	**22EEE52.2, 22EEE52.4, 22EEE52.6**	**8 Hours**

Circuit Families - Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits- Domino Logic, Silicon-On-Insulator Circuit Design.

Introduction, Sequencing Static Circuits, Circuit Design of Latches and Flip-Flops - Conventional CMOS Latches, Conventional CMOS Flip-Flops, Pulsed Latches, Resettable Latches and Flip-Flops.

Case Study	Design and develop combinational logic circuits and sequential logic circuits using MOSFET.
Text Book	Text Book 1: 9.2 (up to 9.2.4.1), 9.5, 10.1, 10.2, 10.3 (up to 10.3.4)

MODULE-5	TIMING ANALYSIS	22EEE52.4, 22EEE52.5	8 Hours

Delay in general, Slew Balancing & Transistor Equivalency, Design of 2-Inputs NAND & NOR Gates for Equal Rise and Fall Slew, MOS Capacitances, Design Techniques for Delay Reduction, Intrinsic Delay of Inverter and its Sizing Effect on Propagation Delay, Inverter Chain Design, Timing Terms - Analysis - Models - Goals, Static Timing Analysis, Timing Constraints & Verification, Timing Convergence, Timing driven Logic and Layout Synthesis.

Case Study	Perform timing analysis on the given CMOS circuits .
Text Book	Text Book 2:10.1 -10.6, 10.8- 10.10, 10.12 -10.15, 10.19 - 10.39

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		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	--
L2	Understand	--
L3	Apply	20
L4	Analyze	20
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2010, ISBN: 978-0321547743
2) VLSI Design, Debaprasad Das, 2nd edition, 2016, Oxford University Press. ISBN: 978-0198067665

Reference Books:

1) CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2007, TMH. ISBN: 978-0072460537
2) Digital Integrated Circuits – A design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Edition, 2016, Prentice-Hall. ISBN: 978-9332573925
3) Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2011, PHI. ISBN: 978-8120309869
4) Static Timing Analysis for Nanometer Designs - A Practical Approach, J. Bhasker, Rakesh Chadha, Springer, 2009. ISBN: 978-0-387-93820-2

Web links and Video Lectures (e-Resources):

- http://vlsi-iitg.vlabs.ac.in/
- http://icbook.eecs.berkeley.edu/resources/powerpoint-slides
- https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/download/
- https://digimat.in/nptel/courses/video/108107129/L01.html

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

- Problem solving approaches
- Case studies
- Virtual Lab sessions
- Seminars

CMOS VLSI DESIGN LAB

Course Code	**22EEL52**	**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:

22EEL52.1	Demonstrate the working of analog and digital CMOS circuits through simulation.
22EEL52.2	Use the schematics of CMOS circuits to construct and verify their layouts.
22EEL52.3	Apply Switch level description to digital CMOS circuits Modeling.
22EEL52.4	Employ the Gate level description of digital CMOS circuits for simulation and synthesis.

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
22EEL52.1	3	3	2	1	3	-	-	-	2	-	-	3	3	2
22EEL52.2	3	-	-	-	3	-	-	-	2	-	-	3	3	2
22EEL52.3	3	-	-	-	3	-	-	-	2	-	-	3	3	2
22EEL52.4	3	3	2	1	3	-	-	-	2	-	-	3	3	2

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to CMOS VLSI Design and analog VLSI Design. Introduction to Verilog and System Design using Verilog.	2	NA
	PART-A		
1	Draw the schematic of CMOS Inverter for the given specifications, and verify using Transient and DC Analyses.	2	22EEL52.1 22EEL52.2
2	Draw the schematic of the following circuits for the given specifications and verify using Transient and DC Analyses: i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate.	2	22EEL52.1 22EEL52.2
3	Draw the schematic of transmission gate for the given specifications, and verify using Transient and DC Analyses.	2	22EEL52.1 22EEL52.2
4	Draw the schematic of the following amplifiers for the given specifications and verify the same using Transient, DC and AC Analyses: i) Common Source amplifier, ii) Common Drain amplifier.	2	22EEL52.1 22EEL52.2
5	Draw the layout of the CMOS Inverter and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design.	2	22EEL52.1 22EEL52.2
6	Draw the layout of the following circuits and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) 2-input CMOS NAND gate ii) 2-input CMOS NOR gate.	2	22EEL52.1 22EEL52.2
	PART-B		
7	For the following circuits, write the switch level Verilog Code, and verify using Test Bench: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates.	2	22EEL52.1 22EEL52.3
8	For the following circuits, write the switch level Verilog Code and verify using Test Bench: i) 2-input EXOR gate using CMOS logic, ii) 2-input EXOR gate using PTL.	2	22EEL52.1 22EEL52.3
9	Synthesize the following circuits using the gate level Verilog Code, with the given Constraints: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates.	2	22EEL52.1 22EEL52.4

10	For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints: i) 4-bit Paralle adder ii) D Flip-flop.	2	22EEL52.1 22EEL52.4
11	For the following circuits, write the Verilog Code, verify using Test Bench and then synthesize with the given Constraints: i) T Flip-flop, ii) 4-bit Synchronous counter.	2	22EEL52.1 22EEL52.4
12	Write the Verilog Code for Sequence detector using Mealy and Moore verify using Test Bench, and then synthesize with the given Constraints.	2	22EEL52.1 22EEL52.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. MOSFET – To plot the (i) output characteristics & (ii) transfer characteristics of an n-channel and p-channel MOSFET
   http://vlsi-iitg.vlabs.ac.in/MOSFET_theory.html
2. Ring Oscillator - To design and plot the output characteristics of a 3-inverter ringoscillator.
   http://vlsi-iitg.vlabs.ac.in/RingOscillator_theory.html
3. 4X1 multiplexer - To design and plot the characteristics of 4x1 digital multiplexer usingpass transistor logic.
   http://vlsi-iitg.vlabs.ac.in/Multiplexer_theory.html
4. Latches - To design and plot the characteristics of a positive and negative latch based on multiplexers.
   http://vlsi-iitg.vlabs.ac.in/Latches_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	05
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Reference Books:

1) CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E. Weste, David Money Harris, 4th Edition,Pearson Education, 2015. ISBN: 978-0321547743
2) VLSI Design, Deba prasad Das, 2nd edition, 2016, Oxford University Press. ISBN: 978-0198067665
3) Digital System design Using Verilog, Charles H. Roth Jr., Lizy Kurian John, Byeong Kil Lee, 1st Edition, 2015,CL Engineering. ISBN: 978-1285051079
4) Digital Design: An Embedded Systems approach Using VERILOG, Peter J. Ashenden, 2014, Elesvier. ISBN: 978-0-12-369527-7.

CONTROL SYSTEMS

Course Code	**22EEE53**	**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:

22EEE53.1	Develop mathematical model of mechanical and electrical systems by using transfer function approach.
22EEE53.2	Analyze the time response of systems and examine their stability.
22EEE53.3	Deduce the closed loop frequency response from open loop system and determine their stability.
22EEE53.4	Design a suitable controller/compensator to meet the required frequency response.
22EEE53.5	Evaluate state model's controllability and observability by state space approach.
22EEE53.6	Implement a suitable closed loop system for a given practical application.

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
22EEE53.1	3	3	2	2	-	-	-	-	-	-	-	-	-	1
22EEE53.2	3	3	2	2	-	-	-	-	-	-	-	-	-	1
22EEE53.3	3	3	3	3	-	-	-	-	-	-	-	-	-	1
22EEE53.4	3	3	3	3	-	-	-	-	-	-	-	-	-	1
22EEE53.5	3	3	3	3	-	-	-	-	-	-	-	-	-	1
22EEE53.6	3	3	2	2	-	-	-	-	-	-	-	-	-	1

MODULE-1	**MATHEMATICAL MODELLING**	**22EEE53.1, 22EEE53.6**	**8 Hours**

Open loop and closed loop systems - Mathematical modelling-Mechanical and electrical systems - electromechanical analogous systems- Transfer function of DC servo motors, AC servo motor-Block diagram reduction techniques - Signal flow graph.

Self-study	Investigate the operation of different control systems applications.
Text Book	Text Book 1: 1.1,2.1,2.2,2.4,2.5,2.6,2.7

MODULE-2	**TIME RESPONSE**	**22EEE53.2, 22EEE53.6**	**8 Hours**

Standard signals-Time response-First and second order systems-Time domain specifications-Steady state error-Static and dynamic error constants - Effect of P-PD-PI-PID controllers.

Applications	Investigate the different types of applications in industries with motors.
Text Book	Text Book 1: 5.1,5.2,5.3,5.4,5.5,5.6,6.7,5.10,10.6

MODULE-3	**STABILITY AND ROOT LOCUS**	**22EEE53.2, 22EEE53.6**	**8 Hours**

Stability Concepts-Location of closed loop poles-Classification of stability-Routh stability criterion-Root locus construction- Addition of open loop poles and zeros - Assessment of relative stability.

Text Book	Text Book 1: 6.1,6.2,6.3,6.4,6.5,6.6,7.1,7.2,7.3,7.4

MODULE-4	**FREQUENCY RESPONSE**	**22EEE53.3, 22EEE53.6**	**8 Hours**

Frequency domain specifications-Correlation between time and frequency domain specifications-Polar plot-Nyquist stability analysis-Bode plot-Determination of closed loop response from open loop frequency response.

Text Book	Text Book 1: 8.1,8.2,8.3,8.4,8.5,8.6,9.3

MODULE-5	**COMPENSATOR DESIGN AND STATE SPACE ANALYSIS**	**22EEE53.4, 22EEE53.5**	**8 Hours**

Compensator design: Performance Criteria-Lag compensator design using bode plots.
Applications: Temperature control system and Position control system.
State Space Analysis: State space representation-State Models-Controllability and Observability.

Self-study	Investigate the state space analysis of a Temperature control system.

Text Book	Text Book 1: 10.1,10.2,10.3,10.5,12.1,12.2,12.3,12.4,12.7

CIE Assessment Pattern (50 Marks – Theory)

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Control Systems Engineering, I.J.Nagrath and M.Gopal, New Age International Publishers, Sixth Edition, 2017, ISBN :9386070111.
2) Control Systems, Principles and Design, M. Gopal, Fourth Edition, Tata McGraw Hill, 2015, ISBN: 9780071333269.
3) Control System Engineering, Norman S. Nise, Sixth Edition, Wiley India, 2011, ISBN: 978-1-118-80082-9

Reference Books:

1) Modern Control Engineering, K. Ogata, Fifth edition, PHI, 2012, ISBN: 0136156738.
2) Control System Engineering, S.K.Bhattacharya, Third Edition, Pearson, 2013, ISBN: 9788131791653.
3) Control System, Dhanesh. N. Manik, Cengage Learning, 2012, ISBN: 9788131518120.
4) Automatic Control systems, Benjamin C. Kuo, Ninth Edition, Wiley, 2014, ISBN: 978-8126552337

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_ee90/preview
- https://onlinecourses.nptel.ac.in/noc24_ee65/preview
- https://www.academia.edu/35425584/Control_System_By_Norman_nise_Sixth_Ed
- https://controltheorymaster.files.wordpress.com/2017/11/farid-golnaraghi-benjamin-c-kuo-automatic-control-systems.pdf

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

- Video demonstration of latest trends in industry applications
- For active participation of students, instruct the students to obtain solution for block diagrams and signal flow graphs
- Organizing Group wise discussions on different control systems applications
- Seminars

CONTROL SYSTEMS LABORATORY

Course Code	**22EEL53**	**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:

22EEL53.1	Understand the characteristics and transfer function of components used in automatic controls.
22EEL53.2	Design a suitable controller and compensator for the desired application.
22EEL53.3	Assess the system performance using time domain and frequency domain analysis.
22EEL53.4	Obtain the state model and test for controllability and observability.

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
22EEL53.1	3	3	2	2	2	-	-	-	2	1	-	-	2	2
22EEL53.2	3	3	2	2	3	-	-	-	2	1	-	-	2	2
22EEL53.3	3	3	3	3	3	-	-	-	2	1	-	-	2	2
22EEL53.4	3	3	3	3	3	-	-	-	2	1	-	-	2	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	Introduction to Electric Circuit Theory	2	NA
	PART-A		
1	Determination of Transfer function of DC servo motor by obtaining its Torque Speed characteristics.	2	22EEL53.1
2	Determination of Transfer function of AC servo motor by obtaining its Torque Speed characteristics.	2	22EEL53.1
3	Experiment to draw synchro pair characteristics.	2	22EEL53.1
4	Obtain the time response of the second order system and determine the time domain specifications and verify the same by simulation.	2	22EEL53.3
5	To design a passive RC lag compensating network for the given specifications and obtain the frequency response and determine the transfer function experimentally.	2	22EEL53.2
6	To design a passive RC lead compensating network for the given specifications and obtain the frequency response and determine the transfer function experimentally.	2	22EEL53.2
	PART-B		
7	To study the effect of P, PI, PD and PID controller on the step response of a feedback control system and verify the same by simulation.	2	22EEL53.2
8	DC position control system .	2	22EEL53.2
9	Temperature Control system.	2	22EEL53.2
10	Stability analysis using Bode and Nyquist of LTIV system using suitable software.	2	22EEL53.3
11	Stability analysis using Root Locus of LTIV and effect of open loop and zeroes on root locus contour using suitable software.	2	22EEL53.3
12	State space model for classical transfer function and verifying the controllability and observability using suitable software.	2	22EEL53.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Determination of the incremental transfer function of an AC Servomotor

http://vlabs.iitkgp.ac.in/psac/newlabs2024/ctrl/Exp4/index.html

2. Study the effect of PI, PD and PID controller on system performance. https://ce-dei.vlabs.ac.in/exp/to-study-the-effect-of-pi-pd-and-pid-controller-on-a-control-system/index.html
3. Analysing the behaviour of control systems and simulation of their responses http://vlabs.iitkgp.ac.in/psac/newlabs2024/ctrl/Exp12/theory.html

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

1) Control Systems Engineering, I.J.Nagrath and M.Gopal, New Age International Publishers, Sixth Edition, 2017, ISBN :9386070111.
2) Control Systems, Principles and Design, M. Gopal, Fourth Edition, Tata McGraw Hill, 2015, ISBN: 9780071333269.
4) Control System Engineering, Norman S. Nise, Sixth Edition, Wiley India, 2011. ISBN: 978-1-118-80082-9
3) Modern Control Engineering, K. Ogata, Fifth edition, PHI, 2012, ISBN: 0136156738.
4) Control System Engineering, S.K.Bhattacharya, Third Edition, Pearson, 2013, ISBN: 9788131791653.
5) Control System, Dhanesh. N. Manik, Cengage Learning, 2012, ISBN: 9788131518120.
6) Automatic Control systems, Benjamin C. Kuo, Ninth Edition, Wiley, 2014. ISBN: 78-8126552337
7) https://onlinecourses.nptel.ac.in/noc20_ee90/preview
8) https://onlinecourses.nptel.ac.in/noc24_ee65/preview

22EEE54X-Professional Elective Course-I

INTRODUCTION TO CYBER SECURITY			
Course Code	**22EEE541**	**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:

22EEE541.1	Understand the cybercrime and associated laws.
22EEE541.2	Develop a deeper understanding and familiarity with various types of cyberattacks, cybercrimes, vulnerabilities and remedies thereto.
22EEE541.3	Analyze the various cybercrime tools and methods.
22EEE541.4	Implement, and monitor cyber security mechanisms to ensure the protection of information technology assets against Phishing and Identity Theft.
22EEE541.5	Justify the need of computer forensics in different situations and responsible use of online social media networks.
22EEE541.6	Select suitable ethical principles and commit to professional responsibilities and human values and contribute value and wealth for the benefit of the society.

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
22EEE541.1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
22EEE541.2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
22EEE541.3	1	1	2	-	-	-	-	-	-	-	-	-	1	-
22EEE541.4	3	1	2	-	-	-	-	-	-	-	-	-	1	-
22EEE541.5	1	2	3	-	-	-	-	-	-	-	-	-	2	1
22EEE541.6	1	1	1	1	2	-	-	-	-	-	-	-	1	1

MODULE-1	**INTRODUCTION TO CYBERCRIME**	**22EEE541.1**	**8 Hours**
Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals, Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives			
Text Book	Text Book 1: 1.1 to 1.5, 1.7-1.9		
MODULE-2	**CYBER OFFENSES**	**22EEE541.2, 22EEE541.6**	**8 Hours**
How Criminals Plan Them: Introduction, how criminals plan the attacks, Social Engineering, Cyber Stalking, Cyber Cafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector.			
Case Study	Develop a strategy and vision for tackling cyber security		
Text Book	Text Book 1: 2.1 to 2.7		
MODULE-3	**TOOLS AND METHODS USED IN CYBERCRIME**	**22EEE541.3, 22EEE541.6**	**8 Hours**
Tools and Methods used in Cybercrime: Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks.			
Text Book	Text Book 1: 4.1 to 4.9, 4.12		
MODULE-4	**PHISHING AND IDENTITY THEFT**	**22EEE541.4**	**8 Hours**
Introduction, methods of phishing, phishing, vphising techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft			
Case Study	Social Media Impersonation		
Text Book	Text Book 1: 5.1, 5.2. 5.3		
MODULE-5	**UNDERSTANDING COMPUTER FORENSICS**	**22EEE541.5, 22EEE541.6**	**8 Hours**

Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics and real time applications.

Text Book	Text Book 1: 7.1. to 7.5, 7.7 to 7.9

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	10	10
L5	Evaluate	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) Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. First Edition, 2011, ISBN: 978-8126521791

Reference Books:

1) Security in Computing, Pfleeger, C.P., 5th Edition, Prentice Hall, Copyright 2010 ISBN 0-13-239077-9.
2) Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press. Edition 2010. ISBN: 978-8172730888.
3) Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. Pearson, 13th November, 2015, ISBN: 978-1516821020
4) Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd. ISBN: 0-7645-7397-7

Web links and Video Lectures (e-Resources):

- https://www.codecademy.com/learn/introduction-to-cybersecurity
- https://www.coursera.org/specializations/intro-cyber-security
- https://www.youtube.com/watch?v=yC_hFm0BX28&list=PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9swu
- https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI_
- https://www.youtube.com/watch?v=6wi5DI6du4&list=PL_uaeekrhGzJlB8XQBxU3z__hDwT95xlk

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

- To familiarize cybercrime terminologies and perspectives
- Demonstration of cyber security
- Demonstration of working of cyber crime

- Video demonstration of latest trends in cyber security
- Contents related activities (Activity-based discussions)
- Organizing Group wise discussions on issues
- Seminars

ENERGY STORAGE SYSTEMS

Course Code	**22EEE542**	**CIE Marks**	50
L: T: P: S	**3:0:0:0**	**SEE Marks**	50
Hours / Week	**03**	**Total Marks**	100
Credits	**03**	**Exam Hours**	03

Course outcomes:

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

22EEE542.1	Understand the various types of energy storage technologies.
22EEE542.2	Develop various thermal storage systems.
22EEE542.3	Choose appropriate battery storage technologies.
22EEE542.4	Design the thermodynamics of fuel cell.
22EEE542.5	Analyze the appropriate storage technologies for different applications.
22EEE542.6	Explore the alternate energy storage technologies.

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
22EEE542.1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
22EEE542.2	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22EEE542.3	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22EEE542.4	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22EEE542.5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
22EEE542.6	3	2	2	-	-	-	-	-	-	-	-	-	2	-

MODULE-1	**INTRODUCTION**	**22EEE542.1, 22EEE542.2**	**3 Hours**

Necessity of energy storage – types of energy storage – comparison of energy storage technologies- Applications.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**THERMAL STORAGE SYSTEM**	**22EEE542.2, 22EEE542.3**	**3 Hours**

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system –Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

Text Book	Text Book 1: Ch. 3

MODULE-3	**ELECTRICAL ENERGY STORAGE**	**22EEE542.4**	**3 Hours**

Fundamental concept of batteries – measuring of battery performance, charging and discharging,power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

Case Study	To analyze the data sheets of different types of battery and observe the parameters
Text Book	Text Book 2: Ch. 1,2,3 and 4

MODULE-4	**FUEL CELL**	**22EEE542.5**	**3 Hours**

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygencells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.

Text Book	Text Book 3: Ch. 1,2 and 3

MODULE-5	ALTERNATE ENERGY STORAGE TECHNOLOGIES	22EEE542.5, 22EEE542.6	3 Hours

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

Case Study	Analyze different types of storage elements available in the market
Text Book	Text Book 2: Ch. 8

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	-
L2	Understand	5	-
L3	Apply	5	10
L4	Analyze	5	10
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) Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications',John Wiley & Sons, 3rd Edition, 2021, ISBN: 978-1-119-71315-9
2) Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storageand conversion', Wiley publications, 2nd Volume set, 2012, ISBN: 978-3-527-64007-2
3) James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rdEdition, 2018, ISBN:9781118613528.

Reference Books:

1) Energy Storage in Power Systems, Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt,Wiley Publication, , Mar 2016. ISBN: 978-1-118-97130-7
2) Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost, Pistoia, Gianfranco, and Boryann Liaw.,Springer International Publishing AG, 2018, ISBN: 9783319699509

Web links and Video Lectures (e-Resources):

- Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course,https://nptel.ac.in/courses/113105102.
- Prof.PK Das, "Energy conservation and waste heat recovery", NPTELCourse, https://nptel.ac.in/courses/112105221.

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

- Video Sessions
- Organizing Group Wise Discussions
- Seminars

ELECTRICAL MACHINE DESIGN

Course Code	**22EEE543**	**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:

22EEE543.1	Understand the fundamental aspects of designing.
22EEE543.2	Identify the properties of materials used in electrical machines.
22EEE543.3	Classify types of electrical machines.
22EEE543.4	Realize various parameters of DC and AC machines.
22EEE543.5	Derive the output equation of different machines.
22EEE543.6	Design all parameters of DC and AC machines.

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
22EEE543.1	3	3	3	-	-	-	-	-	-	-	-	3	-	1
22EEE543.2	3	3	3	-	-	-	-	-	-	-	-	3	-	1
22EEE543.3	3	3	3	-	-	-	-	-	-	-	-	3	-	1
22EEE543.4	3	3	3	-	-	-	-	-	-	-	-	3	-	1
22EEE543.5	3	3	3	-	-	-	-	-	-	-	-	3	-	1
22EEE543.6	3	3	3	-	-	-	-	-	-	-	-	3	-	1

MODULE-1	**FUNDAMENTAL ASPECTS**	**22EEE543.1, 22EEE543.2**	**8 Hours**

Design of machines, design factors, limitations in design, modern trends in design of electrical machines, modern manufacturing techniques.

Electrical Engineering Materials: electrical conductivity materials, high conductivity materials, materials of high resistivity, electrical carbon materials, super-conductivity, magnetic materials, types of magnetic materials, insulating materials, electrical properties of insulating materials, temperature rise of insulating materials, classification of insulating materials, insulating materials used in modern electric machines, applications of insulating materials.

Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14

MODULE-2	**DESIGN OF TRANSFORMERS**	**22EEE543.4, 22EEE543.5, 22EEE543.6**	**8 Hours**

Specifications and design of a transformer, choice of flux density & current density; design of core, yoke and windings; optimum design, design of tank with tubes.

Text Book	Reference Book 1: 3.1 to 3.23

MODULE-3	**DESIGN OF DC MACHINES**	**22EEE543.3, 22EEE543.4, 22EEE543.5, 22EEE543.6**	**8 Hours**

Output equation, selection of number of poles, length of air gap, armature reaction, design of commutator and brushes, design of armature and field system.

Text Book	Text Book 1: 9.10 to 9.36, 9.48, 9.49, 9.50, 9.51, 9.52

MODULE-4	**DESIGN OF THREE PHASE INDUCTION MOTORS**	**22EEE543.3, 22EEE543.4, 22EEE543.5, 22EEE543.6**	**8 Hours**

Output equation, stator winding, rotor design, design of squirrel cage rotor, no load current, short circuit current.

Text Book	Text Book 1: 10.9 to 10.29

MODULE-5	DESIGN OF SYNCHRONOUS MACHINES	22EEE543.3, 22EEE543.4, 22EEE543.5, 22EEE543.6	8 Hours

Types of synchronous machine, constructional aspects of synchronous machines, synchronous motor, specifications, output equation, choice of specific loadings, design of salient pole machine.

Text Book	Reference Book 1: 6.2, 6.3, 6.6, 6.7, 6.8, 6.9, 6.10

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	-
L2	Understand	5	-
L3	Apply	5	10
L4	Analyze	5	10
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) A Course in Electrical Machine Design, A. K. Sawhney, Dhanpat Rai & Co., 2016. ISBN-10: 8177001019, ISBN-13: 978-8177001013
2) A Simplified Text in Electrical Machine Design, A. Nagoor Kani, CBS Publishers & Distributors Pvt. Ltd., 2022. ISBN: 978390709922

Reference Books:

1) Electrical Machine Design, Rajini. V and V. S. Nagarajan, Pearson Education India, 2018. ISBN: 978-93-325-8557-7
2) Design of Rotating Electrical Machines, Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, John Wiley & Sons Ltd., 2014. ISBN: 9781118581575

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=65pGmYm904Q

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

- Video demonstration of the concepts
- Organizing group wise discussions
- Seminars

SPECIAL ELECTRICAL MACHINES

Course Code	**22EEE544**	**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:

22EEE544.1	Acquire knowledge about construction and working principles of special electrical machines.
22EEE544.2	Analyze the performance of special electrical machines.
22EEE544.3	Acquire knowledge on various types of controllers for special motors.
22EEE544.4	Understand the linear and nonlinear characteristics of special electrical machines.
22EEE544.5	Evaluate and formulate the EMF and torque equations.
22EEE544.6	Choose appropriate special machines based on latest applications.

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
22EEE544.1	3	2	2	2	-	-	-	-	-	-	-	-	-	1
22EEE544.2	3	2	2	2	-	-	-	-	-	-	-	-	-	1
22EEE544.3	3	2	2	2	-	-	-	-	-	-	-	-	-	1
22EEE544.4	3	2	2	2	-	-	-	-	-	-	-	-	-	1
22EEE544.5	3	2	2	2	-	-	-	-	-	-	-	-	-	1
22EEE544.6	3	2	2	2	-	-	-	-	-	-	-	-	-	1

MODULE-1	**SYNCHRONOUS RELUCTANCE MOTORS**	**22EEE544.1 22EEE544.6**	**8 Hours**

Constructional features, Principle of operation, Types, Axial and radial air gap motors, Phasor diagram, Torque Characteristics, Non-linear analysis, Power controllers, Microprocessor based control and Computer based control and Applications.

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	**SWITCHED RELUCTANCE MOTOR (SRM)**	**22EEE544.1, 22EEE544.2, 22EEE544.3**	**8 Hours**

Construction, Principle of Working, Basics of SRM Analysis, Constraints on Pole Arc and Tooth Arc, Torque Equation and Characteristics, Power Converter Circuits, Control of SRM, Rotor Position Sensors, Current Regulators, Microprocessor – Based Control of SRM, Sensor less Control of SRM.

Applications	Investigate the different types of applications in industries with SRM motors
Text Book	Text Book 3: 7.15, 7.16, 7.17, 7.19, 7.20 Text Book 3: 4.18

MODULE-3	**PERMANENT MAGNET BRUSHLESS DC MOTORS & ITS CONTROLLERS**	**22EEE544.3, 22EEE544.6**	**8 Hours**

Commutation in DC motors, Hall sensors, Torque and EMF equation, Torque- speed characteristics, Multiphase Brushless motor, square wave permanent magnet brushless motor drives, Microprocessor based controller, Sensor less control and Applications

Text Book	Text Book 1: 3.2 ,3.3,3.4,3.5,3.6,3.9Text Book 2: 1.4, 1.7

MODULE-4	**STEPPING MOTORS & ITS DRIVE SYSTEMS**	**22EEE544.3, 22EEE544.4 22EEE544.6**	**8 Hours**

Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Circuit for open loop & Closed loop control of stepping motor, microprocessor-based controller and Applications

Self-Study	Applications using different types of stepper motor.
Text Book	Text Book 1: 3.11,3.13,3.16 Text Book 2: 1.12, 1.14

MODULE-5	**PERMANENT MAGNET SYNCHRONOUS MOTORS & ITS CONTROLLERS:**	**22EEE544.5 22EEE544.6**	**8 Hours**

Principle of operation, EMF equation, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes and Sensor less control, Applications	
Self-study	Investigate the different types of Permanent magnet synchronous motor 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-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	-
L2	Understand	5	-
L3	Apply	5	10
L4	Analyze	5	10
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) Special Electrical Machines, Mural Deshpande, scitech publications,2017, ISBN, 9385983512, 9789385983511
2) Stepping Motors – A Guide to Motor Theory and Practice, P.P. Aearnley, Peter Peregrines, London, 2002. ISBN-13. 978-0852960295
3) Switched Reluctance Motor and Drives, R. Krishnan, CRC Press, 2017 Washington ISBN 9781315220062

Reference Books:

1) Special electrical machines, E.G. Janardanan, PHI learning Private Limited, 2014Electric machinery, Ashfaq Hussain, Dhanpat Rai& Co, 3rd Edition, 2016. ISBN-10: 8177001663, ISBN-13: 978-8177001662
2) Special Electrical Machines, K. V. Rathnam Orient Black swan 2008, ISBN:9788173716317
3) Stepper Motors – Fundamentals, Applications and Design, V. V. Athani, New Age International Publications, 2006, ISBN-13. 978-8122410068
4) Permanent Magnet and Brushless DC Motors, T. Kenjo and S. Nagamori, Clarendon Press, London, 2007, ISBN:9780198562177

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 DC Motor, Generator/ Transformer
- Demonstration of working of DC machines
- Video demonstration of latest trends in industry applications
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions on issues
- Seminars

COMPETITIVE CODING			
Course Code	**22EEE545**	**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:

22EEE545.1	Use advanced pointer techniques and dynamic memory functions effectively.
22EEE545.2	Summarize the concepts of complex data structures and illustrate their applications in various scenarios.
22EEE545.3	Implement advanced linked lists and arrays in the real time projects.
22EEE545.4	Differentiate between various advanced tree and graph algorithms and contrast their performance.
22EEE545.5	Judge the efficiency of different sorting and searching algorithms by measuring their time and space complexities.
22EEE545.6	Formulate solutions for optimization problems using dynamic programming and devise efficient algorithms.

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
22EEE545.1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
22EEE545.2	3	3	-	-	3	-	-	-	2	-	-	3	3	3
22EEE545.3	3	3	-	-	3	-	-	-	2	-	-	3	3	3
22EEE545.4	3	-	2	2	3	-	-	-	2	-	-	3	3	3
22EEE545.5	3	3	-	-	3	-	-	-		-	-	3	3	3
22EEE545.6	3	3	2	2	-	-	-	-	-	-	-	3	3	3

MODULE-1	**ADVANCED POINTERS AND DYNAMIC MEMORY MANAGEMENT**	**22EEE545.1**	**8 Hours**

Pointers and Double Pointers: Pointer Arithmetic, Double Pointer, Function Pointers, Pointers to Functions Returning Pointers, Dynamic Memory Allocation using Pointers.

Dynamic memory management: Functions for dynamic memory management: malloc, calloc, realloc, and free, Memory Leaks and their prevention, memory pools and custom allocators.

Applications	Given a large dataset that needs to be processed in chunks. Write a C program that dynamically allocates memory for each chunk, processes the data, and then frees the memory. Ensure that the program handles memory allocation failures gracefully.
Text Book	Text Book 1: Chapter 11, 12, 13, 14

MODULE-2	**ADVANCED STRUCTURES AND UNIONS**	**22EEE545.2**	**8 Hours**

Nested Structures, Self-referential Structures, Bit-fields in Structures, Unions and their applications, Anonymous Unions and Structures, Creating and using bit-fields in structures, Enumerated Types and their uses.

Applications	Develop a system to manage student records. Each student has a name, roll number, and marks in three subjects. Use nested structures to store this information. Additionally, use an enumerated type to represent the grade (A, B, C, D, F) based on the average marks. Write a program to input student details, calculate the average marks, assign a grade, and display the student information.
Text Book	Text Book 2: Chapter 10, 11, 12

MODULE-3	**ADVANCED LINKED LISTS AND ARRAYS**	**22EEE545.2 22EEE545.3**	**8 Hours**

Advanced Linked List: Circular Linked Lists, Skip Lists, XOR Linked Lists.

Advanced Arrays: Dynamic Arrays and Resizable Arrays, Multi-dimensional Arrays and their Applications, Sparse Arrays

Applications	Develop a scheduling system for a round-robin tournament. Each team plays every other team exactly once, and the schedule needs to be managed efficiently. Implement a circular linked list to store the schedule of matches. Write functions to add a match, remove a match, and display the schedule in a loop.		
Text Book	Text Book 3: Chapter 3, 4, 5, 6, 7, 8		
MODULE-4	**TREES AND GRAPHS**	**22EEE545.4**	**8 Hours**
Binary Trees and Binary Search Trees: AVL Trees, Red-Black Trees, and Splay Trees, B-Trees and B+ Trees, Trie and Suffix Trees Graph Representations: Adjacency Matrix, Adjacency List, Graph Traversal Algorithms- Depth-first and breadth-first search algorithms.			
Applications	Develop a spell-checking application that uses a trie to store a dictionary of valid words. Implement a trie to store the dictionary and write functions to insert words, delete words, and check if a word is valid. Additionally, implement a function to suggest corrections for misspelled words by finding the closest matches in the trie..		
Text Book	Text Book 3: Chapter 9, 10, 11		
MODULE-5	**ADVANCED ALGORITHMS**	**22EEE545.5 22EEE545.6**	**8 Hours**
Sorting Algorithms: Merge Sort and Heap Sort, Searching Algorithms: Binary Search and Ternary Search, Dynamic Programming: Knapsack Problem, Longest Common Subsequence			
Applications	Develop a resource allocation system for a project management tool. Each task has a specific importance and resource requirement. Implement the knapsack problem to allocate resources to the tasks in a way that maximizes the total importance within the given resource constraints. Write functions to solve the problem using dynamic programming and display the optimal allocation		
Text Book	Text Book 3: Chapter 12		

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	**Remember**		-
L2	**Understand**	5	-
L3	**Apply**	10	5
L4	**Analyze**	5	10
L5	**Evaluate**	5	10
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) C Programming: A Modern Approach, K. N. King, Publisher: W. W. Norton & Company, 2nd Edition, 2022, ISBN: 978-0393979503
2) Programming in ANSI C, E. Balagurusamy , McGraw Hill Education, 8th Edition, 2019. ISBN: 978-9353165130
3) Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson, 2nd Edition, 2019. ISBN: 978-0201498400

Reference Books:

1) Introduction to Algorithms , Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 4th Edition, The MIT Press, 2022. ISBN: 978-0262046305
2) The Art of Computer Programming , Donald E. Knuth, 3rd Edition, Addison-Wesley Professional, 1997. ISBN: 978-0201896831.

Web links and Video Lectures (e-Resources):

- Learn C: Pointers and Memory | Codecademy
- C Programming: Pointers and Memory Management - 4 | Coursera
- C Unions (With Examples) (programiz.com)
- Structures & Unions in C (Solved Problem) - YouTube
- Linked Lists vs. Arrays - Data Structures for Coding Interviews in C++ (educative.io)
- AlgoDaily - Merge Sort vs. Quick Sort vs. Heap Sort

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

- Practical based learning: Provide students with coding exercises that require implementing dynamic programming solutions. Use online coding platforms like LeetCode, HackerRank, or Codeforces for practice.
- Have students exchange their code with peers for review. Each student will review and debug their peer's code, providing feedback and suggestions for improvement.
- Encourage students to participate in online competitive programming contests that feature dynamic programming problems. Platforms like Codeforces, AtCoder, and TopCoder host regular contests.
- Use software tools to visually represent the state space, decision tree, and memorization table for dynamic programming problems. Encourage students to draw these visual aids themselves.

RESEARCH METHODOLOGY AND IPR

Course Code	**22RMK55**	**CIE Marks**	**50**
L: T: P: S	**1:1:0:0**	**SEE Marks**	**50**
Hours / Week	**03**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course outcomes:

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

22RMK55.1	Define a research problem and to formulate research questions.
22RMK55.2	Demonstrate the various processing techniques of research .
22RMK55.3	Choose appropriate methods to formulate research objectives.
22RMK55.4	Develop advanced critical thinking skills and enhance writing skills.
22RMK55.5	Understand the statutory provisions of different forms of IPRs in simple forms.
22RMK55.6	Identify the significance of practice and procedure of patents.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22RMK55.1	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.2	3	3	2	2	2	-	-	-	1	2	-	-
22RMK55.3	3	3	2	2	1	-	-	-	1	2	-	-
22RMK55.4	3	2	2	-	1	-	-	-	1	2	-	-
22RMK55.5	3	3	2	1	-	-	-	1	1	2	-	-
22RMK55.6	3	3	2	1	-	-	-	1	1	2	-	-

MODULE-1	**FORMULATION OF RESEARCH PROBLEM**	**22RMK55.1, 22RMK55.2**	**6 Hours**

Research– Meaning and Objectives – Criteria of Good Research–Problems Encountered by Researchers –Types of Research–Research Approaches-Research Process–Literature Review– Significance of Literature Review–Review of Selected Literature– Research Problem– Identification and Defining the Research Problem.

Text Book	Text Book 1: Ch. 1, 2

MODULE-2	**RESEARCH DESIGN PROCEDURES**	**22RMK55.2, 22RMK55.3**	**6 Hours**

Meaning of Research Design – Need for Research design – Features of a Good Design –Concepts Related to Research Design– Different Research Designs – Basic Principles of Experimental Designs.

Case Study	To find the solution for the given research problem using different types of research methods.
Text Book	Text Book 1: Ch. 3

MODULE-3	**INTERPRETATION AND REPORT WRITING**	**22RMK55.4**	**6 Hours**

Meaning and Technique of Interpretation – Precautions in interpretation – Significance of Report Writing – Different Steps in Report Writing – Layout of a Research Report– Types of Report – Mechanics of Writing a Research Report –Conclusion-Referencing in Academic Writing –Bibliography.

Text Book	Text Book 2: Ch. 14

MODULE-4	**INTRODUCTION TO IPR**	**22RMK55.5**	**6 Hours**

Introduction and Significance of Intellectual Property Rights –Types of Intellectual Property Rights–Need for IPR –Rationale for Protection of IPR–IPR in India and Abroad–Forms of IPR – Royalty – Copyright – Trademark – Patents – Industrial Designs – Trade Secrets – Geographical Indications – Application of Different Forms of IPR– Future Aspects of IPR– Some Examples of IPR.

Text Book	Text Book 2: Ch. 1 and 2

MODULE-5	**BASICS OF PATENTS**	**22RMK55.5, 22RMK55.6**	**6 Hours**

Patents and its Basics – Patentable and Non-Patentable Inventions–Patent Application Process (National and International level) – Searching a Patent-Drafting and Filing a Patent –Types of Patent Applications–Patent

Documents– Specification and Claims–Assignment, Licensing, Infringement–Different Layers of International Patent System–Some Examples of Patent – forms requirement for patent application with charges.	
Case Study	Analyze different domains of filed patents
Text Book	Text Book 2: Ch. 1 and 2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		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) Research Methodology: Methods and Techniques, Kothari, C.R., New Age International, 2018, ISBN-13: 978-8122436235
2) A Text book of Intellectual Property rights, Ramakrishna Chintakunta, Blue Hill Publication, 2022. ISBN: 978-93-91539-62-7

Reference Books:

1) An Introduction to Research Methodology, Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K RBSA Publishers. 2015, ISBN-13:978-8176111652
2) Research methodology, Ranjith Kumar, Saga publications,4th edition, 2014, ISBN-13- 978-9351501336
3) Research Methodology, Sinha, S.C. and Dhiman, A.K., EssEss Publications. 2 volumes, 2012. ISBN: 81-7000-324-5, 81-7000-334-2
4) Intellectual Property Rights, Asha Vijay Durafe, Dhanashree K. Toradmalle , Dreamtech Press,2020, ISBN:9390395917

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=nv7MOoHMM2k
- https://www.youtube.com/watch?v=BGSgZ1J8-yQ

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

- Video Sessions
- Organizing Group Wise Discussions
- Seminars

CRITICAL AND CREATIVE THINKING SKILLS

Course Code	**22SDK56**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**2**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**01**

Course outcomes:

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

22SDK56.1	Demonstrate proficiency in solving quantitative aptitude problems using fundamental concepts.
22SDK56.2	Apply advanced quantitative techniques to address and solve complex real-world problems.
22SDK56.3	Develop and enhance logical reasoning skills essential for problem-solving in various competitive examinations.
22SDK56.4	Cultivate critical and creative thinking skills necessary for analytical reasoning and problem-solving.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SDK56.1	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.2	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.3	3	3	-	-	2	-	-	-	-	-	-	2
22SDK56.4	3	3	-	-	2	-	-	-	-	-	-	2

MODULE-1	**CRITICAL THINKING THROUGH QUANTITATIVE ANALYSIS**	**22SDK56.1 22SDK56.2**	**6 Hours**

Number systems: LCM and HCF of numbers, Squaring and Cubing Techniques, Multiplication Tricks, Divisibility rules, Digit sum method, Speed Math, Simplifications, Approximations.

Percentages: Conversion of Fraction to Percentage Table, Percentage Change, Net percentage change/Effective percentage change, Successive Percentage, Concept of more/less percentage, Percentage of percentage, Product constancy, Increased/decreased by P%, Percentage Changes in Numerator and Denominator, Successive Percentage.

Averages: Basic concept, Consecutive Numbers, Non-Consecutive Numbers, Equation Concept, True/False concept, Including/Excluding concept, Replacement concept, Average Speed concept.

MODULE-2	**NUMERICAL TECHNIQUES FOR PROBLEM SOLVING**	**22SDK56.1 22SDK56.2**	**6 Hours**

Profit and Loss: Basic concept, Profit Percentage, Loss Percentage, Profit/Loss Percentage, Overall Profit/Loss, Dishonest shopkeeper, More/less loss concept.

Discounts: Successive discounts, Buy X and Get Y Free, Profit after allowing discount, True Discount, Difference between percentage profit and percentage discount.

Ratio and Proportion: Concept Explanation, Duplicate Ratio, Triplicate Ratio, Direct Proportion, Indirect Proportion, Double rule of three or compound proportion, Ratio in investment, Ratio in partnership, Ratio in averages, Ratio in profit and loss, Ratio in interest rates.

Time and Work: Unit work, Combined work, Individual efficiency, Group efficiencies, Time taken by an individual or a group, Work done by an individual or a group, Total work done, Chain Rule Concept, Pipes and Cisterns, 4 Rules of Pipes and Cistern.

MODULE-3	**ADVANCED QUANTITATIVE TECHNIQUES**	**22SDK56.1 22SDK56.2**	**6 HOURS**

Algebra: Simple Arithmetic Operations, Linear equation is one, Two and three variables, Methods of solving linear equations, Methods of solving quadratic equations, Surds and indices, Logarithms.

Series and Progressions: Arithmetic Sequences, Geometric Sequences, Harmonic Sequences, Fibonacci Numbers.

Geometry: Concepts of Angles, Different polygons like triangles, rectangle, square, right-angle triangle, Pythagorean Theorem, Perimeter and Area of Triangle, Rectangle, and circles.

Statistics: Mean, Median, Mode, Standard Deviation, Variance.

MODULE-4	ANALYTICAL REASONING AND CREATIVE PROBLEM SOLVING	22SDK56.3 22SDK56.4	6 Hours

Number Series - Missing numbers, Incomplete series - Odd-even series, primes, Fibonacci series, Arithmetic progression, Geometric progression, Harmonic progression, Squares and cubes, Operations on digits, Exponential series, Increasing multiplication, Hybrid series.

Alphabetical Series- Missing alphabets, incomplete letter series - series of words, series of letters, arrangement of words/letters, letters marked with corresponding numbers sequence, positions of letters, ranking of the word in dictionary; Mixed Series - Missing numbers and words/letters, complete the series.

Analogies: Alphabet Classification, Word Classification, Number Classification.

Coding and Decoding: Coding based on order, Letter to Letter Mapping, Letter to number mapping, Letter to digit mapping, Re-ordering sequences; Word sequencing, Match the word to code, Symbol Coding.

MODULE-5	PROBLEM SOLVING THROUGH LOGICAL ANALYSIS	22SDK56.3 22SDK56.4	6 Hours

Directions: Eight Directions, Distance, Displacement, Starting and ending points, Referential directions, Directions of shadows, Axis based problems, Actual and conditional directions.

Seating Arrangements: Linear arrangement, Square Arrangement, Rectangular Arrangement, Circular arrangement, Vertical arrangement, Seating arrangement in a photograph, Tabular arrangement, Hexagonal Seating Arrangement, Complex arrangement, Miscellaneous arrangements.

Blood Relations: Relations defined, Generation Verticals, Family Tree, Single Person Blood Relations, Mixed/Chain Blood Relations, Symbol based Blood Relation.

CIE Assessment Pattern (50 Marks – Theory)

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

ENVIRONMENTAL STUDIES

Course Code	**22ESK57**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**1**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**02**

Course outcomes:

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

22ESK57.1	Understand the concepts of Environment, ecosystem and biodiversity.
22ESK57.2	Explain the strategies for management of natural resources to achieve sustainability.
22ESK57.3	Analyze the control measures of Environmental pollution and global Environmental issues.
22ESK57.4	Apply the knowledge of Environment Impact Assessment, Technology, Environmental acts and laws in protecting Environment and human health.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO100	PO11	PO12
22ESK57.1	-	-	-	-	-	3	3	-	-	-		-
22ESK57.2	-	-	-	-	-	3	3	-	-	-	-	3
22ESK57.3	-	-	-	-	-	3	3	3	-	3	-	3
22ESK57.4	-	-	-	-	1	3	3	3	-	3	-	3

MODULE 1	**INTRODUCTION TO ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**22ESK57.1**	**3hours**

Environment: Definition, Components of Environment; Ecosystem: Types & Structure of Ecosystem, Energy flow in the ecosystem; Biodiversity: Types, Hot-spots, Threats and Conservation of biodiversity.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 1 , 3 & 4

MODULE 2	**NATURAL RESOURCES**	**22ESK57.2**	**3hours**

Advanced Energy resources (Hydrogen, Solar, OTEC, Tidal and Wind), merits and demerits, Water resources – cloud seeding, Mineral resources, Forest resources. Strategies of management, concept of sustainability.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 2

MODULE 3	**ENVIRONMENTAL POLLUTION**	**22ESK57.3**	**3hours**

Definition, Causes, effects and control measures of Air Pollution, Water Pollution, soil Pollution and Noise pollution. Solid wastes and its management. Role of society, NGO and Govt. agencies in prevention of pollution

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 5,6, Text Book 2: Ch. 5

MODULE 4	**GLOBAL ENVIRONMENTAL ISSUES, ENVIRONMENT ACTS AND AMENDMENTS**	**22ESK57.3**	**3hours**

Fluoride problem in drinking water, Acid Rain, Ozone layer depletion, Global warming and climate change. National forest policy, Environmental laws and acts, international agreements and protocols.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 6, Text Book 2: Ch. 6

MODULE 5	**HUMAN POPULATION AND ENVIRONMENT IMPACT ASSESSMENT**	**22ESK57.4**	**3hours**

Population growth & explosion, Population pyramids. Negative impact of agriculture and urbanization, Role of Technology in protecting environment and human health. Environment Impact Assessment.

Self-study / Case Study / Applications	Department Specific Self-study / Case Study / Applications can be added.
Text Book	Text Book 1: Ch. 7

CIE Assessment Pattern (50 Marks – Theory) –

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

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Environmental studies by Benny Joseph, Tata McGraw Hill Education Private Limited, 2009, ISBN: 9870070648135.
2) Environmental Studies: Basic Concepts, Ahluwalia, V. K. The Energy and Resources Institute (TERI) Publication, 2nd edition, 2016. ISBN: 817993571X, 9788179935712.

Reference Books:

1) Handbook of Environmental Engineering by Rao Surampalli, Tian C. Zhang, Satinder Kaur Brar, Krishnamoorthy Hegde, Rama Pulicharla, Mausam Verma; McGraw Hill Professional, 2018. ISBN: 125986023X, 9781259860232
2) Environmental Science and Engineering by P. Venugopala, Prentice Hall of India Pvt. Ltd, New Delhi, 2012 Edition. ISBN: 978-81-203-2893-8.
3) Elements of Environmental Science and Engineering by P. Meenakshi, Prentice Hall of India Pvt. Ltd, 2005 Edition. ISBN: 8120327748, 9788120327740

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/120/108/120108004/
- https://archive.nptel.ac.in/courses/103/107/103107215/

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

- Visit to any company to study the initiative taken for environmental impact.
- Case study based learning on engineering approaches for pollution prevention.
- Video/ model / charts based learning
- Activities/awareness program for preventing environmental pollution

MINI PROJECT-II

Course Code	22EEE58	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:

22EEE58.1	Apply the knowledge learned through several courses to practical issues.
22EEE58.2	Design a small hardware system by using modern tools and technologies.
22EEE58.3	Able to work in teams and manage the conduct of the research study.
22EEE58.4	Communicate and comprehend the work through articles.
22EEE58.5	Articulate the project related activities and findings.
22EEE58.6	Apply the idea gained in mini project to major project.

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
22EEE58.1	3	3	3	2	3	2	2	2	3	3	3	2	2	2
22EEE58.2	3	3	3	2	3	2	2	2	3	3	3	2	2	2
22EEE58.3	3	3	3	2	3	2	2	2	3	3	3	2	2	2
22EEE58.4	3	3	3	2	3	2	2	2	3	3	3	2	2	2
22EEE58.5	3	3	3	2	3	2	2	2	3	3	3	2	2	2
22EEE58.6	3	3	3	2	3	2	2	2	3	3	3	2	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 of recognizing 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

SIXTH SEMESTER
SYLLABUS

POWER ELECTRONICS

Course Code	**22EEE61**	**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:

22EEE61.1	Understand the characteristics of various power semiconductor devices.
22EEE61.2	Investigate the protection, gating and commutation circuits.
22EEE61.3	Examine different types of controlled rectifiers, choppers and inverters.
22EEE61.4	Choose suitable techniques to minimize the harmonics.
22EEE61.5	Analyze the performance of different power converters.
22EEE61.6	Design power converters for industrial applications.

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
22EEE61.1	3	2	1	1	-	-	-	-	-	-	-	-	2	2
22EEE61.2	3	3	2	2	1	-	-	-	-	-	-	-	2	2
22EEE61.3	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEE61.4	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEE61.5	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEE61.6	3	3	2	2	3	-	-	-	-	-	-	-	2	2

MODULE-1	**POWER SEMICONDUCTOR DEVICES**	**22EEE61.1, 22EEE61.2**	**8 Hours**

Introduction, Construction, Principle of Operation – IGBT, MOSFET, SCR – Static and Dynamic Characteristics, Two-transistor model of SCR, Protection Circuits, Commutation Techniques, Firing Circuits.

Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.4, 2.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.12, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

MODULE-2	**AC-DC CONVERTER**	**22EEE61.3, 22EEE61.5**	**8 Hours**

Single phase half and fully controlled rectifiers with R and RL Loads, Three-phase half and fully controlled rectifiers with R Load, Dual converters.

Case Study	Understand the operation of converters with respect to different types of power semiconductor devices.
Text Book	Text Book 1: 6.1, 6.2, 6.3, 6.4, 6.6, 6.8

MODULE-3	**DC-DC CONVERTER AND AC-AC CONVERTER**	**22EEE61.3, 22EEE61.5**	**8 Hours**

DC Chopper-Time ratio control and current limit control, Buck Converter, Boost Converter, Classification of Choppers, Four Quadrant Chopper.
ON-OFF Control and Phase Control, Single phase bi-directional controllers with R and RL Loads.

Case Study	Analyze Choppers and AC voltage regulator circuits with respect to different types of power semiconductor devices.
Text Book	Text Book 1: 7.1, 7.2, 7.3, 7.4, 9.1, 9.2, 9.3 & Text Book 2: 5.8.1, 5.8.2, 5.8.3

MODULE-4	**DC-AC CONVERTER**	**22EEE61.3, 22EEE61.4, 22EEE61.5**	**8 Hours**

Inverters-Single phase bridge inverters, Three phase bridge inverters-1800 and 1200 mode of conduction, PWM schemes, Harmonic distortion analysis.

Text Book	Text Book 1: 8.1, 8.2, 8.4, 8.6, 8.7

MODULE-5	**INDUSTRIAL APPLICATIONS**	**22EEE61.6**	**8 Hours**

SMPS, UPS, Residential and Industrial Applications, HVDC Transmission, Static VAR Compensators, Interconnection of Renewable Energy Sources and Energy Storage Systems to the Utility Grid, Active Filters.

Text Book	Text Book 1: 11.1, 11.2, 11.3; Text Book 3: 16.1, 16.2, 16.3, 17.3, 17.4, 17.5; Reference 2: 5.1, 5.2, 5.3, 6.1, 6.2, 7.1

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		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) Power Electronics, P. S. Bimbhra, Publisher: Khanna Publishers; 5th ed. 2014 edition. ISBN: 81-7409-056-8
2) Power Electronics: Circuits, Devices and Applications by Mohammad H Rashid; Publisher: Pearson, 4th ed. 2014 edition. ISBN 978-0-13-312590-0
3) Power Electronics: Converters, Applications and Design by Ned Mohan; Publisher: Wiley, 3rd ed. 2014 edition. ISBN: 978-0-471-22693-2

Reference Books:

1) Power Electronics: Essentials and Applications by L. Umanand, Publisher: Wiley, 4th ed. 2010 edition. 978-8126519453
2) Simulation of Power Electronics Circuits with MATLAB/Simulink: Design, Analyze and Prototype Power Electronics by Farzin Asadi, Publisher: Apress, 2022 edition. ISBN: 978-1484282199

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108101038
- https://www.youtube.com/watch?v=jgh0TNfx0gQ
- https://www.coursera.org/specializations/power-electronics?

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

- Seminars
- Demonstration of Real time applications using simulation
- Video demonstration of latest trends in power electronics
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
- Encourage collaborative (Group Learning) Learning in the class.
- Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.

POWER ELECTRONICS LABORATORY

Course Code	**22EEL61**	**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:

22EEL61.1	Understand the characteristics of various power semiconductor devices.
22EEL61.2	Inspect the protection, gating, control and commutation circuits.
22EEL61.3	Analyze the performance of power converters for various loads .
22EEL61.4	Design the appropriate converters 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	PO12	PSO1	PSO2
22EEL61.1	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEL61.2	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEL61.3	3	3	2	2	2	-	-	-	-	-	-	-	2	2
22EEL61.4	3	3	2	2	2	-	-	-	-	-	-	-	2	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	Introduction to power semiconductor devices and converters	2	NA
	PART-A		
1	Static characteristics of SCR	2	22EEL61.1
2	Static characteristics of MOSFET and IGBT	2	22EEL61.1
3	Switching Characteristics of MOSFET and IGBT	2	22EEL61.1
4	SCR turn-on circuit using synchronized UJT relaxation oscillator	2	22EEL61.2
5	SCR protection circuit, RC firing circuit and digital triggering circuit for a single-phase controlled rectifier and A.C. voltage controller	2	22EEL61.2
6	Single-phase full-wave controlled rectifier with R and RL loads	2	22EEL61.3
	PART-B		
7	A.C. voltage controller using TRIAC and DIAC combination connected to R load	2	22EEL61.3
8	Speed control of DC motor using single phase semi converter	2	22EEL61.4
9	Speed control of a separately excited DC motor using IGBT or MOSFET chopper	2	22EEL61.4
10	MOSFET or IGBT based single-phase full-bridge inverter connected to R load	2	22EEL61.3
11	Speed control of universal motor using A.C. voltage controller and controlled rectifier	2	22EEL61.4
12	Simulation of power converter circuits	2	22EEL61.3

PART-C

Beyond Syllabus Virtual Lab Content

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

1) MOSFET: Study the transfer and drain characteristics of MOSFET
   https://vlsi-iitg.vlabs.ac.in/MOSFET_theory.html
2) Full Wave Rectification
   https://be-iitkgp.vlabs.ac.in/exp/full-wave-rectification/theory.html

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Power Electronics, P. S. Bimbhra, 7th edition. 2022, Khanna Publishers, ISBN: 9788195123124
2) Simulation of Power Electronics Circuits with MATLAB/Simulink: Design, Analyze and Prototype Power Electronics, Farzin Asadi , 1st edition, 2022, Apress, ISBN : 9781484282205

ELECTRIC VEHICLES

Course Code	**22EEE62**	**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:

22EEE62.1	Understand the electric vehicle architecture and power train components.
22EEE62.2	Apply the concepts of dynamics of electrical vehicles.
22EEE62.3	Analyze the vehicle control for various motor drives .
22EEE62.4	Design and select energy storage systems.
22EEE62.5	Understand the different energy sources and energy management in HEVs.
22EEE62.6	Develop hybrid electric vehicle control strategies.

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
22EEE62.1	3	2	2	2	1	-	-	-	-	-	-	-	2	2
22EEE62.2	3	2	2	2	1	-	-	-	-	-	-	-	2	2
22EEE62.3	3	2	2	2	1	-	-	-	-	-	-	-	2	2
22EEE62.4	3	2	2	2	1	-	-	-	-	-	-	-	2	2
22EEE62.5	3	2	2	2	1	-	-	-	-	-	-	-	2	2
22EEE62.6	3	2	2	2	1	-	-	-	-	-	-	-	2	2

MODULE-1	**ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**	**22EEE62.1, 22EEE62.2**	**8 Hours**

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7

MODULE-2	**MECHANICS OF HYBRID ELECTRIC VEHICLES**	**22EEE62.2**	**8 Hours**

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity.

Simulation	Design of different converters for different power specifications.
Text Book	Text Book 1: 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7

MODULE-3	**CONTROL OF DC AND AC MOTOR DRIVES**	**22EEE62.3**	**8 Hours**

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter-based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

Text Book	Text Book 2: 8.1, 8.2, 8.3, 8.4

MODULE-4	**ENERGY STORAGE SYSTEMS**	**22EEE62.4**	**8 Hours**

Battery: Principle of operation, types, models, estimation of parameters, battery modeling, SOC of battery, Traction Batteries and their capacity for standard drive cycles, Vehicle to Grid operation of EV's. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.

Text Book	Text Book 3:Ch.5

MODULE-5	**HYBRID VEHICLE CONTROL STRATEGY**	**22EEE62.5, 22EEE62.6**	**8 Hours**

HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode - energy management of HEV's.

Text Book	Text Book 4: Ch.3

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		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) Advanced Electric Drive Vehicles, Ali Emadi, 1st Edition, 2015, CRC Press, ISBN-13:978-1-4665-9770-9.
2) Modern Power Electronics and AC Drives, Bimal K Bose, 2nd edition, 2002, Prentice Hall, ISBN-0-13-016743-6.
3) Permanent Magnet Synchronous and Brushless DC Motor Drives, R Krishnan, 2017, CRC Press, ISBN: 978-0-8247-5384-9.
4) Hybrid Electric Vehicle System Modeling and Control, Wei Liu, Second Edition, WILEY, 2017, ISBN: 978-1-119-27932-7

Reference Books:

1) Modern Electric Vehicle Technology, C.C Chan, K.T Chau, 1st Edition, 2001, Oxford University Press, ISBN-13: 978-0198504160

Web links and Video Lectures (e-Resources):

- https://www.electrical4u.com/electrical-engineering-articles/electrical-drives/
- https://archive.nptel.ac.in/courses/108/104/108104140/
- https://archive.nptel.ac.in/courses/108/103/108103009/
- https://www.udemy.com/course/electric-vehicle-basics-u/

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

- Visit to any electrical vehicle manufacturing industry
- Demonstration of DC Motor, AC motor speed control through electrical drive
- Video demonstration of latest trends in EV
- Organizing Group wise discussions on environmental impact of EV
- Seminars

ELECTRIC VEHICLES LABORATORY

Course Code	**22EEL62**	**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:

22EEL62.1	Familiarize with the basic electric component configuration for the electric power train.
22EEL62.2	Design a suitable converter and inverter for the electric vehicle application.
22EEL62.3	Apply Energy management system strategies.
22EEL62.4	Obtain the model and test for the electric vehicle.

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
22EEL62.1	3	3	2	2	2	-	-	-	2	1	-	-	2	2
22EEL62.2	3	3	2	2	3	-	-	-	2	1	-	-	2	2
22EEL62.3	3	3	3	3	3	-	-	-	2	1	-	-	2	2
22EEL62.4	3	3	3	3	3	-	-	-	2	1	-	-	2	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	Introduction to electric vehicles	2	NA
	PART-A		
1	Simulation of SPWM technique for electric vehicle converter using MATLAB/SIMULINK.	2	22EEL62.1
2	PWM Inverter fed 3 phase induction motor using MATLAB	2	22EEL62.2
3	Design of bidirectional battery circuit using Buck / Boost converter using MATLAB/SIMULINK.	2	22EEL62.2
4	Battery controller based on SoC for charging and discharging of battery in EV using MATLAB/SIMULINK.	2	22EEL62.3
5	Modeling and Simulation of BMS for passive cell balancing in EV using MATLAB/SIMULINK.	2	22EEL62.3
6	SoC control of Lithium-Ion battery in MATLAB/SIMULINK for EV.	2	22EEL62.3
	PART-B		
7	Modelling and simulation of electric vehicle dynamics.	2	22EEL62.1
8	Modelling and simulation of power train.	2	22EEL62.1
9	Simulation of bidirectional operation in Electric Vehicle charger using single-phase model.	2	22EEL62.3
10	Modeling and Simulation to calculate electric vehicle speed from motor torque.	2	22EEL62.4
11	Chopper fed DC motor drive simulation.	2	22EEL62.2
12	Simulation of electric vehicle using MATLAB/SIMULINK.	2	22EEL62.4

PART-C

Beyond Syllabus Virtual Lab Content

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

1. Industrial Electric Drives Lab
   https://ied-nitk.vlabs.ac.in/List%20of%20experiments.html
2. Hybrid Electric Vehicle Drive
   https://courses.diyguru.org/learn/virtual-lab/

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

1) https://www.youtube.com/playlist?list=PLVx2vtSRaZo6vngZ7NaVk4-rZczadA0go
2) https://www.youtube.com/watch?v=fQ9wfHCWmf0
3) https://www.youtube.com/live/FVuRA72CKAM?app=desktop

GENERATION, TRANSMISSION AND PROTECTION

Course Code	**22EEE63**	**CIE Marks**	**50**
L:T:P:S	**3:0:0:0**	**SEE Marks**	**50**
Hours / Week	**4**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course outcomes:

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

22EEE63.1	Understand the basic concepts of electrical power system.
22EEE63.2	Identify various types of supporting structures, line conductors and insulators.
22EEE63.3	Computation of line parameters in overhead transmission lines.
22EEE63.4	Analyze the performance of short, medium and long transmission lines.
22EEE63.5	Categorize different types of distribution systems, types of grading in underground cables and examine its quality and performance.
22EEE63.6	Application of various types of protective devices in power systems.

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
22EEE63.1	3	2	2	1	-	-	-	-	-	-	-	-	1	1
22EEE63.2	3	3	2	1	-	-	-	-	-	-	-	-	1	1
22EEE63.3	3	3	2	1	-	-	-	-	-	-	-	-	1	1
22EEE63.4	3	3	2	1	-	-	-	-	-	-	-	-	1	1
22EEE63.5	3	3	2	1	-	-	-	-	-	-	-	-	1	1
22EEE63.6	3	3	2	1	-	-	-	-	-	-	-	-	1	1

MODULE-1	**INTRODUCTION TO ELECTRICAL POWER SYSTEM**	**22EEE63.1**	**8 Hours**

Structure of electric power system: generation, transmission and distribution, conventional and non-conventional energy sources, working of power plants (Thermal, Nuclear, Solar, and Thermal), Advantages of higher voltage transmission, Operating level voltages, Introduction to Feeders, distributors and service mains.

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	**MECHANICAL DESIGN OF OVERHEAD LINES**	**22EEE63.2**	**8 Hours**

Types of supporting structures & line conductors used, Sag calculation- Supports at same level, supports at different levels, Effect of wind & ice on sag calculation, Stringing chart, Sag template& Vibrators, Problems on sag calculation, Types of Insulators used, Potential Distribution over suspension insulator string, String efficiency, Methods to improve string efficiency, grading rings, Arching horns, Testing of Insulators, Problems. Phenomenon of corona, Disruptive & Critical voltages, Power loss due corona, Advantages & Disadvantages of corona, Problems.

Text Book	Text Book 1: 7.15, 7.16, 7.17, 7.19, 7.20 Text Book 2: 4.18

MODULE-3	**ELECTRICAL DESIGN AND PERFORMANCE OF OVERHEAD TRANSMISSION LINES**	**22EEE63.3 22EEE63.4**	**8 Hours**

Introduction, Calculation of inductance of single-phase line, 3phase lines with equilateral spacing, Unsymmetrical Spacing, transposed lines, Inductance of composite conductor lines, Capacitance of single-phase line, 3 phase lines with equilateral spacing, 3 phase lines with unsymmetrical spacing, Skin Effect, Problems.

Introduction, Short transmission lines, medium transmission lines- Nominal T & Π method, End condenser method, long transmission lines, ABCD constants of transmission lines, Ferranti Effect, Line regulation, Problems.

Self-study	Solving numerical on different types of transmission lines
Text Book	Text Book 1: 3.2 ,3.3,3.4,3.5,3.6,3.9Text Book 2: 1.4, 1.7

MODULE-4	**DISTRIBUTION SYSTEMS AND UNDERGROUND CABLE**	**22EEE63.5**	**8 Hours**

Primary and secondary distribution, Connection schemes of Distribution Systems, Design considerations in distribution system, Types of DC Distributors (uniform and concentrated loading), Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems, AC distributors, Problems.

Introduction, types, materials used for underground cables, Insulation resistance, thermal rating of cables, charging current, Grading of cables, Capacitance grading and intersheath grading, Testing of cables.			
Case study	Prepare a report on different types of cables available in market		
Text Book	Text Book 1: 3.11,3.13,3.16 Text Book 2: 1.12, 1.14		
MODULE-5	**POWER SYSTEM PROTECTION**	**22EEE63.6**	**8 Hours**
Basic Protective devices, Fuse law-cut-off characteristics- Time current characteristics- fuse material- HRC fuse - Liquid fuse- Application of fuse. Circuit breaker- Theory of arcing and arc quenching circuit breakers- RRRV, Resistor switching and capacitor switching, Types of Circuit Breaker-Oil, SF_6, Vacuum. Introduction to Relay-General classification, Principle of Operation, Types- Differential, Distance, Relay characteristics. Protection of Alternators and Transmission line. Digital relays -Microprocessor based relays, Basics of Numerical relays.			
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)	Qualitative Assessment (s)/Seminars	MCQ's
		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) A Course of Electrical Power, Soni Gupta & Bhatanagar, DhanpatRai& Sons (New Delhi) ,2014. ISBN: 978-9350143742
2) Electrical Power Systems, C.L.Wadhwa, ,4th edition , 2009, Wiley Easten Ltd, ISBN 0- 470-21808-8

Reference Books:

1) Elements of power System Analysis, W.D. Stevenson, 4th Edition, 1982, TMH, ISBN-: 9780070665842
2) Electric Power Generation Transmission and Distribution, S.M. Singh, 3rd Edition, 2010, Prentice Hall of India Publishers, ISBN: -978-81-203-3560-8.
3) Electrical Power Transmission and Distribution, J.B. Gupta, 2010, S.K. Kataria& Sons Publisher, 2010, 4th Edition, ISBN 978-0470-40863-6
4) Electrical Power Systems, S.L. Uppal, Prof. Sunil S. Rao, Khanna Publication, 2024. ISBN: 978-81-7409-238-0
5) Electrical Power Systems, Ashfaq Hussain, CBS Publication, 2018: ISBN: 978-8123914480
6) Electric Power Distribution, A.S. Pabla, McGraw-Hill, 6th Edition,2012, ISBN: 978-9384323264

7) Principles of Power System, V.K. Mehta, Rohit Mehta, S. Chand, 1st Edition 2013. ISBN: 978-8121924962

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/102/108102047/
- https://electrical-engineering-portal.com/download-center/books-and-guides/electricity-generation-t-d/td-technology
- 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/1782/10257/

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

- Visit to Power Stations, Receiving Stations.
- Video demonstration of latest trends in modern power system
- For active participation of students, instruct the students to prepare Flowcharts and Handouts
- Organizing group wise discussions on issues
- Seminars

22EEE64X-Professional Elective Course-II

HIGH VOLTAGE ENGINEERING

Course Code	**22EEE641**	**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:

22EEE641.1	Understand about electric field distribution in electrode systems.
22EEE641.2	Describe the behavior of gaseous, liquid and solid dielectric under high voltage.
22EEE641.3	Interpret the necessity to generate and measure the voltages and currents for safety of personnel and equipment.
22EEE641.4	Able to analyze various insulation testing of various components in power system.
22EEE641.5	Identify the conditions for over voltages and the principles of insulation coordination.
22EEE641.6	Interpret the different applications of the insulating materials in electrical power apparatus.

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
22EEE641.1	3	1	-	-	-	-	-	-	-	-	-	-	-	1
22EEE641.2	3	2	-	-	-	-	-	-	-	-	-	-	-	1
22EEE641.3	3	3	1	1	-	-	-	-	-	-	-	-	-	1
22EEE641.4	3	3	1	1	-	-	-	-	-	-	-	-	-	1
22EEE641.5	3	1	2	-	-	-	-	-	-	-	-	-	-	1
22EEE641.6	3	3	1	-	-	-	-	-	-	-	-	-	-	1

MODULE-1	**INTRODUCTION TO HIGH VOLTAGE ENGINEERING**	**22EEE641.1, 22EEE641.6**	**8 Hours**
Electric Field Stresses–Uniform and non–uniform field configuration of electrodes –Estimation and control of electric Stress –Numerical methods for electric field computation, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushing.			
Text Book	Text Book 1: 1.5, 1.6, 5.1,5.2,5.3,5.4,5.5,5.7		
MODULE-2	**BREAK DOWN IN DIELECTRIC MATERIALS**	**22EEE641.2**	**8 Hours**
Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law, electro mechanical breakdown, thermal breakdown, breakdown of liquid dielectrics in practice, Breakdown in composite dielectrics in practice.			
Text Book	Text Book 1: 2.1, 2.2 Text Book 2:2.3,2.5,2.6,2.12,2.15		
MODULE-3	**GENERATION AND MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**	**22EEE641.3**	**8 Hours**
Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse.			
Text Book	Text Book 1: 7.1, 7.2, 7.3Text Book 2: 4.1,4.2,4.4,4.5		
MODULE-4	**TESTING OF MATERIALS**	**22EEE641.4**	**8 Hours**
High voltage AC testing methods-Power frequency tests-Over voltage tests on insulators, Isolators, Circuit Breakers and power cables. Artificial Contamination Tests: Contamination flashover phenomena-Contamination Severity-Artificial contamination tests-Laboratory Testing versus in-Service Performance-Case study.			
Self-Study	Understand the laboratory testing versus service phenomena effect with contamination.		
Text Book	Text Book 1: 10.1,10.2,10.3,10.4,10.5 Text Book 2: 7.1,7.2,7.3,7.9		
MODULE-5	**OVER-VOLTAGES AND INSULATION COORDINATION**	**22EEE641.5 22EEE641.6**	**8 Hours**
Natural Causes for Over voltage -Lightning phenomenon, over voltage due to switching surges, Principle of insulation Coordination on High Voltages			
Self-study	Investigate the different types of transformers used in industry.		

Text Book	Text Book 1: 8.1,8.2,8.3

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	-
L2	Understand	5	-
L3	Apply	5	10
L4	Analyze	5	10
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) High Voltage Engineering, M.S.Naidu and V. Kamaraju – TMH Publications, 6th Edition,2020. ISBN-978-9389811223,
2) High Voltage Engineering, C.L.Wadhwa, New Age Internationals (P) Limited, 2010, ISBN-9389802091.

Reference Books:

1) Extra High Voltage AC Transmission Engineering, Rakosh Das Begamudre, New Age International (P) Ltd., New Delhi , 2007, ISBN-10. 190657474X; ISBN-13. 978-1906574741.
2) High Voltage Engineering: Fundamentals, E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition, 2000, ISBN-13978-0750636346.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc23_ee92/preview
- https://www.youtube.com/watch?v=DI8Yt1AQrH8

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

- Visit to any manufacturing high voltage industry, CPRI
- Demonstration of multistage impulse generator
- Demonstration of working of measurement of high voltage
- Video demonstration of latest trends in high voltage
- Contents related activities (Activity-based discussions)

INTRODUCTION TO COMMUNICATION SYSTEMS

Course Code	**22EEE642**	**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:

22EEE642.1	Compare the Generation and Detection of Analog modulation techniques.
22EEE642.2	Evaluate the Power consumption and Bandwidth utilization in Analog modulation techniques.
22EEE642.3	Examine the statistical averages associated with random processes.
22EEE642.4	Apply the fundamentals of digital Communication for baseband signal processing and coding.
22EEE642.5	Categorize digital modulation techniques based on Bit Error Rate performance.
22EEE642.6	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	PO12	PSO1	PSO2
22EEE642.1	3	-	-	-	2	-	-	-	-	-	-	2	3	3
22EEE642.2	3	2	1	-	2	-	-	-	-	-	-	2	3	3
22EEE642.3	3	2	-	-	2	-	-	-	-	-	-	2	3	3
22EEE642.4	3	-	-	-	2	-	-	-	-	-	-	2	3	3
22EEE642.5	3	2	1	-	2	-	-	-	-	-	-	2	3	3
22EEE642.6	3	2	1	-	2	1	1	-	-	-	-	2	3	3

MODULE-1	**ANALOG MODULATION**	**22EEE642.1, 22EEE642.2**	**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**	**22EEE642.3**	**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**	**22EEE642.4**	**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**	**22EEE642.5**	**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**	**22EEE642.6**	**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-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	5	5
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	5	5
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) 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) An Introduction to Analog and Digital Communication, Simon Haykin, 2008, John Wiley India Pvt. Ltd ISBN: -13 978-0-471-43222-7.

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://www.youtube.com/watch?v=-PWg-0k2oks
- https://www.youtube.com/watch?v=wMflxR3KsXg&list=PLt3Fk5B7L7NZJv3PAZkxW83Fp7ww6__JE
- https://www.youtube.com/watch?v=ZW1glqkIgcw&t=135s
- https://www.youtube.com/watch?v=692SRjrT2MY

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.
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare presentations on current research topics in communication sector.
  - Organizing Group wise discussions on applications or products.
  - Seminars.

DIGITAL SIGNAL PROCESSING

Course Code	**22EEE643**	**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:

22EEE643.1	Apply the knowledge of Fourier analysis to compute Discrete Fourier Transforms of signals.
22EEE643.2	Use the concept of convolutional operators for linear filtering techniques.
22EEE643.3	Determine the DFT and inverse DFT using Fast Fourier Transform algorithms.
22EEE643.4	Design the digital filters to obtain the desired response.
22EEE643.5	Illustrate the basic features of programmable Digital Signal Processor.
22EEE643.6	Develop different digital signal processing applications using DSP processor.

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
22EEE643.1	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22EEE643.2	3	3	-	-	3	-	-	-	-	-	-	2	3	2
22EEE643.3	3	3	2	-	-	-	-	-	-	-	-	2	3	2
22EEE643.4	3	3	2	-	3	-	-	-	-	-	-	2	3	2
22EEE643.5	3	-	-	-	-	-	-	-	-	-	-	2	3	2
22EEE643.6	3	-	-	1	3	-	-	-	-	-	-	2	3	2

MODULE-1	**INTRODUCTION TO SIGNAL PROCESSING AND DISCRETE FOURIER TRANSFORMS**	**22EEE643.1**	**8 Hours**

Classification of signals and systems, Frequency domain sampling and reconstruction of discrete timesignals, DFT as a linear transformation, its relationship with other transforms, Computation of N - point DFT and IDFT, Properties of DFT.

Self-Study	Investigate the various characteristics of LTI System.
Text Book	Text Book1: 7.1, 7.2

MODULE-2	**DSP ALGORITHMS**	**22EEE643.2,22EEE643.3**	**8 Hours**

Convolution: Linear Convolution, Circular convolution, Stockham Method.
Fast Convolution overlap-save and overlap-add method.
FFT algorithm: Need for efficient computation of the DFT, Radix-2 FFT algorithm for the computationof DFT and IDFT, decimation-in time and decimation-in-frequency algorithms.

Case Study	Case study on Designing wind speeds using fast Fourier transform.
Text Book	Text Book 1: 8.1,8.1.3

MODULE-3	**FIR AND IIR FILTERS**	**22EEE643.4**	**8 Hours**

Design of FIR filter: Need, types and characteristics of window, design of FIR filters usingRectangular and Hamming window.
Design of IIR Filter: Analog to analog frequency transformations, Impulse Invariance method,Bilinear Transformation, Digital Butterworth filter design.

Self-study	Realization of FIR and IIR filters -Direct Form 1 and 2, Cascade and Parallel.
Text Book	TextBook1:9.2.1, 10.2.1, 10.2.2 Text Book1: 9.3.1, 9.3.3, 9.3.4, 10.3.2, 10.3.3, 10.3.4, 10.4.1

MODULE-4	**PROGRAMMABLE DIGITAL SIGNAL PROCESSOR**	**22EEE643.5, 22EEE643.6**	**8 Hours**

An Introduction to Programmable Digital Signal Processor: DSP system, Features of Digital Signal Processors, shifter, Barrel Shifter, MAC unit, Pipelining in DSP Processor
Number formats: Fixed point and Floating-Point formats, Q notation.

Applications	Interfacing FIR LPF of order 5 and cut off frequency of 1000 HZ. Audio application using C/C++.
Text Book	Text Book2: -1.1,1.2,1.3, 3.1,3.2 ,4.1,4.2,4.3 ,7.2

MODULE-5	**MULTI-RATE DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS**	**22EEE643.5, 22EEE643.6**	**8 Hours**

Introduction, decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by the factor of I/D, Digital Filter Banks.
Application: Radar signal Processing, DSP based measurement system.

Applications	Noise cancelation using adaptive filters.
Text Book	Text Book2: 1.1,1.2,1.3, 3.1,3.2 ,4.1,4.2,4.3 ,7.2

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	**Remember**	5	5
L2	**Understand**	5	10
L3	**Apply**	10	5
L4	**Analyze**	5	5
L5	**Evaluate**	-	-
L6	**Create**	-	-

SEE Assessment Pattern (50 Marks – Theory)

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

Suggested Learning Resources:

Text Books:

1) Digital signal processing: Principles, Algorithms & Applications, Proakis & Monalakis, 4thEdition, 2014, Pearson education. ISBN: 978-8131710005
2) Digital Signal Processing, Avtar Singh & S. Srinivasan, Thomson Brooks /Cole, 2004, ISBN: 0534-39123-0
3) Digital Signal Processing, P. Ramesh Babu, 6th Edition, 2014, Scitech Publications, ISBN: 978-8183716307

Reference Books:

1) Discrete Time Signal Processing, Oppenheim & Schaffer, 7th Edition, 2010, TMH. ISBN: 978-0132162920
2) Digital Signal Processing, S. K. Mitra, 4thEdition, 2014, Tata Mc-GrawHill. ISBN: 978-1259098581

Web links and Video Lectures (e-Resources):

- https://youtu.be/QcuIYJZ4RRE
- https://www.youtube.com/watch?v=rwENxNH0zdA
- https://www.youtube.com/watch?v=ADnSkJnprBY
- https://www.youtube.com/watch?v=Bdw3XcXgHa8
- https://www.youtube.com/watch?v=HVGW85eGPQQ&list=PLyqSpQzTE6M_h5UgZWpybzBVDGmHGhQQb
- https://www.youtube.com/watch?v=MQzY8cIBiFs&list=PLgMDNELGJ1CYvviJ_ZHrHy5TKLb- Vn7-r
- https://www.youtube.com/watch?v=Iw77CYUT74c&t=17s

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

- Video demonstration of latest trends in Digital Signal Processing
- Contents related activities (Activity-based discussions)
- For active participation of students, conduct problem solving sessions
- Organizing Group wise discussions on issues
- Seminars

ADVANCED CONTROL SYSTEMS

Course Code	**22EEE644**	**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:

22EEE644.1	Understand state space model of a system by applying various techniques.
22EEE644.2	Analyze time response of states and outputs of LTIV systems.
22EEE644.3	Apply the controllability and observability from the state models.
22EEE644.4	Design a state feedback controller that meets the desired specifications.
22EEE644.5	Design full order and reduced order state observers for state measurement.
22EEE644.6	Analyze and evaluate the behavior and stability of nonlinear systems.

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
22EEE644.1	3	3	2	2	-	-	-	-	1	-	-	-	1	1
22EEE644.2	3	3	2	2	-	-	-	-	1	-	-	-	1	1
22EEE644.3	3	3	3	3	-	-	-	-	1	-	-	-	1	1
22EEE644.4	3	3	3	3	-	-	-	-	1	-	-	-	1	1
22EEE644.5	3	3	3	3	-	-	-	-	1	-	-	-	1	1
22EEE644.6	3	3	2	2	-	-	-	-	1	-	-	-	1	1

MODULE-1	**STATE SPACE REPRESENTATION**	**22EEE644.1**	**8 Hours**
Advantages of state space analysis - Introduction – State, state variable, state trajectory, state space, state model - State space representation using physical, phase and canonical variables –Non uniqueness of state model			
Text Book	Text Book 1: 5.1 to 5.7		
MODULE-2	**TIME RESPONSE**	**22EEE644.2**	**8 Hours**
Existence and uniqueness of solutions to Continuous-time state equations – Solution of Linear Time Invariant State equations – Evaluation of matrix exponential			
Applications	Investigate the state space representation in time domain		
Text Book	Text Book 3: 9.1 to 9.4		
MODULE-3	**CONTROLLABILITY AND OBSERVABILITY**	**22EEE644.3**	**8 Hours**
Controllability - Observability – Canonical forms – Stabilizability and Detectability – Output Controllability – Reducibility			
Text Book	Text Book 1: 6.1 to 6.8		
MODULE-4	**STATE FEEDBACK**	**22EEE644.4, 22EEE644.5**	**8 Hours**
Introduction – Necessary and Sufficient Condition for Arbitrary Pole-placement – pole placement design – design of full order and reduced order state observers – State Feedback with integral control			
Self-Study	Analyze the pole placement technique and design the state observers		
Text Book	Text Book 1: 7.1,7.2,7.3,7.4,7.5		
MODULE-5	**ANALYSIS OF NON-LINEARITIES**	**22EEE644.6**	**8 Hours**
Types of non-linearity – Typical examples – Equivalent linearization – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations			
Self-study	Analysis the stability condition of non-linear systems		
Text Book	Text Book 1: 10.1 to 10.5		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	10	10
L4	Analyze	10	10
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) Digital control and state variable methods: Conventional and Intelligent Control Systems, M Gopal, McGraw Hill Education, Fourth Edition 2012.ISBN(13):978-0-07-133327-6
2) Control Systems, Principles and Design, M. Gopal, Fourth Edition, Tata McGraw Hill, 2015. ISBN (13): 978-0071333269
3) Modern Control Engineering, K. Ogata, Fifth edition, PHI, 2012. ISBN-13: 978-9332550162

Reference Books:

1) Control System Engineering, Norman S. Nise, Sixth Edition, Wiley India, 2011 ISBN 978-1-118-80082-9
2) Modern Control Theory, R. V. Parvatikar, Prism Books Pvt. Ltd., 1st Edition,2014 ISBN: 978-93-881-0858-4

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/103/108103007/
- https://distance.mst.edu/distance-programs/distance-graduate-certificates/advanced-control-systems/
- https://www.youtube.com/watch?v=8OVD2BHA5Hg&list=PLLy_2iUCG87CVglDEadTd_PRjA-g1KqVo
- https://www.manchester.ac.uk/study/masters/courses/list/04166/msc-advanced-control-and-systems-engineering/
- https://www.careers360.com/university/indian-institute-of-technology-roorkee/advanced-linear-continuous-control-systems-applications-matlab-programming-and-simulink-certification-course/

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

- Visit to any process/manufacturing/aero/auto industry
- Digital simulation of mathematical modelling of physical systems
- Video demonstration of modelling of a non-linear system
- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to prepare presentation and Handouts
- Organizing Group wise discussions on issues
- Seminars

MACHINE LEARNING FOR ELECTRICAL ENGINEERING

Course Code	**22EEE645**	**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:

22EEE645.1	Understand the basics of machine learning.
22EEE645.2	Apply the different learning algorithms for prediction.
22EEE645.3	Develop skills to analyze and evaluate the performance of machine learning models using appropriate metrics and techniques.
22EEE645.4	Design a model to solve classification /clustering problems using supervised or unsupervised machine learning algorithms.
22EEE645.5	Evaluate the performance of various machine learning algorithms using different real world data sets.
22EEE645.6	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	PO12	PSO1	PSO2
22EEE645.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
22EEE645.2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
22EEE645.3	3	3	-	-	-	-	-	-	-	-	-	-	3	3
22EEE645.4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
22EEE645.5	3	3	3	3	-	-	-	-	-	-	-	3	3	3
22EEE645.6	3	3	3	3	3	-	-	-	-	-	-	3	3	3

MODULE-1	**INTRODUCTION TO MACHINE LEARNING**	**22EEE645.1 22EEE645.2**	**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).

Text Book	Text Book 1: 1.1, 1.2, 1.6

MODULE-2	**SUPERVISED LEARNING**	**22EEE645.1 22EEE645.2 22EEE645.3 22EEE645.4**	**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**	**22EEE645.1 22EEE645.2 22EEE645.3 22EEE645.4**	**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).

Text Book	Text Book 2: 6.12		
MODULE-4	**TRENDS IN MACHINE LEARNING**	**22EEE645.5**	**8 Hours**
Ensemble Learning- Combining Multiple models, bagging, boosting, stacking-Algorithms-Random Forest, ada-boost. Introduction to Reinforcement Learning –Exploration, exploitation, rewards, penalties.			
Text Book	Text Book 1: 17, Text book 2: Ch 13		
MODULE-5	**APPLICATIONS OF MACHINE LEARNING**	**22EEE645.5 22EEE645.6**	**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-NPTEL	
		Test (s)	Qualitative Assessment (s)
		25	25
L1	**Remember**	5	5
L2	**Understand**	5	5
L3	**Apply**	5	5
L4	**Analyze**	5	10
L5	**Evaluate**	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) Introduction to Machine, E. Alpaydin Learning, 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: 0 521 82583 0
3) Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2016, ISBN: 978-1-4939-3843-8

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

- Contents related activities (Activity-based discussions)
- For active participation of students, instruct the students to read research topics on Machine Learning, Class Presentation.

PROJECT PHASE – I

Course Code	**22EEE65**	**CIE Marks**	**50**
L:T:P:S	**0:0:2:0**	**SEE Marks**	**50**
Hrs / Week	**0**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

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

22EEE65.1	Identify the specified needs with appropriate consideration of the society and organize them into multi-disciplinary areas Engineering
22EEE65.2	Conduct a thorough literature review to reach sustainable conclusions
22EEE65.3	Integrate appropriate techniques and modern tools to solve complex real-world problems
22EEE65.4	Evaluate the methodologies and select based on specific criteria
22EEE65.5	Interpret the progress and outputs of the project through professional engineering reports and present it to a community or industry
22EEE65.6	Function effectively as an individual and as a team

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**
22EEE65.1	3	3	3	2	3	2	-	-	-	-	1	-	2	2
22EEE65.2	3	3	3	2	3	2	-	-	-	-	-	-	2	2
22EEE65.3	3	3	3	2	3	2	-	-	-	-	2	1	2	2
22EEE65.4	3	3	3	2	3	2	-	-	-	-	-	-	2	2
22EEE65.5	3	3	3	-	3	2		1	-	3	2		2	2
22EEE65.6	-	-	-	-	-	-	-	-	3	-	-		-	-

Project is an experimental learning 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 of recognizing a problem with appropriate consideration about societal needs in multiple area and solve it using latest tools and technologies. Based on the ability/abilities of the student/s and recommendations of the guide, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. The project work will be reviewed by a panel of experts throughout the semester. The CIE marks awarded for the 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 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

PROBLEM SOLVING SKILLS

Course Code	**22SDK66**	**CIE Marks**	**50**
L:T:P:S	**0:0:1:0**	**SEE Marks**	**-**
Hrs / Week	**3**	**Total Marks**	**50**
Credits	**1**	**Exam Hours**	**1**

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

22SDK66.1	Infer the complex problems using the concepts of data structures and C programming
22SDK66.2	Apply object-oriented programming concepts in C++and Java to solve real time problem statements.
22SDK66.3	Solve real-world problem using python and C#.
22SDK66.4	Develop the skills of handling data base queries and procedures.

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
22SDK66.1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.2	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.3	3	3	3	2	2	-	-	-	-	-	-	2	2	2
22SDK66.4	3	3	3	2	2	-	-	-	-	-	-	2	2	2

MODULE-1	**PROBLEM SOLVING ON DATA STRUCTURES AND C**	**22SDK66.I**	**6 Hours**

Data Structures using C: Stack and queues, list, graph, tree, sorting and searching, Hash functions
Advanced C programming: Pointers, Recursion, Functions, Structure, Union, C Preprocessor

MODULE-2	**PROBLEM SOLVING ON OBJECT ORIENTED PROGRAMMING USING CPP**	**22SDK66.2**	**6 Hours**

Object Oriented Programming: Inheritance, Polymorphism, Exception handling, File Handling, Predefined function, Void function, Name spaces, Input and output streams.

MODULE-3	**PROBLEM SOLVING ON JAVA AND XML**	**22SDK66.2**	**6 Hours**

Object oriented programming using Java: Inheritance, Polymorphism, Abstract class and Interface, Collections, Exception handling, Streams, Functional Interface.
XML: DTD, Schema, Server Path, DOM, XSLT, Name Space, AJAX.

MODULE-4	**PROBLEM SOLVING USING C # AND PYTHON**	**22SDK66.3**	**6 Hours**

Python: Functions, iterators, Object oriented Programming, Exception Handling, Packages, Frame works- Django, Collections.
C#: Object oriented Programming, Delegate, Collections and generic, Name space.

MODULE-5	**SCENARIO BASED PROBLEMS ON DBMS**	**22SDK66.4**	**6 Hours**

ER Model, SQL- DDL, DML, TCL, DCL, Joins, subquery, PL/SQL-Index, Sequence, procedures and functions, normalization, B tree, B+ tree, Forms.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Test (s)** 50
L1	**Remember**	5
L2	**Understand**	10
L3	**Apply**	20
L4	**Analyze**	15
L5	**Evaluate**	-

L6	**Create**	-	

Suggested Learning Resources:

Reference Books:

1) Python-The Complete Reference, Martin C Brown, Mc Graw Hill, 4th edition, 2020, ISBN: 978-9387572942
2) Data Structures using C, Reema Tharega, Oxford University Press, 2020, ISBN: 978-0198099307
3) A complete guide to program in C++, Ullakirch-Prinz, Jonas and Bartlett Learning, 2022, ISBN: 978-0763718176
4) Headfirst Java, Kathy Sierra, O'reilly Media, 2021, ISBN: 978-1491910771
5) Headfirst C#, Andrew Stellman, O'reilly Media, 2021, ISBN: 978-9351103530

Web links and Video Lectures (e-Resources):

- **https://www.learncpp.com/**
- **https://www.programiz.com/dsa**
- **https://code.visualstudio.com/Docs/languages/csharp**
- **https://www.udemy.com/course/the-complete-java-course-from-basics-to-advanced/?couponCode=ST16MT70224**
- **https://www.codecademy.com/learn/paths/c**

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

- Analysis of industry relevant use cases
- Problem solving on scenario-based questions
- Placement portal practice sessions

22EEE67X - Ability Enhancement Course – V

POWER SYSTEM PROTECTION, ETAP AND DIALUX			
Course Code	**22EEE671**	**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:

22EEE671.1	Analyze the different characteristics of electro mechanical relays .
22EEE671.2	Identify appropriate protection schemes for different power system components.
22EEE671.3	Evaluate different faults and relay coordination in protection using ETAP.
22EEE671.4	Apply the simulation for motor and generator protection.

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
22EEE671.1	3	3	3	3	2	-	-	-	-	-	-	-	**2**	-
22EEE671.2	3	3	3	3	2	-	-	-	-	-	-	-	**2**	-
22EEE671.3	3	3	3	3	2	-	-	-	-	-	-	-	**2**	-
22EEE671.4	3	3	3	3	2	-	-	-	-	-	-	-	2	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to relays, ciruit breaker and fuses	2	NA
	PART-A		
1	Motor protection simulation studies	2	22EEE671.2 22EEE671.4
2	IDMT over current characteristics of Electro mechanical relays	2	22EEE671.1, 22EEE671.2
3	DMT under voltage characteristics of Electro mechanical relays	2	22EEE671.1, 22EEE671.2
4	Introduction to ETAP in power system protection	2	22EEE671.3
5	Study the characteristics of Negative Sequence Relays	2	22EEE671.2
6	Study the characteristics of Merz price protection scheme	2	22EEE671.2
	PART-B		
7	Fuse characteristics.	2	22EEE671.2
8	Relay Coordination Using ETAP	2	22EEE671.3
9	Generator protection Unit	2	22EEE671.2, 22EEE671.4
10	DMT over current characteristics of Electro mechanical relays	2	22EEE671.1, 22EEE671.2
11	IDMT under voltage characteristics of Electro mechanical relays	2	22EEE671.1, 22EEE671.2
12	Fault current analysis using ETAP	2	22EEE671.3
	PART-C **Beyond Syllabus Virtual Lab Content**		

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

1. Virtual Power System Protection Laboratory
   http://www.nitttrkol.ac.in/virlab.php#top

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Power System Protection, Static Relays with Microprocessor applications, T.S. Madava Rao, TMH, Second edition, 2004, ISBN: 978-0074603079.

2) A Course in Electrical Power, Soni, Gupta & Bhatnagar, Dhanpat Rai Publishing Company (P) Ltd., 2009th edition. 2008, ISBN: 978-8177000207

MULTISIM FOR ELECTRICAL DESIGN			
Course Code	**22EEE672**	**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:

22EEE672.1	Understand the basic concepts, basic laws and analysis of DC and AC networks.
22EEE672.2	Analyze the circuits and troubleshoot circuits.
22EEE672.3	Realize and verify the operation of analog integrated circuits .
22EEE672.4	Design real time application circuits .

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
22EEE672.1	3	3	3	3	2	-	-	-	-	-	-	-	2	-
22EEE672.2	3	3	3	3	2	-	-	-	-	-	-	-	2	-
22EEE672.3	3	3	3	3	2	-	-	-	-	-	-	-	2	-
22EEE672.4	3	3	3	3	2	-	-	-	-	-	-	-	2	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Introduction to MULTISIM software, Design Procedure and Steps.	2	NA
	PART-A		
1	To evaluate current and voltage for series and parallel circuit	2	22EEE672.1
2	To evaluate current and voltage using KCL	2	22EEE672.1, 22EEE672.2
3	To evaluate current and voltage using KVL	2	22EEE672.1, 22EEE672.2
4	To design of dependent source circuits for dc excitation	2	22EEE672.1
5	To design of dependent source circuits for ac excitation	2	22EEE672.1, 22EEE672.2
6	To evaluate current and voltage using Voltage divider circuit	2	22EEE672.1, 22EEE672.2
	PART-B		
7	To design half wave and Full wave rectifier circuits	2	22EEE672.3, 22EEE672.4
8	To design Bridge rectifier circuits	2	22EEE672.3, 22EEE672.4
9	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier	2	22EEE672.3, 22EEE672.4
10	To realize using op-amps i) Summing Amplifier ii) Difference amplifier	2	22EEE672.3, 22EEE672.4
11	To design LED glow circuit	2	22EEE672.3, 22EEE672.4
12	To design Automatic Door Lock System	2	22EEE672.3, 22EEE672.4

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

1) Full-Wave Bridge Rectifier
   https://www.multisim.com/content/HjVJib9TcNYxueUuUH3jYV/full-wave-bridge-rectifier/
2) MultisimLive:
   https://www.multisim.com/content/BWyLQUVt8MWkVykgTfpodV/virtual-lab/

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) Circuit Analysis with Multisim, David Baez-Lopez (Author), Felix Guerrero-Castro (Author) SpringerPublication, ISBN-10: 3031798392
2) NI MULTISIM User manual, https://www.ni.com/docs/enS/bundle/multisim/resource/374483d.pdf

LABVIEW FOR ELECTRICAL APPLICATIONS			
Course Code	**22EEE673**	**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:

22EEE673.1	Implement basic arithmetic and Boolean operations using given software.
22EEE673.2	Analyze characteristics of electric circuit elements, and design circuits to verify different electric laws.
22EEE673.3	Simulate voltage dividers, analyze resistor configurations, and investigate circuit theorems .
22EEE673.4	Control, analyze, design and test various circuits.

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
22EEE673.1	3	3	3	3	2	1	1	-	-	1	1	1	1	-
22EEE673.2	3	3	3	3	2	1	1	-	-	1	1	1	1	-
22EEE673.3	3	3	3	3	2	1	1	-	-	1	1	1	1	-
22EEE673.4	3	3	3	3	2	1	1	-	-	1	1	1	1	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	Cos
	Prerequisite Experiments / Programs / Demo		
	Introduction to LabVIEW Environment and Basic Programming Concepts Familiarization with LabVIEW Interface Creating a Simple VI (Virtual Instrument) Running and Debugging Vis. Data acquisition and signal processing.	2	NA
	PART-A		
1	Realize the following: - Basic arithmetic operations: addition, subtraction, multiplication and division; Boolean operations: AND, OR, XOR, NOT and NAND.	2	22EEE673.1
2	Analyzing characteristics of resistors, capacitors, and inductors in DC & AC circuits.	2	22EEE673.2
3	Design a resistor circuit with a variable resistor. Use LabVIEW to adjust the voltage source and measure the current. Verify the Ohm's law by using LabVIEW's tools.	2	22EEE673.2
4	Construct a circuit with a resistor and capacitor (or inductor). Apply a step voltage and to track the voltage across the capacitor (or inductor) over time. Determine the time constant by observing the circuit's charging/discharging behavior.	2	22EEE673.2
5	Test LED Brightness: Connect LED and resistor in series with PWM pin. Use LabVIEW for PWM signal with varying duty cycles. Observe LED brightness changes with duty cycle adjustment.	2	22EEE673.4
6	Build virtual circuits with series and parallel resistors, analyze equivalent resistance, and study voltage/current relationships. Investigate Thevenin's theorem.	2	22EEE673.3
	PART-B		
7	Analyze and simulate half wave and full wave rectifier circuits.	2	22EEE673.3
8	Design and simulate the first order low pass and high pass filter circuits.	2	22EEE673.3

9	Investigate the system stability for the first order and second control system by using Bode plot and Nyquist plot analysis.	2	22EEE673.3
10	Build a Buck & boost converter circuit to simulate its operation to analyze output voltage regulation and efficiency.	2	22EEE673.4
11	Simulate or control a simple power inverter circuit. Analyze the generation of AC waveforms from a DC source through pulse width modulation (PWM) techniques.	2	22EEE673.4
12	Design a PID controller to regulate the speed of a DC motor. Use feedback from a position or speed sensor to adjust the motor's control signal for precise control.	2	22EEE673.4

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

1. Overview of labVIEW software
   https://www.ni.com/en/shop/labview/virtual-instrumentation.html

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

Reference Books:

1) LabVIEW for Electrical Engineers and Technologists, Stephen Philip Tubbs, 2011. ISBN-13: 978-0981975337.
2) LabVIEW for Electric Circuits, Machines, Drives, and Laboratories, Nesimi Ertugrul, Pearson, 2002. ISBN-13: 978-0130618863

LATEX FOR TECHNICAL WRITING

Course Code	**22EEE674**	**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:

22EEE674.1	Install LaTex and a writing environment to create, styling and formatting the Latex documents.
22EEE674.2	Express Proficiency in Insert Tables, Figures and Plots into a LaTex document with a range of formatting options.
22EEE674.3	Learn citations and how to build a bibliography and Mathematical Contents.
22EEE674.4	Create professional LaTex presentations using Beamer.

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
22EEE674.1	3	1	1	3	2	-	-	2	1	2	1	-	-	-
22EEE674.2	3	1	1	3	2	-	-	2	1	2	1	-	-	-
22EEE674.3	3	1	1	3	2	-	-	2	1	2	1	-	-	-
22EEE674.4	3	1	1	3	2	-	-	2	1	2	1	-	-	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	Overview, Install LaTeX	2	22EEE674.1
	PART-A		
1	Introduction: Create First LaTeX Document -Section levels and ToC	2	22EEE674.1
2	Styling Pages - 1: Paper size and Margins, Page Styles (Header and footer), More on formatting pages (Writing footnotes, Orientation, page breaks)	2	22EEE674.1
3	Styling Pages- 2: Multicolumn document (multicol package), Reading error messages	2	22EEE674.1
4	Formatting Content - 1: Formatting Text, Coloring Text, Aligning Text, Spacing Text, Bullets and Numbering	2	22EEE674.1 22EEE674.3
5	Formatting Content – 2: Writing Mathematics -- I (Math Mode, Align, equation and cases)	2	22EEE674.1 22EEE674.3
6	Formatting Content - 3: Writing Mathematics -- II (Math alphabets, Mathematical Symbols, : Mathematical structures)	2	22EEE674.1 22EEE674.3
	PART-B		
7	Tables and Images – 1: Creating Tables, Table Borders, Merging Rows and Columns	2	22EEE674.2
8	Tables and Images - 2: Saviour for Large Tables, Table Environment, Reading error messages	2	22EEE674.2
9	Tables and Images – 3: Including Images, Image Properties, Working with Image Borders, Figure and Sub-Figures	2	22EEE674.2
10	Referencing and Indexing: Creating Title Page, Hyperlinks, Cross Referencing, Creating Indexes, Creating Bibliography	2	22EEE674.3
11	Presentation using Beamer -1: Introduction to Beamer, Blocks and Columns, Overlays	2	22EEE674.4
12	Presentation using Beamer – 2: Customize Basic Information, Customize Themes, Aspect Ratio	2	22EEE674.4
	PART-C		

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

1. Online LATex editor
   https://www.overleaf.com/project/

CIE Assessment Pattern (50 Marks – Lab)

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

Suggested Learning Resources:

References:

1) LATEX in 24 Hours, a practical guide for scientific writing by Dilip Datta, 2017, ISBN: 978-3319478302
2) Guide to LATEX - UC Davis Mathematics, by H Kopka · 2004, ISBN: 978-0321173850
3) https://learning.edx.org/course/course-v1:IITBombayX+LaTeX101x+1T2021/home
4) https://www.udemy.com/course/learn-latex-the-complete-latex-course/?couponCode=HOLI24
5) https://www.overleaf.com/learn/latex/Choosing_a_LaTeX_Compiler

ELECTRONICS CIRCUIT DESIGN USING PROTEUS

Course Code	**22EEE675**	**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:

22EEE675.1	Apply the fundamental concepts of electronics for creating schematics and layout of electronics design problems.
22EEE675.2	Simulate electronic circuits to study the behavior of components and circuits before building Physically.
22EEE675.3	Learn citations and how to build a bibliography and Mathematical Contents Make use of software interface for placing components on the board and routing traces to establish connections, mimicking the real-world PCB fabrication process.
22EEE675.4	Analyze the functionality of the code and its interaction with the hardware components without needing physical hardware.

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
22EEE675.1	3	-	-	-	2	-	-	-	-	-	-	2	3	3
22EEE675.2	3	3	1	1	2	-	-	-	-	-	-	2	3	3
22EEE675.3	3	3	1	1	2	-	-	-	-	-	-	2	3	3
22EEE675.4	3	3	1	1	2	-	-	-	-	-	-	2	3	3

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Basic Electronics Knowledge • Proteus Software Installation • Components and Libraries • Circuit Design Basics. • Circuit Simulation	2	22EEE675.1
	PART-A		
1	To understand the principles of LED operation and current limiting	2	22EEE675.1
2	To investigate the charging behavior of capacitors.	2	22EEE675.1
3	To design transistor as a Switch	2	22EEE675.1
4	To design and analyze an inverting amplifier	2	22EEE675.1 22EEE675.3
5	To create a square wave generator using 555 Timer in A stable Mode	2	22EEE675.1 22EEE675.3
6	To convert an AC signal to DC Using a Rectifier (Half wave)	2	22EEE675.1 22EEE675.3
	PART-B		
7	To obtain a stable 5V DC output using LM7805 Voltage Regulator	2	22EEE675.2
8	To investigate the basic logic gates	2	22EEE675.2
9	To Investigate serial to parallel conversion using Shift register	2	22EEE675.2
10	To design and analyze a crystal oscillator	2	22EEE675.3
11	To display frequency of an input signal using 7-segment Display	2	22EEE675.4
12	To convert an AC signal to DC Using a Rectifier (Full wave)	2	22EEE675.4

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

1. Draw the layout for 5V DC Power Supply circuit on Proteus.
   https://www.studocu.com/row/document/air-university/electrical-circuit-analysis/1634537390389-lab5- pcb-designing-in-proteus/25746984
2. Design and Simulation of Hartley Oscillator.
   https://www.youtube.com/watch?v=akqoYmkaiSc
3. Flashing Led's Using 555 Ic Circuit, Simulation, And PCB Layout Design.
   https://www.youtube.com/watch?v=j2A35oHB3tM
4. Half Adder using Proteus.
   https://www.youtube.com/watch?v=CAMURFssBaQ

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	5
L3	Apply	20
L4	Analyze	15
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

References:

1) Proteus PCB Design Examples, George Shopov, - ARES Kindle: 2020, ASIN : B07XFG3R1Y.
2) Essential Circuit Analysis Using Proteus, Farzin Asadi, eBook ISBN 978-981-19-4353-9, 2023.
3) https://www.labcenter.com/

Syllabus of NSS/PED/YOGA

NATIONAL SERVICE SCHEME (NSS)			
Course Code	**22NSS50, 22NSS60**	**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:

22NSSX50/60.1	Understand the importance of his / her responsibilities towards society.
22NSS50/60.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSS50/60.3	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.
22NSS50/60.4	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	PO12
22NSS50/60.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50/60.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50/60.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSS50/60.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
5TH 22NSS50	1. Developing Sustainable Water management system for rural areas and implementationapproaches. 2. 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. 3. Spreading public awareness under rural outreach programs. (minimum 5 programs).	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 Hours
6TH 22NSS60	4. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 5. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1, 22NSS60.2, 22NSS60.3, 22NSS60.4	30 Hours

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:

- Students should have a service-oriented mindset and social concern.
- Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
- 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 by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

2.	Waste management– Public, Private and Govtorganization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Site selection /proper consultation/Co ntinuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams /College campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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 by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
5.	Preparing an actionablebusiness proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/Governm ent Schemes officers	School selection/prope r consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/prope rconsultation/ Continuous monitoring/ Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

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/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/pro per consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/prope r consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer
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/prope r consultation/ Continuous monitoring / Information board	Report should be submitted by individual to theconcerned evaluation authority	Evaluation as per the rubrics of scheme and syllabus by NSS officer

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)			
Course Code	**22PED50, 22PED60**	**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:

22PED50/60.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.
22PED50/60.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.
22PED50/60.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PED50/60.4	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
22PED50/60.1	-	-	-	-	-	2	-	3	3	-	-	2
22PED50/60.2	-	-	-	-	-	2	-	3	3	-	-	2
22PED50/60.3	-	-	-	-	-	2	-	3	3	-	-	2
22PED50/60.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
5TH 22PED50	**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.	22PED50.1, 22PED50.2, 22PED50.3, 22PED50.4	Total 30 Hrs/ Semester 2 Hrs/week

	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.		
6TH 22PED60	**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 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	22PED60.1, 22PED60.2, 22PED60.3, 22PED60.4	Total 30 Hrs/ Semester 2 Hrs/week

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	**22YOG50, 22YOG60**	**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:

22YOG50/60.1	Understanding the origin, history, aim and objectives of Yoga
22YOG50/60.2	Become familiar with an authentic foundation of Yogic practices
22YOG50/60.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of
22YOG50/60.4	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	PO12
22YOG50/60.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50/60.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50/60.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOG50/60.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
5TH 22YOG50	**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	22YOG50.1, 22YOG50.2, 22YOG50.3, 22YOG50.4	Total 32 Hrs/ Semester 2 Hrs/week
6TH 22YOG60	**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	22YOG60.1, 22YOG60.2, 22YOG60.3, 22YOG60.4	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:

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

Web links and Video Lectures (e-Resources):

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

APPENDIX A

List of Assessment patterns

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

APPENDIX B

Outcome Based Education

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

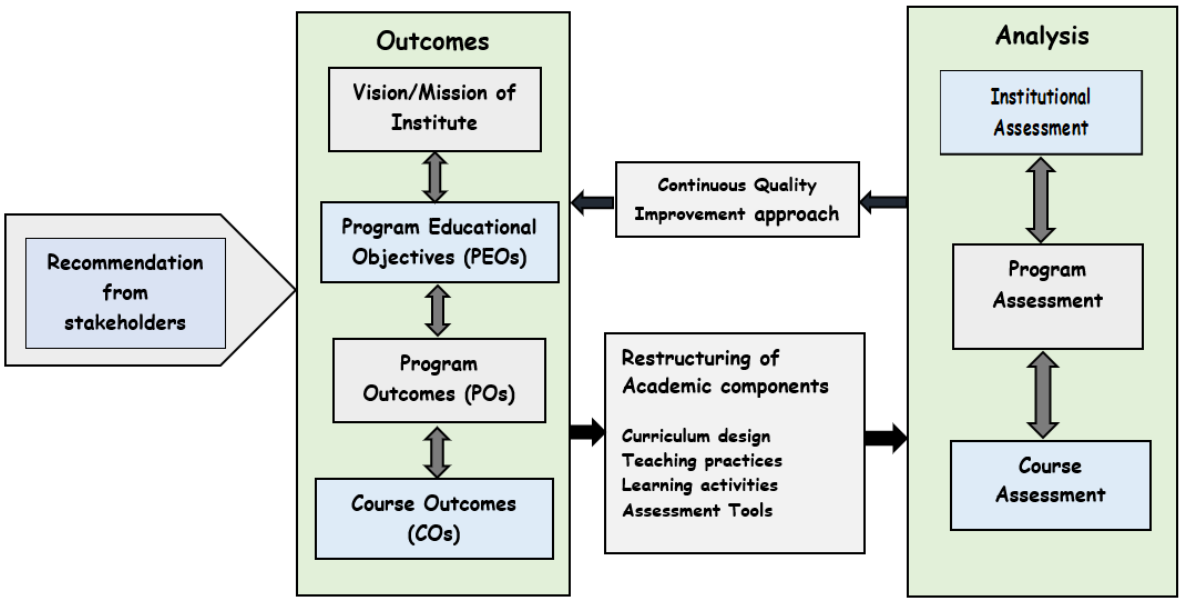
There are three educational Outcomes as defined by the National Board of Accreditation:

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

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

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

Mapping of Outcomes



APPENDIX C

The Graduate Attributes of NBA

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

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

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

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

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

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

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

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

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

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

presentations, and give and receive clear instructions.

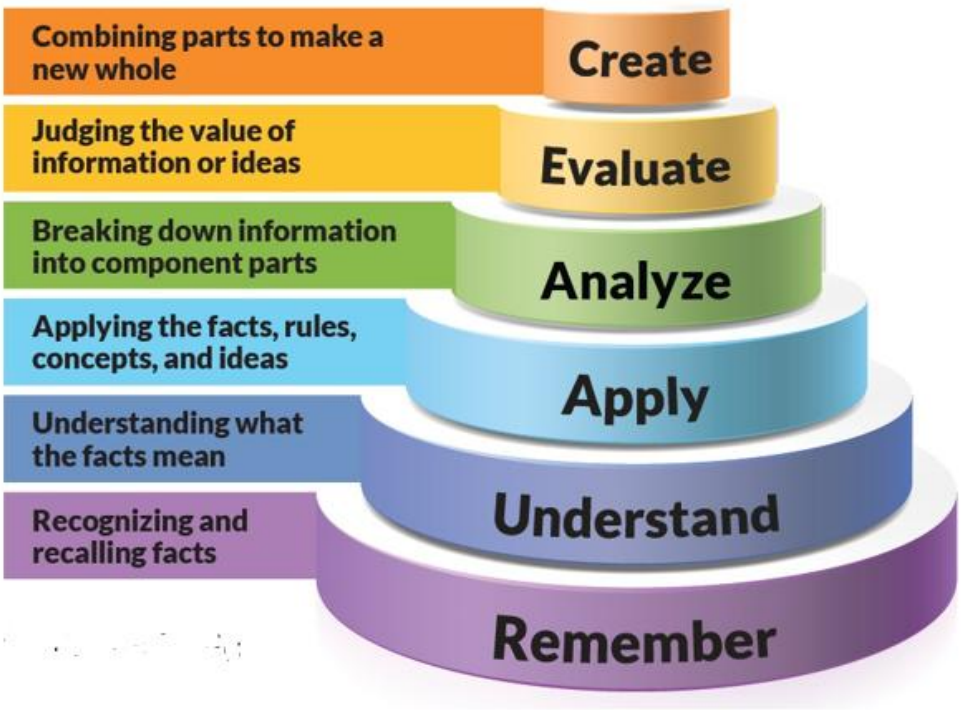
Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

APPENDIX D

BLOOM'S TAXONOMY

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



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

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