|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)

SJB Institute of Technology

An AUTONOMOUS INSTITUTION UNDER VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Approved by AICTE, 2(f) and 12(B) recognized by UGC, New Delhi
Accredited by NAAC, Accredited by NBA, Certified by ISO 9001 - 2015

BACHELOR OF ENGINEERING [B.E.]

Electrical & Electronics Engineering

AUTONOMOUS
SCHEME & SYLLABUS

THIRD YEAR

V & VI SEMESTER

2023 SCHEME

SERVICE TO MANKIND IS SERVICE TO GOD

His Divine Soul Padmabhushana

Sri Sri Sri Dr. Balagangadharanatha MahaSwamiji

Founder President, Sri Adichunchanagiri Shikshana Trust®

Belief in God is not ignorance or illusion. It is a belief that there is an unseen, ineffable Power that transcends all our powers of muscles, mind and lives.

His Holiness Parama Pujya

Sri Sri Sri Dr. Nirmalanandanatha MahaSwamiji

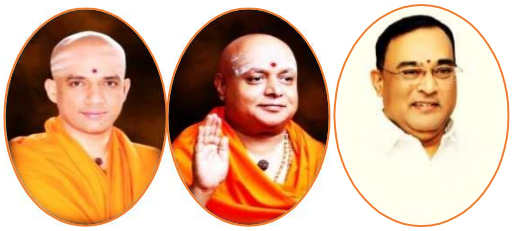
President, Sri Adichunchanagiri Shikshana Trust ®

True richness is the generosity of heart. Cultivate it and work to help the less fortunate ones in life.

Revered Sri Sri Dr. Prakashanatha Swamiji

Managing Director, BGS & SJB Group of Institutions & Hospitals

People and prosperity follow the path which the leaders take. So the elders and leaders should make sure that they give the right lead and take the right path.



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Department of Electrical and Electronics Engineering

Vision and Mission

Department Vision

To become one among the best departments in engineering and research arena through professional faculty and state of art laboratories and to make the students successful engineers with good ethics.

Department Mission

1. M1: To provide learner-centric environment through quality education and training.
2. M2: To lay the foundation for research by fortifying peers & establishing incubation center.
3. M3: To develop the overall personality of the students to face the challenges of the real world.

SJB INSTITUTE OF TECHNOLOGY
BGS Health & Education City, Dr. Vishnuvardhan Road, Kengeri, Bengaluru – 560060 Karnataka, INDIA.
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2023 Scheme - UG

Syllabus Book for EEE

Syllabus for 5th & 6th Semester

The syllabus, scheme and guidelines are provided in detail.
The syllabus, scheme and guidelines are subjected to changes if any needed.
The updates will be done timely.
Regularly access the institution website for the updated information.

The Syllabus book is available on	www.sjbit.edu.in
For any queries, please write to	academicdean@sjbit.edu.in

UPDATES

Release / Revision	Date	Remarks
Release		

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 3rd Year EEE

SCHEME: 2023 **SEM: V** **Revision date: 05-04-2025**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O		SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/ABL / SL/etc.	CIE Marks	Dur.	Th.	Lab	Tot.
1	PCC	3	23EET501	Power System Analysis and Stability	EE	EE	**3**	3	0	0		50	03	50	-	100
2	IPCC	5	23EEI502	Signals and DSP	EE	EE	**4**	3	0	2	@	50	03	50	-	100
3	IPCC	6	23EEI503	Power Electronics	EE	EE	**4**	3	0	2		50	03	50	-	100
4	PCCL	3	23EEL504	Industrial Automation Lab	EE	EE	**1**	0	0	2		50	03	-	50	100
5	PEC	1	23EEP51y	Professional Elective Course - 1	EE	EE	**3**	3	0	0		50	03	50	-	100
6	ETC	3	23EEE53y	Emerging Technology Course - 3	EE	EE	**3**	3	0	0	@	50	03	50	-	100
7	HSMC	6	23SFHH06/ 23UHVH07	Bioscience or UHV-Universal Human Values	any dept	any dept	**1**	0	2	0	@	50	02	50	-	100
8	AEC	5	23EEAE5y	Ability Enhancement Course - 5	EE	EE	**1**	1	0	0		50	02	50	-	100
								(or)								
								0	0	2		50	02	-	50	100
9	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	**PP/NP**	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
Total							**20**	**16**	**2**	**8**	**2**	**450**		**350**	**100**	**850**

PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; AEC: Ability Enhancement Course; HSMC: Humanities, Social Sciences & Management Course; NCMC: Non Credit Mandatory Course;
{@ - Compulsory one activity during the semester};
{I.E.-Industry Experts}.
PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning

ETC (Emerging Technology Course):

For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

Bioscience & UHV-Universal Human Values:

1) Any one of the course will be offered by the departments in each semester of IV & V based on the institutional planning.
2) Both the courses shall be studied and completed by the students registering each in the two semesters. For example, if Bioscience is offered in the IV semester, UHV-Universal Human Values is offered in the V semester.

Ability Enhancement Course-5: 23EEAE5y - 1 Credit course

1) The courses and the syllabus shall be defined by the respective dept. BOS.
2) SEE will be MCQ if offered as theory course. If offered as LAB course, SEE will be practical, with two internal examiners. Handled by Controller of Examinations.

NCMC (Non Credit Mandatory Course) for course type series-4: Refer to guidelines in III SEM.

Professional Elective Course - 1		Emerging Technology Course - 3		Ability Enhancement Course - 5	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
23EEP511	Electrical Machine Design	23EEE531	Big Data for Power System engineering	23EEAE51	Computer Aided Electrical Drawing
23EEP512	Electrical Estimation and Costing	23EEE532	Battery Management System	23EEAE52	Energy Audit Project
23EEP513	Renewable Energy Sources	23EEE533	VLSI Circuits & Design	23EEAE53	Renewable Energy Project
23EEP514	Energy Conservation & Audit	23EEE534	Introduction to Core Java programming	23EEAE54	OOP with Java Lab

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 3rd Year EEE

SCHEME: 2023 **SEM: VI** **Revision date: 05-04-2025**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O		SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/ABL / SL/etc.	CIE Marks	Dur.	Th.	Lab	Tot.
1	PCC	4	23EET601	Computer Techniques in Power System Analysis	EE	EE	3	3	0	0		50	03	50	-	100
2	IPCC	7	23EEI602	Control Systems	EE	EE	4	3	0	2		50	03	50	-	100
3	PCCL	4	23EEL603	Power System Simulation lab	EE	EE	1	0	0	2		50	03	-	50	100
4	PEC	2	23EEP62y	Professional Elective Course - 2	EE	EE	3	3	0	0		50	03	50	-	100
5	OEC	1	23EEO61y	Open Elective Course - 1	Any dept.	Any dept.	3	3	0	0		50	03	50	-	100
6	ETC	4	23EEE64y	Emerging Technology Course - 4	EE	EE	3	3	0	0	@	50	03	50	-	100
7	AEC	6	23RMAE61	Research Methodology & IPR	EE	EE	3	3	0	0	@	50	03	50	-	100
8	PRJ	1	23EEPRJ1	Major Project - Phase I	EE	EE	2	0	0	4	@	50	03	-	50	100
9	HSMC	7	23SCRH08	Social Connect & Responsibility	Any dept	Any dept	1	1	0	0	@	50	-	-	-	50
10	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	PP/NP	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
Total							**23**	**19**	**0**	**8**	**2**	**500**		**300**	**100**	**900**

PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; PEC: Professional Elective Course; OEC: Open Elective Course;
HSMC: Humanities, Social Sciences & Management Course; AEC: Ability Enhancement Course; NCMC: Non Credit Mandatory Course; PRJ: Project work.
{@ - Compulsory one activity during the semester}; {I.E.-Industry Experts}; PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning
NOTE: CIE & SEE guidelines for S. #7: AEC-23RMAE61-Reserach Methodology & IPR will be same as 3 credit courses BSC/ESC/PCC/ETC/PEC/OEC as mentioned in serial no. 1 of CIE & SEE guidelines.

Open Elective Courses (OEC):

1) Open Electives listed here are to offer for other department students.
2) Students shall select open elective courses offered from other departments, separate consolidated list of courses offered from various departments will be published time to time.

ETC (Emerging Technology Course):

For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

NCMC (Non Credit Mandatory Course) for course type series-4: Refer to guidelines in III SEM.

Professional Elective Course - 2 (23EEP62y)		Open Elective Course - 1 (23EEO61y)		Emerging Technology Course - 4 (23EEE64y)	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
23EEP621	Drives & Traction	23EEO611	Alternate Energy Sources	23EEE641	Artificial Intelligence in Power System
23EEP622	Energy Storage System	23EEO612	Fundamentals of Electric Vehicles	23EEE642	EV Battery Charging Methods & Topologies
23EEP623	Embedded Systems	23EEO613	Micro and Nano electronics	23EEE643	Electronic Circuits using Verilog
23EEP624	Smart Grid	23EEO614	Energy Conservation and Audit	23EEE644	IOT & its Applications

Ref: SJBIT/DEEE/2025/14

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Department of Electrical and Electronics Engineering
(Accredited by NBA)

Date: 07/01/2025

Academic Year: 2024-25

Self-Learning Course 1 & 2 (NPTEL) for 2023 Scheme

Board of Studies (BOS) members was deliberated over list of NPTEL course for 2023 scheme, 3rd sem EEE students on 3rd January 2025.

Sl. No.	Name of Experts	Role	Stakeholder Type	Details	Signature
1	Dr. M J Chandrashekar	Chairman	HOD	Professor & HOD, Dept. of EEE, SJBIT	
2	Dr. Sandeep S R	Member	Faculty Member	Associate Professor, Dept. of EEE, SJBIT	
3	Dr. Rekha P S	Member	Faculty Member	Associate Professor, Dept. of EEE, SJBIT	
4	Mr. Dwarakanath S K	Member	Faculty Member	Assistant Professor, Dept. of EEE, SJBIT	
5	Mr. Vijay Kumar K	Member	Faculty Member	Assistant Professor, Dept. of EEE, SJBIT	
6	Mr. Prakyath D	Member	Faculty Member	Assistant Professor, Dept. of EEE, SJBIT	

When selecting NPTEL (National Programme on Technology Enhanced Learning) courses for students, especially in the context of an engineering curriculum such as the 3rd semester for Electrical and Electronics Engineering (EEE) students, there are several guidelines to ensure that the courses align with both academic goals and industry needs. Here are some guidelines that could be used for selecting NPTEL courses:

1. Relevance to the Curriculum
   (1) Core Subjects: Ensure the course aligns with the core topics in the curriculum.
   (2) Advanced Topics: Choose courses that supplement the theoretical knowledge with practical applications, such as power systems, control systems, microelectronics, or signal processing.

(3) Industry Trends: Consider courses that cover emerging trends or technologies in the field of electrical engineering like smart grids, renewable energy, electric vehicles, or Internet of Things (IoT).

2. Difficulty Level

(1) Course Difficulty: Choose courses that are neither too easy nor too difficult for the 3rd-semester students. Consider courses that cater to students who already have some background knowledge in basic electrical engineering.

(2) Progressive Learning: The course should be appropriately challenging while still being accessible for students at their current academic level. Look for courses that gradually increase in complexity.

3. NPTEL courses can vary in the amount of time required for completion. Choose courses that fit well with the academic workload of 3rd-semester EEE students. Duration of the Course: Course duration and make sure it doesn't overlap significantly with the regular academic semester or exam periods.

4. Interdisciplinary Courses: Encourage students to take courses that can help them develop interdisciplinary skills, such as machine learning for electrical engineers or data analytics in power systems.

5. Courses that enhance employability, or are recognized by industry professionals, should be given priority.

6. Member also suggested to document all the courses offered for 2023 scheme and mention as active and Inactive for respective courses in each semester.

The list of active and Inactive courses for Jan- April 2025 is attached herewith.

Encl. : List of active and inactive courses for Jan - April 2025

Self - Learning Course List for UG BE – 2026-27

Scheme: 2023

Release Date: 07/01/2025

Self- Learning Course -1 (NPTEL/ VTU online course)				
SL Num	**Code**	**Course Name**	**NPTEL ID**	**Course Status**
1	23EES101	An Introduction To Coding Theory	noc23-ee101	Active
2	23EES102	Machine Learning And Deep Learning - Fundamentals And Applications	noc23-ee87	Inactive
3	23EES103	Electrical Equipment And Machines: Finite Element Analysis	noc23-ee104	Inactive
2	23EES104	Design Of Photovoltaic Systems	noc23-ee107	Active
5	23EES105	Electronic Systems For Cancer Diagnosis	noc23-cs110	Inactive
6	23EES106	Pattern Recognition And Application	noc23-ee119	Inactive
3	23EES107	Dc Microgrid And Control Systems	noc23-ee123	Active
4	23EES108	Applied Optimization For Wireless, Machine Learning, Big Data	noc23-ee99	Active
9	23EES109	Mathematical Aspects Of Biomedical Electronic System Design	noc23-ee90	Inactive
10	23EES110	Introductory Neuroscience & Neuro- Instrumentation	noc23-ee89	Inactive
11	23EES111	Transducers for Instrumentation	noc25-ee82	Active
12	23EES112	Smart Grid: Basics to Advanced Technologies	noc25-ee79	Active
13	23EES113	Power Management Integrated Circuits	noc25-ee63	Active
14	23EES114	Operation and Planning Of Power Distribution Systems	noc25-ee57	Active
15	23EES115	Industrial Automation and Control	noc25-ee42	Active
16	23EES116	Deep Learning For Visual Computing	noc25-ee17	Active
17	23EES117	Computer-Aided Design of Electrical Machines	noc25-ee14	Active
18	23EES118	Computer Aided Decision Systems - Industrial practices using Big Analytics	noc25-hs06	Active
19	23EES119	Advance Power Electronics	noc25-ee02	Active
20	23EES120	Embedded Sensing, Actuation and Interfacing Systems	noc25-ee31	Active
21	23EES121	EMI /EMC and Signal Integrity: Principles, Techniques and Applications	noc25-ee32	Active
22	23EES122	Power System Dynamics, Control and Monitoring	noc25-ee66	Active
23	23EES123	Optical Fiber Sensors	noc25-ee58	Active
24	23EES124	Applied Linear Algebra	noc25-ee07	Active
25	23EES125	Design and Analysis of VLSI Subsystems	noc25-ee18	Active
26	23EES126	Power Quality	noc25-ee64	Active

Self – Learning Course -2 (NPTEL/ VTU online course)				
SL Num	Code	Course Name	NPTEL ID	Course Status
1	23EES201	Understanding Incubation And Entrepreneurship	noc25-de07 (old -noc23-de 16)	Active
2	23EES202	Learning Analytics Tools	noc23-ge42	Active
3	23EES203	Economics of IPR	noc24-hs92	Inactive
4	23EES204	Deep Learning - IIT Ropar	noc25-cs21 (old -noc23-cs110)	Active
5	23EES205	Big Data Computing	noc23-cs112	Active
6	23EES206	Privacy And Security In Online Social Media	noc23-cs69	Active
7	23EES207	Artificial Intelligence: Search Methods For Problem Solving	noc23-cs92	Inactive
8	23EES208	Cyber Security and Privacy	noc23-cs127	Inactive
9	23EES209	Entrepreneurship And IP Strategy	noc23-hs 144	Inactive
10	23EES210	Patent Law For Engineers And Scientists	noc23-hs97	Active
11	23EES211	Artificial Intelligence: Knowledge Representation And Reasoning	noc25-cs07	Active
12	23EES212	Cryptography and Network Security	noc25-cs16	Active
13	23EES213	Introduction To Industry 4.0 And Industrial Internet Of Things	noc25-cs43	Active
14	23EES214	Introduction To Internet Of Things	noc25-cs44	Active
15	23EES215	Machine Learning for Engineering and science applications	noc25-cs49	Active
16	23EES216	The Joy of Computing using Python	noc25-cs69	Active
17	23EES217	Data Analytics with Python	noc25-cs17	Active
18	23EES218	Introduction to Machine Learning	noc25-cs46	Active
19	23EES219	Fundamentals of Automotive Systems	noc25-de02	Active
20	23EES220	Strategies for Sustainable Design	noc25-de04	Active
21	23EES221	Usability Engineering	noc25-de08	Active
22	23EES222	Leadership and Team Effectiveness	noc25-mg38	Active
23	23EES223	Qualitative Research Methods and Research Writing	noc25-ge27	Active
24	23EES224	Matlab Programming for Numerical Computation	noc25-ch29	Active
25	23EES225	Introduction to Aircraft Control System	noc25-ae07	Active

7/1/2025
HOD
Dr. M J Chandrashekar

08/1/25
Academic Dean
Dr. Babu N V

28.1.2025
Principal
Dr. K. V. Mahendra Prashanth

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Guidelines for Self-learning courses – Under Graduation (UG)

1) As per the Scheme of Teaching & Examinations (ST&E) the UG students to earn totally 06 credits by studying and completing 02 NPTEL/SWAYAM courses of 12 weeks each earning 03 credits.
2) The credits so earned by successful completion of the courses will be credited in the 8th SEM grade card.
3) The successful completion of the courses means earning of the course completion certificates from NPTEL/SWAYAM.
4) The courses shall be studied and completed starting from 3rd Semester and shall be completed before the announcement of 8th Semester End Examinations. However, it is advised to complete both the courses before the 7th SEM of their graduation.
5) The respective department BOS shall identify the professional courses related to the respective discipline either core or multidisciplinary from the list of courses released by NPTEL/SWAYAM every season. At least ten such courses shall be identified and finalized after the discussions in the respective BOS meetings, and the list shall be approved by the Academic Dean.
6) The approved list shall be published by the departments to the students at the beginning of the 3rd SEM itself and the student shall be given an option to choose up to 02 courses for the study and earn certificates of completion.
7) The practicing of studying and completion of NPTEL/SWAYAM courses starting from 3rd SEM itself has multi-fold effect:
   i) Enhances the self-learning ability of the students.
   ii) Study of self-learning courses will have impact on the learning of other courses in the scheme of teaching & examinations.
   iii) Will address the real time challenges/difficulties/differences in the calendars of NPTEL/SWAYAM & Institution.
8) The respective departments shall make holistic efforts to bring awareness to the students about the objectives and importance of self-learning courses. The departments shall thrive towards fulfilment of the objectives.
9) The departments shall continuously monitor & track the progress of the accomplishment of the courses by the students.
10) The departments shall assign course mentors as per the guidelines of the NPTEL/SWAYAM.

11) The departments shall take care that the registered courses and the examinations shall be under the local chapter of the Institution.
12) Every care must be taken by the departments to guide, motivate, to help the students in completing the courses as the academic calendar of the institution and the calendar of the NPTEL/SWAYAM does not match. The faculty advisory system or Mentor System must play a significant role.
13) Every season new courses may be added to the identified list and a fresh list of courses shall be prepared based on the list announced by the NPTEL/SWAYAM every season. However, the courses published from the first list shall be maintained if the NPTEL/SWAYAM list has the courses.
14) If the students are unable to successfully complete the course, they shall be given an option to re-register for the same course multiple times if the courses are available during the respective seasons in NPTEL/SWAYAM list.
15) An option for making fresh choice shall be given to the students until the successful completion of the courses and earning of required number of credits within the defined time.
16) The list of students registered for the courses and completion of the courses shall be submitted to the dean office on completion of every season.
17) All the regulations such as "Dropping of courses", "Withdrawal of Courses", etc. as described in the academic regulations shall be applicable to the Self Learning Courses (SLC).
18) The performance of the students in the assignments and the certification exam of the NPTEL/SWAYAM shall be considered for awarding the grade points to the students in the self-learning courses.
19) If the students are successfully completing more than the prescribed number of courses in their period of study, best performed courses (group wise) may be considered for the award of credits.
20) The CIE & SEE marks as prescribed in the Scheme of Teaching & Examinations (ST&E) shall be considered as per the performance of the student in the successfully completed NPTEL/SWAYAM course. The obtained assignment marks in the successfully completed NPTEL/SWAYAM course shall be mapped to the CIE and obtained exam certification percentage in the successfully completed NPTEL/SWAYAM course shall be mapped for SEE marks.
21) The students unable to complete the self-learning courses and earn the required credits will not be awarded the degree. Degree shall be awarded only after successful completion and earning of credits.

Academic Dean
Dr. Babu N V

Principal
Dr. K V Mahendra Prashanth

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32	23EEE643	Electronic Circuits using Verilog	86-88
33	23EEE644	IOT & its applications	89-91
34	23EEPRJ1	Major Project - Phase I	92-93

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Autonomous Syllabus: V Semester

Semester:	**V**	**Course Type:**	**PCC**		
Course Title: Power System Analysis and Stability					
Course Code:	**23EET501**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03 Hours**

I. Course Objectives: At the end of the course student will be able to

- Introduce the per unit system and explain its advantages and computation.
- Explain the concept of one line diagram and its implementation in problems.
- Explain analysis of symmetrical faults on synchronous machine and simple power systems.
- Discuss selection of circuit breaker.
- Explain symmetrical components and construction of sequence network of power system.
- Explain the analysis of synchronous machine and simple power systems for different unsymmetrical faults using symmetrical components.
- Discuss the dynamics of synchronous machine and analyse power system stability.

II. Teaching-Learning Process (General Instructions):

- Chalk and Talk
- PPT presentation & Animations

III. COURSE CONTENT

Module-1: Representation of Power System Components	**8 Hrs**

Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Representation of Loads, Numerical.

Textbook: Chapter: sections: Modern Power System Analysis: Chapter 4: Section 4.1 to 4.7

Pre-requisites (Self Learning): Circuit models of transmission line, synchronous machines, transformer and load.

RBT Levels: L1, L2, L3

Module-2: Symmetrical Fault Analysis	**8 Hrs**

Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine (On No Load), Short Circuit of a Loaded Synchronous Machine, Selection of Circuit Breakers, Numerical.

Textbook: Chapter: sections: Modern Power System Analysis: Chapter 9: Section 9.1 to 9.5

Pre-requisites (Self Learning): Nature and Causes of Faults	
RBT Levels: L1, L2, L3	
Module-3: Symmetrical Components	**8 Hrs**
Introduction, Symmetrical Component Transformation, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System, Numerical. **Textbook: Chapter: sections: Modern Power System Analysis: Chapter 10: Section 10.1 to 10.9**	
Pre-requisites (Self Learning): Phase Shift in Star-Delta Transformers	
RBT Levels: L1, L2, L3	
Module-4: Unsymmetrical Fault Analysis	**8 Hrs**
Introduction, Symmetrical Component analysis of unsymmetrical faults, Single Line-to-Ground (LG) Fault, Line-to-Line (LL) Fault, Double Line-to-Ground (LLG) Fault, Open Conductor Faults, Numerical. **Textbook: Chapter: sections: Modern Power System Analysis: Chapter 11: Section 11.1 to 11.6**	
Pre-requisites (Self Learning): Effects of Faults & Fault Statistics	
RBT Levels: L1, L2, L3	
Module-5: Power System Stability	**8 Hrs**
Introduction, Dynamics of a Synchronous Machine, Power Angle Equation, Steady State Stability, Transient Stability, Equal Area Criterion, Numerical. Numerical Solution of Swing Equation. **Textbook: Chapter: sections: Modern Power System Analysis: Chapter 12: Section 12.1 to 12.11**	
Pre-requisites (Self Learning): Factors Affecting Transient Stability.	
RBT Levels: L1, L2, L3	

IV. COURSE OUTCOMES

CO1	Understand one-line diagram, per unit system & construct per unit impedance diagram of power system.
CO2	Analyse three phase symmetrical faults on power system and understand selection of circuit breaker rating.
CO3	Discuss and Analyse unbalanced phasors using sequence components and construct corresponding sequence networks.
CO4	Explore different types of unbalanced faults and their implications on power systems.
CO5	Inspect dynamics of synchronous machine and determine the power system stability.

V. CO-PO-PSOMAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3											3	3		
CO2	3	3				2	2						3	2		
CO3	3	3				2	2						3	2		

CO4	3	3				2	2						3	2		
CO5	3	2											3	2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexture section 1

Continuous Internal Evaluation (CIE): Refer Annexture section 1

Semester End Examination (SEE): Refer Annexture section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Modern Power System Analysis	D P Kothari and I J Nagrath	4th Edition, 2012	Tata McGraw Hill Publications

VII(b): Reference Books:

1	Elements of Power System Analysis	William D. Stevenson	4th Edition	McGraw Hill Publications
2	Power System Analysis	Hadi Sadat	3rd Edition	Tata McGraw Hill Publications
3	Electrical Power Systems	Debapriya Das	2nd Edition, 2024	New Age International
4	Computer Methods in Power System Analysis	Stagg & El-Abiad	2019	Medtech scientific international

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/@eeedepartment4878

https://onlinecourses.nptel.ac.in/noc21_ee77/course

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminars, different faults data collections, building prototype models of different faults.

Semester:	V	Course Type:	IPCC		
Course Title: Signals and DSP					
Course Code:	23EEI502			**Credits:**	4
Teaching Hours/Week (L:T:P:O)			3:0:2:@	**Total Hours:**	40(Theory)+ 12 (Lab slots)
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- To explain basic signals, their classification, basic operations on signals, sampling of analog signals, and the properties of the systems.
- To explain the convolution of signals in continuous and discrete time domain and the properties of impulse response representation.
- To explain the computation of Discrete Fourier Transform of a sequence by direct method, Linear transformation Method and using Fast Fourier Transformation Algorithms.
- To explain design of IIR all pole analog filters and transform them into digital filter using Impulse Invariant and Bilinear transformation Techniques and to obtain their Realization.
- To explain design of FIR filters using Window Method and Frequency Sampling Method and to obtain their Realization.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Self-Paced courses using MATLAB software.

III. COURSE CONTENT

III(a). Theory PART

Module-1: Introduction to Signals & Systems — **8 Hrs**

Introduction: Definitions of a Signal and a System, Classification of Signals, Basic Operations on Signals, Basic Elementary Signals, properties of systems, concept of frequency in continuous and Discrete time signals, sampling of analog signals, the sampling theorem. Numerical only on Odd, Even, Periodic, Non-Periodic, Power and Energy Signals are included.

Textbook 1: Chapter: Section: Digital Signal Processing by A Anand Kumar: Chapter 1: Section 1.1 to 1.6.
Textbook 2: Chapter: Section: Signals and Systems by A Nagoor Kani: Chapter 1 & 2: Section 1.1 to 1.5 and 2.1 to 2.8.

Pre-requisites (Self Learning): Fundamentals of control systems, Analog and Digital Systems

RBT Levels: L1, L2, L3

Module-2 Discrete Fourier Transforms (DFT) — **8 Hrs**

Discrete Fourier Transforms (DFT): Introduction to DFT, definition of DFT and its inverse, matrix relation to find DFT and IDFT, Properties of DFT -Linearity, Periodicity, circular time shift, circular frequency shift, circular folding. Circular Convolution- Circle method, Matrix method and Stock hams Method, Linear Convolution. Signal segmentation-overlap-save and overlap-add method only Numerical.

Textbook 1: Chapter: Section: Digital Signal Processing by A Anand Kumar: Chapter 6: Section 6.1 to 6.13. **Textbook 2: Chapter: Section: Signals and Systems by A Nagoor Kani: Chapter 6 & 9: Section 6.10 & 6.11 and 9.1 to 9.5.**
Pre-requisites (Self Learning): Fundamentals of Fourier Series and Fourier Transforms.
RBT Levels: L1, L2, L3

Module-3: Fast-Fourier-Transform (FFT) algorithms	**8 Hrs**

Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, Advantages of FFT over DFT, need for efficient computation of the DFT (FFT algorithms), speed improvement factor, Radix-2 FFT algorithm for the computation of DFT, Decimation-in-time and Decimation-in-frequency algorithms, Radix-2 FFT algorithm for the computation of Inverse DFT, Convolution in DIT and DIF FFT.

Textbook 1: Chapter: Section: Digital Signal Processing by A Anand Kumar: Chapter 7: Section 7.1, to 7.7. **Textbook 2: Chapter: Section: Signals and Systems by A Nagoor Kani: Chapter 9: Section 9.6 to 9.10**
Pre-requisites (Self Learning): Fundamentals of Fourier Series and Fourier Transforms.
RBT Levels: L1, L2, L3

Module-4:Design of IIR Filters	**8 Hrs**

IIR filter design: Introduction, Classification of analog filters, Design of low pass Butterworth filters, Design of low pass Chebyshev filters, and Numerical only on Low pass Butterworth and Chebyshev filters only. design of digital Butterworth and Chebyshev filters using bilinear transformation, Impulse invariance transformation technique, Mapping of transfer functions from S-Plane to Z-Plane.

Textbook 1: Chapter: Section: Digital Signal Processing by A Anand Kumar: Chapter 8: Section 8.1 to 8.11. **Textbook 2: Chapter: Section: Digital Signal Processing by John G Proakis: Chapter 10: Section 10.1 to 10.5.**
Pre-requisites (Self Learning): Fundamentals of analog and digital circuits and Linear ICs.
RBT Levels: L1, L2, L3, L4

Module-5: Design of FIR Filters	8 Hrs

Design of FIR filters: Introduction, advantages& disadvantages, characteristics of FIR systems, symmetric and antisymmetric FIR filters, design of linear phase FIR filters using window functions-Numerical on Rectangular, Hamming, and Hanning windows only.
Realization of discrete-time systems: IIR Filters - direct form I& II (only) FIR filters-direct form and cascade form only.

Textbook 1: Chapter: Section: Digital Signal Processing by A Anand Kumar: Chapter 9: Section 9.1 to 9.7. **Textbook 2: Chapter: Section: Signals and Systems by A Nagoor Kani: Chapter 10: Section 10.1 to 10.5.**
Pre-requisites (Self-Learning): Fundamentals of Analog and digital circuits and Linear ICs.
RBT Levels: L1, L2,L3

III(b). PRACTICAL PART

Sl.No	Experiments
1	Generation of different signals in both continuous and discrete time domains

2	Verification of Sampling Theorem in time and frequency domains
3	To perform basic operations on given sequences- Signal folding, evaluation of even and odd signals
4	Evaluation of impulse response of a system.
5	Evaluation of linear convolution of given sequences
6	Evaluation of circular convolution of given sequences
7	Computation of N- point DFT and IDFT of a given sequence by using DFT and FFT approach.
8	Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters).

IV. COURSE OUTCOMES

CO1	Discuss the classification of signals, system and Analyze signals to perform various signal processing operations
CO2	Able to compute DFT and Convolution concepts efficiently using different techniques.
CO3	Explain and implement the FFT algorithms for efficient computation of the DFT.
CO4	Design, implement and present various analog and digital filter designs for the required specifications

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2		2	3				2	2		2			3
CO2	3	2		2	3				2	2		2			3
CO3	3	2		2	3				2	2		2			3
CO4	3	2	2	2	3				2	2		2			3

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 2

Continuous Internal Evaluation (CIE): Refer Annexure Section 2

Semester End Examination (SEE): Refer Annexure Section 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Digital Signal Processing	A Anand Kumar	2nd Edition, 2015	PHI Learning Pvt.Ltd.
2	Signals & Systems	A. Nagoor Kani	20th reprint 2018	McGraw Hill
3	Digital Signal Processing – Principles, Algorithms, and Applications	Jhon G. Proakis Dimitris G. Manolakis	4th Edition. 2007	Pearson

VII(b): Reference Books:

1	Introduction to Digital Signal Processing	Jhonny R. Jhonson	1st Edition, 2016.	Pearson
2	Digital Signal Processing	D Ganesh Rao	3rd Edition, 2017	Mc Graw Hill Publication

VII(c): Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/117102060
2. https://www.youtube.com/playlist?list=PLOzRYVm0a65cU4xstihnbnrCPHenmJJ7f
3. https://nptel.ac.in/courses/108106151

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	V	Course Type:	IPCC		
Course Title: Power Electronics					
Course Code:	23EEI503			**Credits:**	04
Teaching Hours/Week (L: T:P:O)			3:0:2:0	**Total Hours:**	40(Theory)+ 12(Lab Slots)
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- Understand an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics.
- Follow power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
- Explain the techniques for design and analysis of single-phase diode rectifier circuits.
- Understand different power transistors, their steady state and switching characteristics and Limitations.
- Explain different types of Thyristors, their gate characteristics and gate control requirements.
- Know the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC-AC converters and Voltage controllers.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit
- Peer presentation and learning

III. COURSE CONTENT

III(a). Theory PART

Module-1: Power Diodes and Transistors **8 Hrs**

Introduction, working principle, characteristics (static & dynamic) of Power Diodes, Schottky diodes, Sic diodes. Structure, Applications of Power Electronics, Peripheral effects.

Power Transistors: – Steady State Characteristics, Switching Characteristics, Switching Limits of IGBT, MOSFET, MOSFET Gate Drive, Isolation of Gate and Base Drives, Pulse transformers and Opto-couplers.

Textbook: Chapter: sections: Power Electronics, Circuit Devices and Applications, Muhammad H Rashid, Chapter 1,2,4, Section: 1.1 to 2.7, 4.1 to 4.3, 4.6 to 4.7, 4.9, 4.10 to 4.11, 4.14 to 4.17.

Pre-requisites (Self Learning): Basics of operation of Diode, transistors, Basics of Electronics

RBT Levels: L1, L2, L3

Module-2: Thyristors **8 Hrs**

Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn-On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection, Thyristor Firing Circuits-types.

Textbook:Chapter:Sections:

1. **Power Electronics, Circuit Devices and Applications, Muhammad H Rashid. Chapter: 9, Section: 9.1 to 9.6, 9.9, 9.10, 9.13, 9.14.**
2. **Power Electronics, JS Chithode, Chapter: 3, Sections:3.7(Firing circuits)**

Pre-requisites (Self Learning): Basic knowledge on Thyristors & its operation

RBT Levels: L1, L2, L3

Module-3: Rectifiers & Choppers	**8 Hrs**

Controlled Rectifiers: Introduction, Single phase half wave circuit with R,RL,RLE Load,Single-Phase Full Converters with R,RL,RLE Load, Single-Phase Dual Converters.
Choppers: Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.

Textbook:Chapter:sections:

1. **Power Electronics, Circuit Devices and Applications, Muhammad H Rashid. Chapter: 5, Sections: 5.1 to 5.8.**
2. **Power Electronics, JS Chithode, Chapter:5, Sections: 5.1 to 5.6**

Pre-requisites (Self Learning) : Knowledge of Electronic devices & its operation

RBT Levels: L1, L2, L3

Module-4: Inverters & Voltage controllers	**8 Hrs**

Inverters: Introduction, principle of operation single phase bridge inverters, voltage control of single-phase inverters (VSI), Current source inverters (CSI),3-ϕ inverter-120°&180°.

AC Voltage Controllers: Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads & Inductive Loads.

Textbook:Chapter:Sections:

1. **Power Electronics, Circuit Devices and Applications, Muhammad H Rashid, Chapter: 6. Sections: 6.1 to 6.9.**
2. **Power Electronics, JS Chithode, Chapter: 6, Sections: 6.1 to 6.5**

Pre-requisites (Self Learning):- Complete knowledge structure & operation of all popular types of switches.

RBT Levels: L1, L2, L3

Module-5: Power Electronics in Industrial and Renewable Systems	**8 Hrs**

Multilevel Inverters: Introduction, Diode-Clamped, Flying Capacitor, Cascaded H-Bridge.
Power Electronics for: Induction heating, Battery charger, Static Circuit Breaker
Power Electronics for Drives: Motor drives, UPS, DC-drives, AC-drives.
Power Electronics in Renewable Energy: Solar, wind, and HVDC system intro

Textbook:Chapter:Sections:

1. **Power Electronics, Circuit Devices and Applications, Muhammad H Rashid. Chapter 11. Section: 11.8.**

Reference book :Chapter: Sections:

1. **Power Electronics P.S. Bimbhra, Chapter:11&12, Sections: 11.1-11.12,12.1**

Pre-requisites (Self Learning): Commutation techniques of all switches

RBT Levels: L1, L2, L3

III(b). PRACTICAL PART	
Sl. No	**Experiments**
1	Static Characteristics of SCR, MOSFET and IGBT.
2	SCR turn on circuit using synchronized UJT relaxation oscillator.
3	SCR digital triggering circuit for a single-phase controlled rectifier and ac voltage regulator.
4	Single phase controlled full wave rectifier with R load, R –L load, R-L-E load with and without freewheeling diode.
5	AC voltage controller using TRIAC and DIAC combination connected to R and RL loads.
6	Speed control of DC motor using single semi converter.
7	Speed control of stepper motor.
8	Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper.
9	Single phase MOSFET/IGBT based PWM inverter.

IV. COURSE OUTCOMES

CO1	Explain the structure and working of power diodes, Schottky, SiC diodes, MOSFETs, IGBTs, and thyristors.
CO2	Analyze switching characteristics and gate/base drive circuits of power transistors and thyristors.
CO3	Use rectifiers, choppers and inverters in power conversion with various loads.
CO4	Analyze power electronics for industrial, renewable energy systems and other applications.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											2	3	2	
CO2	3		2										2	3	2	
CO3	3	2											2	3	2	
CO4			2	2		2	2					2	2	3	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 2

Continuous Internal Evaluation (CIE): Refer Annexure section 2

Semester End Examination (SEE): Refer Annexure section 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Power Electronics, Circuit Devices and Applications	M. H. Rashid	4th Edition, 2018	Pearson

2	Power Electronics	J S Chithode	3rd Edition,2018	Technical Publications
3	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins,	3rd Edition, 2011	Wiley India Pvt Ltd, ISBN: 978-0-471-22693-2
VII(b): Reference Books:				
1	Power Electronics	P.S. Bimbhra	5th Edition, 2012	Khanna Publishers
2	Power Electronics	Daniel W Hart	1st Edition, 2011	Mc. Graw Hill,

VII(c): Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/105/108105066/
- Power Electronics – NPTEL+
- Power Electronics - Course (nptel.ac.in)
- NPTEL :: Electrical Engineering - NOC:Power Electronics

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	V	Course Type:	PCCL		
Course Title: Industrial Automation Lab					
Course Code:	23EEL504			**Credits:**	01
Teaching Hours/Week (L:T:P:O)			0:0:2:0	**Total Hours:**	12 Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Practical			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- Conduct velocity and position control of Industrial drive using PLC
- Write a PLC ladder programming for different applications

II.COURSE CONTENT

Sl. No.	Experiments / Programs / Problems
1.	Indra drive hardware interface and overview, Enable/halt the drive.
2.	Hardware based Velocity control of Servomotor using Analog input
3.	Hardware based Velocity control (Remote and software based) of Servomotor using Digital inputs
4.	Homing/ Reference of servomotor & Hardware based Absolute position control of Servomotor using Digital inputs
5.	Indra drive hardware interface setup using PLC and library function blocks applications
6.	PLC based Enable/halt the drive
7.	PLC based Velocity control of Servomotor using Ladder programming
8.	PLC based Absolute position control of Servomotor using Ladder programming
9.	PLC based Relative position control of Servomotor using Ladder programming
10.	PLC based real-time control of drive for different applications, Master/ Slave configuration of drive.

III.COURSE OUTCOMES

CO1	Conduct velocity and position control of servomotor
CO2	Execute the PLC program for different application of industrial drives
CO3	Perform Master/ Slave configuration of drives with time delay

IV.CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2			3	1				1	1	1		3	3	
CO2	3	2			3	1				1	1	1		3	3	
CO3	3	2			3	1				1	1	1		3	3	

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 4

Continuous Internal Evaluation (CIE): Refer Annexure section 4

Semester End Examination (SEE): Refer Annexure section 4

VI. Learning Resources

VI(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Programmable Logic Controllers	W Bolton	Fourth Edition, 2015	ELSEVIER
2	Programmable Logic Controllers	Frank D Petruzella	Fourth Edition 2011	McGraw Hill

VI(b): Reference books:

1	Programmable Logic Controllers an Engineer's Guide	E A Parr	3rd edition, 2013	Newnes
2	Introduction Programmable Logic Controllers	Gary Dunning	3rd edition, 2006	Cengage

Web links and Video Lectures (e-Resources):

- https://youtu.be/uOtdWHMKhnw?si=kqxVgEUDtcNraM59
- https://youtu.be/gKMXEoBFXKY?si=tJ5hckrPAfGIlwmg
- https://onlinecourses.nptel.ac.in/noc21_me67/preview
- https://archive.nptel.ac.in/courses/108/105/108105062/

VII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Industry visit, Self-study activities, GD, miniature projects

Semester:	V	Course Type:	PEC		
Course Title: Electrical Machine Design					
Course Code:	23EEP511			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3 Hours

I. Course Objectives: At the end of the course student will be able to

- To discuss design factors, limitations in design and modern trends in design and manufacturing of electrical machines, properties of electrical, magnetic and insulating materials used in the design of electrical machines.
- To derive the output equation of DC machine, single phase, three phase transformers, induction motor and synchronous machines.
- To discuss the selection of specific loadings, for various machines, separation of main dimensions for different electrical machines.
- To evaluate the performance parameters of transformer, design of cooling tubes for the transformer for a given temperature rise.
- To discuss the need of starters for dc shunt, series motors, 3 phase slip ring Induction motor and working of regulators.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit

III. COURSE CONTENT

Module-1: Fundamental Aspects of Electrical Machine Design **8 Hrs**

Introduction: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

Electrical Engineering Materials: Desirability's of Conducting Materials, Comparison of Aluminium and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel.

Textbook: Chapter: sections: Electrical Machine Design, A K Sawhney: Chapter 1 and 2: Section 1.1 to 1.6 and 2.1 to 2.14

Pre-requisites (Self Learning): Material Types, characteristics

RBT Levels: L1 and L2

Module-2: Design of DC Motors **8 Hrs**

Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap.

Textbook: Chapter: sections: Electrical Machine Design, A K Sawhney: Chapter 9: Section 9.1 to 9.54

Pre-requisites (Self Learning): Motor, Poles, Windings

RBT Levels: L1, L2 and L3

Module-3: Design of Transformers	**8 Hrs**

Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Design of Tank and Cooling (Round and Rectangular) Tubes.

Textbook: Chapter: sections: Alternating Current Machines, M G Say: Chapter 6: Section 6.1 to 6.6

Pre-requisites (Self Learning): Transformers principle, types, Cooling techniques

RBT Levels: L1, L2 and L3

Module-4: Design of Three Phase Induction Motors & Synchronous machines	**8 Hrs**

Design of Three Phase Induction Motors: Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring.
Design of Three Phase Synchronous machines: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient Rotors. Magnetic Circuit and Field Winding

Textbook: Chapter: sections: : Alternating Current Machines, M G Say: Chapter 9: Section 9.1 to 9.3, Chapter 11 : Section 11.1 to 11.8

Pre-requisites (Self Learning):IM Motor working concepts.

RBT Levels: L1, L2 and L3

Module-5: Starters and Field Regulators	**8 Hrs**

Motor starters, Calculation of resistance steps, Starters for DC shunt motors, Starters for DC series motors, Starters for three phase slip ring Induction motors, field regulators.

Textbook: Chapter: sections: Electrical Machine Design, A K Sawhney: Chapter 13: Section 13.1 to 13.3

Pre-requisites (Self Learning): Starters and Regulators working concepts

RBT Levels: L1, L2 and L3

IV. COURSE OUTCOMES

CO1	Compare electrical engineering materials and its properties, fundamental aspects of electrical machine design
CO2	Design the main dimension, ampere turns for magnetic circuit of DC machine.
CO3	Design output equations, main dimension, estimate the number of cooling tubes of transformer
CO4	Design output equation, stator and rotor circuits of Induction machine and Synchronous Machine
CO5	Explore the working of starters for DC shunt, series motors, induction motor and regulators working in an electrical machine

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2															
CO2	3	3	2	2		2	2							3		
CO3	3	3	2	2		2	2							3		
CO4	3	3	2	2		2	2						3	3		
CO5	3	2	2	2		2	2						3	3		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	A course in Electrical Machine Design	A.K.Sawhney	6th Edition, 2013	DhanpatRai
2	Performance and Design of Alternating Current Machines	M.G. Say	3rd Edition, 2002	CBS Publisher

VII(b): Reference Books:

1	Design Data Handbook	A. Sanmugasundaram	1st Edition, 2011	New Age International
2	Design of Electrical Machines	V N Mittle	5th Edition, 2002	N C Jain Publication

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.
https://archive.nptel.ac.in/courses/108/105/108105155/
https://onlinecourses.nptel.ac.in/noc23_ee140/preview
http://www.digimat.in/nptel/courses/video/108106023/L40.html

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	V	Course Type:	PEC		
Course Title: Electrical Estimation and Costing					
Course Code:	**23EEP512**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand the purpose of estimation and costing,
- Discuss market survey, estimates, purchase enquiries, tenders, comparative statement and payment of bills and Indian electricity act and some of the rules.
- Design and analyse distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories, fittings and fuses.
- Know design of lighting points and its number, total load, sub-circuits, size of conductor.
- Discuss different types of service mains and estimation of power circuits.
- Discuss estimation of overhead transmission and distribution system and its components.
- Understand main components of a substation, their graphical representation and preparation of single line diagram of a substation.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit
- Peer presentation and learning

III. COURSE CONTENT

Module-1: Principles of Estimation **8Hrs**

Introduction to Estimation and Costing, Electrical Schedule, Catalogues, Market Survey and Source Selection, Determination of Required Quantity of Material, Labour Conditions, Determination of Cost Material and Labour, General Idea about IE Rule, Indian Electricity (IE) Act and IE Rules - 29,30,45,46,47,50,51,54,55,77 and79.

Textbook: Chapter: Sections: A Course in Electrical Installation Estimating and Costing-J. B. Gupta- Chapter 1: Section-1.1 to 1.18

Pre-requisites (Self Learning): Electrical circuits, Analysing the costs.

RBT Levels: L1, L2

Module-2: Domestic Wiring **8Hrs**

Wiring: Introduction, Distribution of energy in a Building, (PVC Casing and Capping, Conduit Wiring, Desirability's of Wiring). Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables Wiring, Main-Switch, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Size of Fuse.
Internal Wiring: General rules for wiring, Design of Lighting, Number of Points, Determination of Total Load, Number of Sub –Circuits, Ratings Main Switch and Distribution Board and Size of Conductor. Current Density, Layout.

Textbook: Chapter: Sections: A Course in Electrical Installation Estimating and Costing-J. B. Gupta, Chapter:2,3, 8: Section 2.1 to 2.6, 3.1 to 3.19, 8.1 to 8.8

Pre-requisites (Self Learning): Basics of electrical equipment's, types of wires, used in domestic wiring & earthing, Line diagrams

RBT Levels: L1,L2,L3

Module-3: Service Mains & Power Circuits	**8Hrs**

Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections. **Design and Estimation of Power Circuits**: Introduction, Important Considerations Regarding Motor Installation Wiring, Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse, Size of Condit, Distribution Board Main Switch and Starter

Textbook: Chapter: Sections: A Course in Electrical Installation Estimating and Costing-J. B. Gupta-Chapter 9,12 Section 9.1 to 9.7, 12.1 to 12.2.

Pre-requisites (Self Learning): General knowledge on power circuits, Line diagrams.

RBT Levels: L1,L2,L3

Module-4: Estimation of Overhead Lines	**8Hrs**

Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances, Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers, Muffs, Points to be Considered at the Time of Erection of Overhead Lines, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Jointing of Conductors, Dead End Clamps, Positioning of Conductors and Attachment to Insulator's, Jumpers, Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor From Ground, Spacing Between Conductors.

Textbook: Chapter: Sections: A Course in Electrical Installation Estimating and Costing-J. B. Gupta-Chapter 10: Section 10.4 to10.37

Pre-requisites (Self Learning) General knowledge on equipment's used in transmission & distribution, Line diagrams.

RBT Levels: L1,L2,L3

Module-5: Estimation of Substations	**8Hrs**

Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation main Connection Diagram, Single Line Diagram of Typical Substations, Equipment for Substation, Substation Auxiliaries Supply, Substation Earthing

Textbook: Chapter: Sections: A Course in Electrical Installation Estimating and Costing-J. B. Gupta, Chapter 13, Section-13.6 to 13.11

Pre-requisites (Self Learning): Basics of substation, Equipment's used in substation, Earthing concepts, Line diagrams.

RBT Levels: L1,L2,L3

IV. COURSE OUTCOMES

CO1	Acquire knowledge on general principles of estimation & costing, IE rules, IE-Act
CO2	Discuss the considerations to be made & estimate the Residential wiring, applying Safety rules.
CO3	Analyze & design aspects for service connections, Power circuits & their Earthing.
CO4	Estimate the cost of Overhead Lines & Sub-station.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2	1	2				1	3	2		
CO2	3	3	2	2		3	2	3				2	3	2		
CO3	3	2	2	2		2	1	2				2	3	2		
CO4	3	2	2	2		1	1	2			1	1	3	2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	A Course in Electrical Installation Estimating and Costing	J. B. Gupta	9th Edition, 2019	Katson Books,

VII(b): Reference Books:

1	Electrical Design Estimating and Costing,	K.B.Raina, S.K.Bhattacharya	3rd Edition,2024	New Age International
2	Electrical Wiring Estimating and Costing	Uppal	5thEdition,1997	Khanna Publishers

VII(c): Web links and Video Lectures (e-Resources):

- Principles of Electrical Sciences - Course
- Estimation And Costing Of House Wiring, Materials Required
- Estimating for Electrical Contractors: A How To Guide - PowerPlay |
- Electrical Estimation & Costing - Electrical4U

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Seminars,Assignments,Quiz,Case-studies,mini-project,self-study activities,Industryvisit,group discussion, etc.,

Semester:	V	Course Type:	PEC		
Course Title: Renewable Energy Sources					
Course Code:	**23EEP513**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand solar energy concepts and applications in solar cells and thermal systems.
- Explore hydrogen, geothermal, and their environmental impacts.
- Examine biomass and biogas production processes and their uses in energy generation.
- Study the principles and applications of wave energy, ocean thermal energy, and fuel cells.
- Analyse the benefits and challenges of various renewable energy systems.

II. Teaching-Learning Process (General Instructions):

- Chalk and Talk
- Keynote presentation
- YouTube videos
- Group discussion

III. COURSE CONTENT

Module-1: Introduction to Energy Sources, Solar Basics and Geometry **8 Hrs**

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development

Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth — Sun Angles and their Relationships, Solar Thermal Energy Applications.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I-V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic panels (series and parallel arrays).

Textbook: Chapter: sections: Non-conventional sources of energy by Shobh Nath Singh: Chapter: 1, 2 & 4 Sections: 1.5 to 1.7, 2.1 to 2.3, 2.5, 4.1 to 4.3, 4.5.4, 4.6 and 4.7

Pre-requisites (Self Learning): Energy Resources and Classification, Renewable Energy-Worldwide Renewable Energy Availability, Renewable Energy in India.

RBT Levels: L1, L2 and L3

Module-2: Solar Thermal Collectors and its applications **8 Hrs**

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish — Stirling Engine System, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Textbook: Chapter: sections: Non-conventional sources of energy by Shobh Nath Singh: Chapter 3, Sections: 3.1 to 3.17

Pre-requisites (Self Learning): Fundamentals related to solar collectors and types and operating principle.

RBT Levels: L1 and L2

Module-3: Wind, Geothermal and Hydrogen energy **8 Hrs**

Wind Energy: Introduction, Basic Principles of Wind Energy Conversion, Site Selection Considerations, Basic components of WECS, Advantages and Disadvantages of WECS
Geothermal Energy: Introduction, Geothermal Sources, Hydrothermal (Convective) Resources, Advantages and Disadvantages of Geothermal Energy over other Energy Forms, Applications
Hydrogen Energy: Introduction, Hydrogen Production, Hydrogen Storage, Utilization of Hydrogen Gas

Textbook: Chapter: sections: Non-conventional sources of energy by G D Rai, Chapter: 6, 8 & 11 Sections: 6.1, 6.2, 6.4, 6.6, 6.7, 8.1, 8.4, 8.5, 8.12, 8.13, 11.1 to 11.5.

Pre-requisites (Self Learning): Basic concepts related to wind and geothermal energy conversion.

RBT Levels: L1 and L2

Module-4: Biomass, Biogas and Tidal Energy:	**8 Hrs**

Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Applications of Biomass Gasifier.
Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production (Construction parts of Biogas plant), Benefits of Biogas.
Tidal Energy: Tidal power basin (Single and double basin), Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy.

Textbook: Chapter: sections: Non-conventional sources of energy by Shobh Nath Singh Chapter: 9, 10 & 11 Sections: 9.1 to 9.10, 10.1 to 10.7, 11.1 to 11.6 &11.8 to 11.10

Pre-requisites (Self Learning): Basic knowledge of biological processes, chemistry, and renewable energy technologies.

RBT Levels: L1 and L2

Module-5: Ocean Thermal Energy and Fuel Cell	**8 Hrs**

Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC
Fuel Cell: Schematics of fuel cell, molten carbonate and phosphoric acid fuel cells, sources of over voltage in fuel cells, fuels for fuel cells, advantage, disadvantages of fuel cells

Textbook: Chapter: sections: Non-conventional sources of energy by Shobh Nath Singh Chapter:13 & 14 Sections: 13.1 to 13.3, 13.7, 13.8, 14.2, 14.9.2, 14.9.3 &14.10 to 14.14

Pre-requisites (Self Learning): Fundamentals of Ocean Thermal Energy conversion and Principles of Fuel Cell

RBT Levels: L1 and L2

IV. COURSE OUTCOMES

CO1	Understand energy scarcity, solar energy, functioning of solar devices and their uses in generating and storing energy.
CO2	Explain the concepts of wind, geothermal, and hydrogen energy systems.
CO3	Describe the processes and applications of biomass, biogas, and tidal energy production.
CO4	Analyse the operating principles, benefits, challenges, and applications of Ocean Thermal Energy Conversion and fuel cells.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2	2						3	2		
CO2	3	2				2	2						3	2		

CO3	3	2				2	2						3	2		
CO4	3	2				2	2						3	2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Non-conventional Energy Resources	Shobh Nath Singh	1st Edition, 2015.	Pearson
2	Non-conventional Energy Resources	G D Rai	6th Edition, 2017	Khanna publishers

VII(b): Reference Books:

1	Nonconventional Energy Resources	B.H. Khan	3rd Edition	McGraw Hill
2	Renewable Energy; Power for a sustainable Future.	Godfrey Boyle	3rd Edition, 2012	Oxford
3	Renewable Energy Sources: Their Impact on global Warming and Pollution	Tasneem Abbasi S.A. Abbasi	1st Edition, 2011	PHI

VII(c): Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/115/105/115105127
2. https://archive.nptel.ac.in/courses/103/103/103103206/
3. https://archive.nptel.ac.in/courses/115/105/115105127/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Case Study, Assignments, Quiz, Mini projects and Industrial visits

Semester:	V	Course Type:	PEC		
Course Title: Energy Conservation and Audit					
Course Code:	**23EEP514**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand the importance of energy management and conservation in various systems.
- Describe energy policies, the Indian energy scenario, and the Energy Conservation Act, 2001.
- Recognize the types, methods, and benefits of conducting energy audits.
- Identify ways to improve energy efficiency in electrical systems, including motors and load management.
- Evaluate energy-saving opportunities in industrial systems like compressed air, HVAC, and fans.
- Apply energy-efficient technologies, such as demand controllers and efficient lighting, to reduce consumption.

II.**Teaching-Learning Process (General Instructions):**

- Chalk and Talk
- Keynote presentation
- YouTube videos
- Group discussion

III.COURSE CONTENT

Module-1: Energy Scenario	**8 Hrs**

Renewable and non-renewable energy, Indian energy scenario, integrated energy policy, energy intensity on purchasing power parity, Energy sector reforms, energy and environment, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features.

Textbook: Chapter: sections: Guidebooks for National Certification Examination for Energy Manager Energy Auditors Book-1 General Aspects Chapter: 01 and 02 Sections: 1.4, 1.7, 1.9,1.10,1.11, 1.14, 1.15 and 2.2

Pre-requisites (Self Learning): General awareness related Energy types, policies, conservation, reforms.

RBT Levels: L1 and L2

Module-2: Energy Conservation Technologies	**8 Hrs**

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Textbook: Chapter: sections: Guidebooks for National Certification Examination for Energy Manager Energy Auditors Book-3 General Aspects Chapter: 10 Sections: 10.1 to 10.8

Pre-requisites (Self Learning): Basic knowledge related Energy concepts, auditing, costs, optimization.

RBT Levels: L1 and L2	
Module-3: Energy Efficiency in Electrical Systems	**8 Hrs**
Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement benefits, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. **Electric motors:** motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors **Textbook: Chapter: sections: Guide books for National Certification Examination for Energy Manager Energy Auditors Book-3 General Aspects Chapter: 1, 2 and 7 Sections: 1.2 to 1.4, 1.7 and 2.4,2.7,2.8 and 7.5**	
Pre-requisites (Self Learning) Basic knowledge related Electrical systems, load management, motors	
RBT Levels: L1, L2 and L3	
Module-4: Energy Management & Audit	**8 Hrs**
Definition, energy audit, need, types of energy audit and approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. **Textbook: Chapter: sections: Guide books for National Certification Examination for Energy Manager Energy Auditors Book-1 General Aspects Chapter: 04 Sections: 4.1 to 4.12**	
Pre-requisites (Self Learning) Fundamentals related to Energy efficiency, motor controls, technologies.	
RBT Levels: L1, L2 and L3	
Module-5: Demand-Side Management and Sustainable Energy Development	**8 Hrs**
Demand side Management: Scope of DSM, Evolution of DSM concept, DSM planning and Implementation, Load management as a DSM strategy, Applications of Load Control, End use energy conservation, Tariff options for DSM. **Sustainable Energy Development:** Introduction, energy problems, energy use trends in developing countries, prospects of changes in energy supply and agenda for sustainable development. **Textbook: Chapter: sections: Generation of Electrical Energy Chapter: 19 & 21 Sections: 19.1 to 19.7 & 21.1 to 21.5**	
Pre-requisites (Self Learning) Basic understanding of energy demand, conservation methods, and sustainable energy practices.	
RBT Levels: L1 and L2	

IV.COURSE OUTCOMES

CO1	Understand the Energy scenario and Energy conservation technologies to improve energy efficiency.
CO2	Analyse energy efficiencies in electrical systems for improved performance.
CO3	Explain energy management and auditing processes for optimizing energy usage.
CO4	Identify demand-side management strategies and sustainable energy development practices.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3				2	2						2	2		
CO2	3	3				2	2						2	2		
CO3	3	3				2	2						2	2		

CO4	3	3				2	2						2	2		

VI.Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII.Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Guide books for National Certification Examination for Energy Manager Energy Auditors Book-1 General Aspects	Bureau of energy efficiency	4th Edition, 2015	Bureau of energy efficiency
2	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities	Bureau of energy efficiency	4th Edition, 2015	Bureau of energy efficiency
3	Generation of Electrical Energy	By Gupta B.R.	7th Edition, 2017	S Chand
VII(b): Reference Books:				
1	Energy Management	W.R. Murphy &G. Mckey Butterworths	2007	New Age International Publisher
2	Handbook on Energy Audit and Management,	Amit kumar Tyagi	2011	TERI (Tata Energy Research Institute
3	Energy conversion systems,	Rakosh Das Begamudre,	10th Edition 2000	New Age International Publishers
4	Utilization of Electrical Energy and Conservation	S. C. Tripathy	Reprint 1991	McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):

1.Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
2. https://nptel.ac.in/courses/112105221
3. https://onlinecourses.nptel.ac.in/noc23_me122/preview
4. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
5. https://elearn.nptel.ac.in/shop/iit-workshops/completed/design-principles-of-building-energy-conservation/?v=c86ee0d9d7ed

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Case Study, Assignments, Quiz, Mini projects and Industrial visits

Semester:	V	Course Type:	ETC		
Course Title: Big Data for Power System Engineering					
Course Code:	23EEE531			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- Defining big data, explaining its use, and explaining how analytics may be used to power systems.
- To describe how big data is used in smart grid communications and how it is optimized for electric power systems.
- to describe data mining techniques for detecting theft in power systems and security measures for infrastructure communication.
- To describe how the unit commitment approach is used in smart grid control.
- To describe a transformer protection algorithm based on the identification of data patterns.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit

III. COURSE CONTENT

Module-1: Big Data Application and Analytics in a Large-Scale Power System **8 Hrs**

Introduction: Big Data, Future Power Systems.
Big Data Application and Analytics in a Large - Scale Power System: Introduction, General Applications of Big Data, Algorithms for Processing Big Data, Application of Big Data in Power Systems.

Textbook: Chapter: sections: Big Data Analytics in Future Power System, Ahmed F Zobaa, Trevor J Bihl: Chapter 1,2 sections: 1.1 to 1.3, 2.1 to 2.4

Pre-requisites (Self Learning): Big data, Power system

RBT Levels: L1, L2, L3

Module-2 Big Data in Smart Grid Communications & Optimization **8 Hrs**

Role of Big Data in Smart Grid Communications: Introduction, The Grid Modernization, The Grid Interconnection with the Internet of Things, Data Traffic Pattern in a Smart Grid Environment, The Massive Flow of Information in a Smart Scenario, The Volume of Generated Data in a Smart Distribution System: A Case of Study.
Big Data Optimization in Electric Power Systems: Introduction, Background, Scientometric Analysis of Big Data, Big Data and Power Systems, Optimization Techniques Used in the Big Data Analysis.

Textbook: Chapter: sections: : Big Data Analytics in Future Power System, Ahmed F Zobaa, Trevor J Bihl: Chapter 3,4 Sections: 3.1 to 3.6, 4.1 to 4.5

Pre-requisites (Self Learning): Smart grid, optimization techniques

RBT Levels: L1, L2, L3

Module-3: Security Methods for Critical Infrastructure Communications	**8 Hrs**

Security Methods for Critical Infrastructure Communications: Introduction, Effects of Successful Communication System Threats, General Communication System Operations, Industrial Control Networks and Operations, High-Level Communication System Threats, Cyber Threats and Security.

Data - Mining Methods for Electricity Theft Detection: Introduction, Transmission and Distribution System Losses, Electricity Theft Methods, Data Mining and Electricity Theft, Issues and Directions in Electricity Theft-Related Data-Mining Research.

Textbook: Chapter: sections: : Big Data Analytics in Future Power System, Ahmed F Zobaa, Trevor J Bihl: Chapter 5,6 Sections: 5.1 to 5.6, 6.1 to 6.5

Pre-requisites (Self Learning): Communication, Network Operations

RBT Levels: L1, L2, L3

Module-4: Unit Commitment Control of Smart Grids	**8 Hrs**

Unit Commitment Control of Smart Grids: Introduction, Renewable Energy Resources, The Unit Commitment Problem, A Multi-agent Architecture, Illustrative Example.

Textbook: Chapter: sections: : Big Data Analytics in Future Power System, Ahmed F Zobaa, Trevor J Bihl: Chapter 7 Sections: 7.1 to 7.5

Pre-requisites (Self Learning): Renewable Energy Resources.

RBT Levels: L1, L2, L3

Module-5: Transformer Differential Protection Algorithm Based on Data Pattern Recognition	**8 Hrs**

Transformer Differential Protection Algorithm Based on Data Pattern Recognition: Big Data and Power System Protection, Methods for Differential Protection Blocking, Principal Component Analysis, Curvilinear Component Analysis (CCA), PCA Applied to Discriminate Between Inrush and Fault, Currents in Transformers, Application of the CCA as a Base for a Differential Protection, System Under Study, Results.

Textbook: Chapter: sections: Big Data Analytics in Future Power System, Ahmed F Zobaa, Trevor J Bihl: Chapter 8, Sections: 8.1 to 8.8

Pre-requisites (Self Learning): Power system Protection

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Analyse the Comprehensive Role of Big Data in Power Systems
CO2	Apply Big Data Techniques and Analytics in Power Systems
CO3	Evaluate Big Data Integration in Smart Grid Communications and Optimization
CO4	Design Advanced Techniques for Smart Grids and Protection Systems

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	2	2		1			1						1		
CO2	2	2	1	1	1		1						1		
CO3	2	2		1		1	1						1		

CO4	2	2	1	1	1		1						1		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Big Data Analytics in Future Power Systems	Ahmed F. Zobaa and Trevor J. Bihl	First Edition 2019	CRC Press Taylor & Francis Group

VII(b): Reference Books:

1	Big Data Application in Power Systems	Reza Arghandeh, Yuxun Zhou	2nd Edition - July 1, 2024	elsevier

VII(c): Web links and Video Lectures (e-Resources):

https://onlinecourses.swayam2.ac.in/arp20_ap10/preview
https://www.youtube.com/watch?v=PbFxc_W-QDI
https://www.youtube.com/watch?v=n-NOW9CbHU8

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	V	Course Type:	ETC		
Course Title: Battery Management System					
Course Code:	**23EEE532**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Make a comprehensive understanding of Battery Management Systems (BMS) and associated design considerations.
- Make a comprehensive understanding of State of Charge (SOC) estimation & State of health for batteries, covering some estimation methods.
- Provide students with a comprehensive understanding of battery cell balancing techniques, including the causes of imbalance, design considerations and balancing circuits.
- Aims to provide students with a comprehensive understanding of battery capacity measurement techniques, rapid-test methods, state of charge (SOC) estimation, and battery monitoring systems

II. Teaching-Learning Process (General Instructions):

- Chalk & Talk Method
- Presentations/Keynote
- Videos
- Case Studies/ Group Discussion/Blended mode

III. COURSE CONTENT

Module-1: Introduction to Battery Management Systems **8 Hrs**

Definition of battery management system, A general battery management system (BMS), Battery management system parts-power module, battery, DC/AC converter, load, communication channel. Historical overview, Battery systems definitions, battery design, battery characteristics, General operational mechanism of batteries- introduction, basic thermodynamics, kinetic and diffusion overpotentials, double-layer capacitance, battery voltage.

Text Book: Chapter: Section: Battery Management Systems Design by Modelling by Henk. Jan Bergveld Wanda S. Kruijt Peter H.L. Notten: Chapter: 1,2,3: Sections: 1.2 , 2.1 to 2.2.5 , 3.1 to 3.3.5

Pre-requisites (Self Learning): Battery system configurations , design , characteristics and operation mechanism

RBT Levels: L1, L2

Module-2: Battery Management System Requirements **8 Hrs**

Primary Purpose of BMS, Battery pack topology, BMS design Requirements, Battery pack sensing-voltage, temperature, current, Brief explanation on- High voltage contactor control, Isolation sensing, Thermal control. Protection, charger control, communication via CAN bus, Log book function. SOC estimation, energy estimation, battery pack total energy estimation, power estimation, Battery pack power estimation, Diagnostics.

Textbook: Chapter: Section: Battery Management System -Vol II , Gregory L Plett : Chapter:1: Sections: 1.1 to 1.16

Pre-requisites (Self Learning): Basics of Electrical & Electronics Engineering**.**

RBT Levels: L1, L2
Module-3: State-of-the-Art of battery SOC determination & A state of charge indication algorithm. **8 Hrs**
Battery State-of-Charge determination: Introduction, Battery technology and applications. History of state of charge indication, A general state of charge system. Possible state of charge indication methods-direct measurements. **State of charge indication algorithm:** Introduction to the algorithm, Battery measurements and modelling for the State-of-Charge indication algorithm. States of the state of charge algorithm, Main issues of the algorithm. General remarks on the accuracy of SOC indication systems. **Textbook: Chapter: Section: Battery Management Systems- Valer Pop, Henk Jan Bergveld, Peter H.L. Notten : Chapter: 2, 3: Sections: 2.1 to 2.5.3, 3.1 to 3.5**
Pre-requisites (Self Learning): Understanding battery types (e.g., lithium-ion, lead-acid) and their operational mechanisms, characteristics and applications.
RBT Levels: L1, L2
Module-4: Cell Balancing **8 Hrs**
Introduction, causes & not causes of imbalance, Balancer design choices, balance set point, when to balance, how to balance, circuits for balancing- dissipative fixed shunt resistor, switched shunt resistor. Non-dissipative -multiple switched capacitors, one switched capacitor, switched transformer, shared transformer, shared bus. **Textbook: Chapter: Section: Battery Management System -Vol II Gregory L Plett : Chapter:5, Sections: 5.1 to 5.5**
Pre-requisites (Self Learning): Basic circuit analysis
RBT Levels: L1,L2
Module-5: Battery Aging Process & Battery Testing & Diagnostic Instrumentation **8 Hrs**
Battery Aging Process: General aspects of battery aging. EMF measurements as a function of battery aging. Over potential dependence on battery aging, adaptive systems. **Battery Testing and Diagnostic Instrumentation** :Introduction, capacity measurement by discharge, Rapid-Test Methods, State of charge measurements, Battery Monitoring. **Textbook: Chapter: Section: 1.Battery Management Systems-,Valer Pop, Henk Jan Bergveld, Peter H.L. Notten: Chapter: 6, Sections: 6.1 to 6.4.2** **2. Lead Acid Battery Technologies-Joey Jung,Lei Zhang : Chapter: 8 : Section: 8.1 to 8.5**
Pre-requisites (Self Learning) Understanding of battery chemistry, types (particularly lithium-ion, and lead acid) general operating principles.
RBT Levels: L1, L2

IV. COURSE OUTCOMES

CO1	Understand the fundamentals of battery management systems
CO2	Identify and evaluate the key design requirements for a Battery Management System to ensure optimal performance and safety.
CO3	Comprehend the principles and methods for determining battery SOC, including indication systems, algorithms, battery types, mechanisms, and factors affecting SOC accuracy
CO4	Discuss the concept of Cell balancing and aging process.

CO5	Explain the battery testing and diagnostic methods, such as capacity measurement, rapid-test methods, and state of charge measurements.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2	2					1		2	1	
CO2	3	2				2	2	2				1		2	1	
CO3	3	2				3	2	2				1		2	1	
CO4	3	2				3	2	1				1		2	1	
CO5	3	2				3	2	2				1		2	1	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Battery Management Systems Design by Modelling	Henk. Jan Bergveld Wanda S. Kruijt Peter H.L. Notte	1st Edition 2002	SPRINGER-SCIENCE+BUSINESS MEDIA, B.V.
2	Battery Management System-Vol II	Gregory L Plett	1st Edition 2015	Artech House
3	Lead Acid Battery Technologies	Joey Jung,Lei Zhang	1st Edition, 2015	CRC Press

VII(b): Reference Books:

1	Battery Technology Handbook	H.A.Kiehne	2nd Edition, 2003	CRC Press

VII(c): Web links and Video Lectures (e-Resources):

www.coursera.org/learn/battery-management-systems
https://youtu.be/mQ5hJjHlQfo
https://elearn.nptel.ac.in/shop/executive-workshops/execedu-closed/battery-cell-technology-materials-and-industrial-applications/?v=c86ee0d9d7ed

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Industry visit, Self-study activities, GD, miniature projects

Semester:	V	Course Type:	ETC		
Course Title: VLSI Circuits and Design					
Course Code:	**23EEE533**			**Credits:**	**3**
Teaching Hours/Week (L:T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand the fundamental aspects of circuits in silicon
- Relate to VLSI design processes and design rules

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos

III. COURSE CONTENT

Module-1: A Review of Microelectronics and an Introduction to MOS Technology	**08 Hrs**

Introduction: to integrated circuit technology. Introduction, VLSI technologies, MOS transistors, fabrication, thermal aspects.

Basic Electrical Properties of MOS And BICMOS Circuit: Drain to source current Ids versus Vds relationships-BICMOS latch up susceptibility. MOS transistor characteristics, figure of merit, pass transistor NMOS and COMS inverters, circuit model, latch up in CMOS circuits.

Textbook: Chapter: sections: Basic VLSI Design- Douglas A Pucknell and Kamran Eshraghian, Chapter:1,2 sections: 1.1 to 1.9, 2.1, 2.9 to 2.14

Pre-requisites: Electronics Circuits and Digital Logic

RBT Levels: L1, L2

Module-2: MOS and BICMOS Circuit Design Processes & Basic Circuit Concepts	**08 Hrs**

MOS and BICMOS: MOS layers, stick diagrams, design, symbolic diagrams.

Basic Circuit Concepts: Sheet resistance, capacitance layer inverter delays, wiring capacitance, choice of layers

Textbook: Chapter: sections: Basic VLSI Design- Douglas A Pucknell and Kamran Eshraghian, Chapter: 3,4, sections: 3.1 to 3.8, 4.1, 4.2, 4.4 to 4.7,4.9 to 4.11

Pre-requisites: Electronics Circuits and Digital Logic

RBT Levels: L1, L2

Module-3: Scaling of MOS Circuits	**08 Hrs**

Scaling model and scaling factors- Limitations due to current density.

Textbook: Chapter: sections: Basic VLSI Design- Douglas A Pucknell and Kamran Eshraghian, Chapter:5, sections 5.1 to 5.7

Pre-requisites: Electronics Circuits and Digital Logic

RBT Levels: L1, L2, L3

Module-4: Subsystem Design and Layout	**08 Hrs**

Architectural issues, systems considerations. Examples of structural design clocked sequential circuits.

Textbook: Chapter: sections: Basic VLSI Design- Douglas A Pucknell and Kamran Eshraghian, Chapter:6, sections 6.1 to 6.5

Pre-requisites: Electronics Circuits and Digital Logic

RBT Levels: L1, L2, L3

Module-5: Subsystem Design Processes & Illustration of The Design Process	**08 Hrs**

Subsystem Design Processes: General considerations, illustration of design process, observations

Illustration of The Design Process: Observation on the design process, Regularity Design of an ALU subsystem. Design of 4-bit adder, implementation of ALU functions.

Textbook: Chapter: sections: Basic VLSI Design- Douglas A Pucknell and Kamran Eshraghian, Chapter:7,8 sections 7.1, 7.2, 8.1- 8.3

Pre-requisites: Electronics Circuits and Digital Logic

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Identify the CMOS layout levels, and the design layers used in the process sequence.
CO2	Describe the general steps required for processing of CMOS integrated circuits.
CO3	Design static CMOS combinational and sequential logic at the transistor level.
CO4	Demonstrate different logic styles such as complementary CMOS logic, pass-transistor Logic, dynamic logic, etc.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3													2	
CO2	3	3	2												2	
CO3	3	3	2												2	
CO4	3	3	2												2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**

1	Basic VLSI Design	Douglas A Pucknell and Kamran Eshraghian	Third edition 2010	PHI
VII(b): Reference Books:				
1	"CMOS Digital Integrated Circuits, Analysis And Design	Sung – Mo (Steve) Kang, Yusuf Leblebici	3rd Edition, 2003	Tata McGraw Hill
VII(c): Web links and Video Lectures (e-Resources):				
https://youtu.be/ifLNELMfLTA?si=0Ft0Fxk-zPzXQMx8 https://youtu.be/etIVu0vMKMs?si=MthTjCeuB2nRWtjq https://youtu.be/6OZLl689pi0?si=qbhp9voXxYJ4NlCA				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Activities like seminar, assignments, quiz, self-study activities, group discussions, etc				

Semester:	V	Course Type:	ETC		
Course Title: Introduction to Core Java programming					
Course Code:	**23EEE534**		**Credits:**		**03**
Teaching Hours/Week (L: T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- To learn the basics of java concepts and fundamentals of platform independent object-oriented language
- To understand the concept as well as the purpose and usage principles of inheritance, polymorphism, interfaces and packages.
- To develop skills needed for writing programs using exception handling techniques and multithreading.
- To understand basics of I/O, Event Handling and Applets

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method.
- Power point presentation / keynotes
- Videos
- Project based
- Product based

III. COURSE CONTENT

Module-1: Overview of Java **8Hrs**

Introduction, Java World wide web and Beyond, Identifiers, Variables, Assignment Statements and Assignment expressions, Constants, Numeric data types and operations, character Data type and operations

Textbook: Chapter: Sections: 1. Introduction to JAVA Programming by Y. Daniel Liang: Chapter:1 and 2 sections:1.6, 2.1 to 2.10

Pre-requisites (Self Learning): Programming Knowledge in C++ and Basic knowledge in Data Structures.

RBT Levels: L1, L2 and L3

Module-2: Elementary Programming, Classes and Objects **8 Hrs**

Selection and Loops: if and switch statements, conditional expressions, while, do-while, for loop, nested loops, keywords break and continue
Classes and Objects: Introduction, defining a class, Methods declarations, Creating Objects, Accessing class members, Constructors

Textbook: Chapter: Sections: 1. Introduction to JAVA Programming by Y. Daniel Liang Chapter: 3, 4 & 5 sections: 3.1 to 3.3, 4.1 to 4.6 and 5.1 to 5.5 & 5.7
Textbook: Chapter: Sections: 2. Programming with Java, by E Balagurusamy Chapter : 8 sections: 8.1 and 8.10.

Pre-requisites (Self Learning): Programming Knowledge in C++ and Basic knowledge in Data Structures.

RBT Levels: L1, L2 and L3

Module-3: Methods, Arrays and Strings **8Hrs**

Methods: Defining a method, calling a method, void method example, passing parameters by value, overloading methods, static members and Nesting of methods
Arrays and Strings: Introduction, Array basics, one dimensional arrays, creating an array and Basic built in operations on strings

Textbook: Chapter: Sections: 2. Programming with Java, by E Balagurusamy, Chapter: 9 sections: 9.1 and 9.8

Pre-requisites (Self Learning): Programming Knowledge in C++ and Basic knowledge in Data Structures.

RBT Levels: L1, L2 and L3

Module-4: Vectors and Interfaces	**8Hrs**

Vectors: vectors, wrapper classes, Enumerated Types.
Interfaces: Introduction, defining interfaces, Extending Interfaces, implementing interfaces, and Accessing interface variables.

Textbook: Chapter: Sections: 2. Programming with Java, by E Balagurusamy, Chapter: 9,10 sections: 9.1 and 9.8, 10.1 and 10.5

Pre-requisites (Self Learning): Programming Knowledge in C++ and Basic knowledge in Data Structures.

RBT Levels: L1, L2 and L3

Module-5: Packages and Multithreaded Programming	**8Hrs**

Packages: Putting classes together: Introduction, Java API packages, naming conventions, creating packages, Accessing a package.
Multi-threaded Programming: Introduction, creating threads, extending the thread class, stopping and blocking a thread, life cycle of a thread.

Textbook: Chapter: Sections: 2. Programming with Java, by E Balagurusamy, Chapter: 11,12 sections: 11.1 & 11.6, 12.1 and 12.5

Pre-requisites (Self Learning): Programming Knowledge in C++ and Basic knowledge in Data Structures.

RBT Levels: L1, L2 and L3

IV. COURSE OUTCOMES

CO1	Comprehend the concepts of OOP and fundamentals of Java programming by implementing classes and objects for structured program development.
CO2	Demonstrate the importance of interface, methods and strings by implementing modular programming and achieving abstraction in Java applications.
CO3	Use packages and multithreading concepts to develop inter-process communication, ensuring efficient resource sharing in Java applications.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	3	2		1							2			3
CO2	3	3	2		1							2			3
CO3	3	3	2		1							2			3

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Introduction to Java Programming	Y.Daniel Liang	7th Edition, 2009	Pearson Education
2	Programming with Java	E Balagurusamy	6th Edition, 2023	McGraw Hill

VII(b): Reference Books:

1	Java the Complete Reference	Herbert Schildt	12th Edition, 2023	McGraw Hill, Chennai
2	JAVA One step Ahead	Anita Seth and B L Juneja	2017	Oxford University Press
3	Programming with Java	Mahesh Bhave and Sunil Patekar	First Edition, 2008	Pearson Education

VII(c): Web links and Video Lectures (e-Resources):

1. http://www.javatpoint.com/java-tutorial
2. http://www.javatutorialpoint.com/introduction-to-java/
3. http://www.programmingsimplified.com/cpp
4. http://www.stroustrup.com

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical shall be performed by students based on domains, Activities like assignments, quiz, mini projects, self-study activities, Activity Based Learning, Practical Based learning, Project Based learning, Demonstration of simple projects, etc

Semester:	V	Course Type:	AEC		
Course Title: Computer Aided Electrical Drawing					
Course Code:	**23EEAE51**			**Credits:**	**1**
Teaching Hours/Week (L:T:P:O)			**0:0:2:0**	**Total Hours:**	**12 lab Slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Practical**			**Exam Hours:**	**02**

I. Course Objectives: At the end of the course student will be able to

- Understand the usage of CAED tool
- Design and procedure to draw winding of DC machines.
- Discuss the terminology of DC and SLD diagrams

II. PRACTICAL

Sl. No.	Experiments / Programs / Problems
1	Developed Winding Diagrams of D.C. Machines: Simplex single layer armature Lap windings.
2	Developed Winding Diagrams of D.C. Machines: Simplex double layer armature Lap windings.
3	Developed Winding Diagrams of D.C. Machines: Simplex single layer armature Wave windings.
4	Developed Winding Diagrams of D.C. Machines: Simplex double layer armature Wave windings.
5	Draw the single line diagram of generating stations
6	Draw a single line diagram of Substations.
7	Draw a single line diagram of receiving stations.

Instructions for conduction of practical part: All the experiments are conducted using AutoCAD tool

III. COURSE OUTCOMES

CO1	Design and illustrate the procedure to draw armature winding diagrams for DC machines.
CO2	Analyze substation equipment, determine their optimal location in a substation, and develop a layout for the generating station, substation.

IV. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2		3								3	2		
CO2	2	2			3								2	2		

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexture section 4

Continuous Internal Evaluation (CIE): Refer Annexture section 4

Semester End Examination (SEE): Refer Annexture section 4

VI. Learning Resources

VI(A): Reference Books:

Sl. No.	Title of the Book	Name of the	Edition and Year	Name of the

		author		publisher
1	Electrical Drafting	S F Devalapur	2006	Eastern Book Promoters

VI (B): Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=pvKVy-eMDYc
- https://youtu.be/YXLhvA7dMb4?feature=shared
- https://youtu.be/X1TTGjNgyrg?feature=shared
- https://youtu.be/T2y2Wh6wvZI?feature=shared

VII: Activity Based Learning / Practical Based Learning/Experiential learning:

Drawing a winding diagram of DC machines for different designs and drawing SLD for different ratings.

Semester:	V	Course Type:	AEC		
Course Title: Energy Audit Project					
Course Code:	**23EEAE52**			**Credits:**	**01**
Teaching Hours/Week (L: T:P:O)			**0:0:2:0**	**Total Hours:**	**12 Lab slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Practical**			**Exam Hours:**	**02**

I. Course Objectives: At the end of the course student will be able to

- Along with prescribed hours of teaching –learning process, provide opportunity to perform the experiments/programmes at their own time, at their own pace, at any place as per their convenience and repeat any number of times to understand the concept.
- Provide unhindered access to perform whenever the students wish.
- Vary different parameters to study the behaviour of the circuit without the risk of damaging equipment /device or injuring themselves.
- To carryout Energy Audit for an industry, business establishment, organization and its computation using Scilab Software and proposing possible remedial measures to reduce the energy consumption.

II. Teaching-Learning Process (General Instructions):

- Project Based

III. COURSE CONTENT

Instructions for conduction of practical part:
Students can select appropriate projects with the approval of the guide. The projects are application oriented and can be considered any of the following below or any other.

(1) Building and Utility Data Analysis: The main purpose of this step is to evaluate the characteristics of
the energy systems and the patterns of energy use for the premises considered. The premises characteristics can be collected from the architectural/ mechanical/electrical drawings and/or from consultation/discussions with premises operators. The energy use patterns can be obtained from a compilation of utility bills over a period.
(2) Walk-Through Survey: This step should identify potential energy savings measures. The results of this step are important since they determine if the building warrants any further energy auditing work. Some of the tasks involved in this step are • Identify the customer's concerns and needs • Check the current operating and maintenance procedures • Determine the existing operating conditions of major energy use equipment (lighting, HVAC systems, motors, etc.) • Estimate the occupancy, equipment, and lighting (energy
use density and hours of operation).
(3) Baseline for Building Energy Use: The main purpose of this step is to develop a base-case model that represents the existing energy use and operating conditions for the building. This model will be used as a reference to estimate the energy savings due to appropriately selected energy conservation measures.
Evaluation of Energy-Saving Measures: In this step, a list of cost-effective energy conservation measures is determined using both energy savings and economic analysis.

IV. COURSE OUTCOMES

CO1	Analyze the data collected for energy audit of a building or industry or organization.

CO2	Perform comparative analysis with and without energy audit.
CO3	Analyze the energy saving measures to be considered with economy considerations.
CO4	Analyse in a systematic way, think better, and perform better

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1					3		2		3	3	3		3	2		
CO2					3		2		3	3	3		3	2		
CO3					3		2		3	3	3		2			
CO4					3		2		3	3	3		2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE):

Semester End Examination (SEE):

VII: Learning Resources

VII(A): Text Books:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Energy Management Handbook	W.C. Turner,	7th edition	John Wiley, and Sons

VII(B): Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc25_ar10**
- **https://beeindia.gov.in/en/programmes/demand-side-management-programme-dsm**

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical Based Learning

Semester:	V	Course Type:	AEC		
Course Title: Renewable Energy Project					
Course Code:	**23EEAE53**			**Credits:**	**01**
Teaching Hours/Week (L: T:P:O)			**0:0:2:0**	**Total Hours:**	**12 Lab slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Practical**			**Exam Hours:**	**02**

I. Course Objectives: At the end of the course student will be able to

- Along with prescribed hours of teaching –learning process, provide opportunity to perform the experiments/programmes at their own time, at their own pace, at any place as per their convenience
- and repeat any number of times to understand the concept.
- Provide unhindered access to perform whenever the students wish.
- Vary different parameters to study the behaviour of the circuit without the risk of damaging equipment/ device or injuring themselves

II. Teaching-Learning Process (General Instructions):

- Project Based

III. COURSE CONTENT

Instructions for conduction of practical part:

Students can select appropriate projects with the approval of the guide. The projects are application oriented and can be considered any of the following below or any other.

- Automatic solar tracking system.
- Solar based small traffic control system.
- Solar mobile charger.
- Vertical axis wind turbine system.
- Solar powered Smart irrigation system.
- Renewable energy-based home automation system.
- Domestic illumination using solar.
- Solar grass cutter.
- Solar UP

IV. COURSE OUTCOMES

CO1	Analyse in a systematic way, think better, and perform better.
CO2	Develop skills in planning and designing renewable energy projects considering various constraints
CO3	Infer the broader societal and environmental impacts of renewable energy projects, fostering commitment to sustainable practices and community engagement.
CO4	Communicate effectively work as a team member/leader to manage projects and costs in a diversified environment.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2	2	1	2	2	2					3	2		
CO2	3	2	2	2	1	2	2	2					3	2		
CO3	3	2	2	2		2	2	2					2			

CO4								1	3	3	2		2			

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE):

Semester End Examination (SEE):

VII. Learning Resources

VII (A): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Non-conventional Energy Resources	Shobh Nath Singh	1st Edition, 2015.	Pearson
2	Non-conventional Energy Resources	G D Rai	6th Edition, 2017	Khanna publishers

VII(B): Web links and Video Lectures (e-Resources):

- **https://onlinecourses.nptel.ac.in/noc25_ch40**
- **https://archive.nptel.ac.in/courses/115/105/115105127**
- **https://archive.nptel.ac.in/courses/103/103/103103206/**

IX: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical Based Learning

Semester:	V	Course Type:	AEC		
Course Title: OOP with Java Lab					
Course Code:	**23EEAE54**			**Credits:**	**1**
Teaching Hours/Week (L:T:P:O)			**0:0:2:0**	**Total Hours:**	**12 lab Slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**CIE Marks:**	**50**
SEE Type:	**Practical**			**Exam Hours:**	**02**

II. Course Objectives: At the end of the course student will be able to

- Learn primitive constructs of JAVA programming language.
- Understand Object Oriented Programming Features of JAVA.

II.COURSE CONTENT

Sl. No.	Experiments / Programs / Problems
1.	Develop a Java Program to Calculate Simple Interest. Accept User Inputs: Principal Amount, Rate of Interest & Duration (time).
2.	Develop a Java Program to Add two Complex Numbers using a class with real and imaginary components and perform addition using a method.
3.	Develop a Java Program to Check if a given year is a leap year or not using conditional statements.
4.	Write a Java Program to check whether an element is present in an array or not using linear search or binary search (if sorted).
5.	Develop a Java Program for Sorting an Array using any sorting algorithm such as Bubble Sort, Selection Sort, or Arrays.sort().
6.	Develop a Java Program to Demonstrate the use of a class with an instance variable, constructor, and a method to display the values.
7.	Develop a Java Program to Demonstrate Runtime Polymorphism through Method Overriding using the concept of inheritance and overridden methods
8.	Develop a Java Program to Demonstrate Method Overriding in Java using parent and child classes with the same method signature.

III.COURSE OUTCOMES

CO1	Develop simple Java programs using basic input-output operations and arithmetic calculations.
CO2	Implement object-oriented programming concepts like classes, objects, and methods to solve real-world problems.
CO3	Apply decision-making, looping, and search algorithms to solve mathematical and logical problems.
CO4	Demonstrate the concepts of method overloading, method overriding, and polymorphism for efficient program design.

IV.CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3	2		3	1						2			3	
CO2	3	3	2		3	1						2			3	
CO3	3	3	2		3	1						2			3	

CO4	3	3	2		3	1						2			3	

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 4

Continuous Internal Evaluation (CIE): Refer Annexure section 4

Semester End Examination (SEE): Refer Annexure section 4

VI. Learning Resources

VI(A): Textbooks

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Introduction to Java Programming	Y.Daniel Liang	7th Edition, 2009	Pearson Education
2	Programming with Java	E Balagurusamy	6th Edition, 2023	McGraw Hill

VI(B): Reference Books

1	Java the Complete Reference	Herbert Schildt	12th Edition, 2023	McGraw Hill, Chennai
2	JAVA One step Ahead	Anita Seth and B L Juneja	2017	Oxford University Press
3	Programming with Java	Mahesh Bhave and Sunil Patekar	First Edition, 2008	Pearson Education

VI(C): Web links and Video Lectures (e-Resources):

//www.javatpoint.com/java-tutorial
2. http://www.programmingsimplified.com/cpp
3. http://www.stroustrup.com

VII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical Based Learning

|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)
SJB Institute of Technology
BGS Health and Education City, Dr. Vishnuvardhana Road, Kengeri, Bengaluru-560060
Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 – 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)
Department of Electrical and Electronics Engineering
(Accredited by NBA)

VI Semester

Semester:	**VI**	**Course Type:**	**PCC**		
Course Title: **Computer Techniques in Power System Analysis**					
Course Code:	**23EET601**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03 Hours**

I. Course Objectives: At the end of the course student will be able to

- Explain formulation of network models and bus admittance matrix for solving load flow problems
- Solve power flow problem for simple power systems using iterative techniques.
- Study optimal generation scheduling and unit commitment problems for thermal power plants.
- Analyse voltage stability, collapse & prevention measure.
- Understand compensation of line, load, series & shunt compensators in power system.

II. Teaching-Learning Process (General Instructions):

- Chalk and Talk
- PPT presentation & animations

III. COURSE CONTENT

Module-1: Network topology **8 Hrs**

Introduction, Elementary graph theory-oriented graph, tree, co-tree, basic cut-sets, basic loops, formation of incidence matrices (A^ & A only), Primitive network- Impedance form and admittance form, Formation of Y_{Bus} by Inspection Method and Y_{Bus} by Singular Transformation method with and without mutual coupling. Illustrative examples.

Textbook: Chapter: sections: Computer Techniques and Models in Power Systems: Chapter 2 & 3, Sections: 2.1 to 2.6 & 3.2.

Pre-requisites (Self Learning): Matrix operations.

RBT Levels: L1, L2, L3

Module-2: Load Flow studies 1 **8 Hrs**

Introduction, Classification of buses. Power flow equations, Operating Constraints, Gauss-Seidel(GS) iterative method, algorithm of GS method for PQ buses and PV buses included, acceleration of convergence, Illustrative examples.

Textbook: Chapter: sections: Computer Techniques and Models in Power Systems: Chapter: 7, Sections: 7.1 to 7.6.

Pre-requisites (Self Learning): Data for Load flow

RBT Levels: L1, L2, L3

Module-3: Load Flow studies-2	**8 Hrs**

Newton-Raphson(NR) method for load flow in polar coordinates, Algorithm for NR method in polar coordinates, Fast decoupled load flow method, Flow charts of LFS methods. Comparison of Load Flow Methods. Illustrative examples.

Textbook: Chapter: sections: Computer Techniques and Models in Power Systems, Chapter: 7, Sections: 7.7 to 7.11.

Pre-requisites (Self Learning): Decoupled load flow method

RBT Levels: L1, L2, L3

Module-4: Economic Operation of Power System	**8Hrs**

Economic Operation of Power System: Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic dispatch including transmission losses, Derivation of transmission loss formula. Illustrative examples.
Unit Commitment: Introduction, Constraints, unit commitment solution by prior list method and dynamic programming method (Flow chart and Algorithm only).

Textbook: Chapter: sections: Computer Techniques and Models in Power Systems, Chapter :8, Sections: 8.1 to 8.7.

Pre-requisites (Self Learning): Economic generation scheduling including generator limits and neglecting losses.

RBT Levels: L1, L2, L3

Module-5: Voltage Stability & Compensation in power system	**8 Hrs**

Voltage Stability: Introduction, Voltage stability, voltage collapse, reactive power flow and voltage collapse, mathematical formulation of voltage stability problem, prevention of voltage collapse.
Compensation in power system: Introduction, loading capability, load compensation, line compensation, series compensation & shunt compensators.

Textbook: Chapter: sections: Modern Power System Analysis, Chapter:15 & 17, Sections 15.1 to 15.6, 17.1 to 17.7

Pre-requisites (Self Learning): voltage stability state-of-the art, future trends and challenges.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Formulate network matrices for solving load flow problems.
CO2	Perform load flow studies using iterative techniques.
CO3	Solve economic load dispatch and unit commitment problems.
CO4	Analyse voltage stability & understand the compensation in power system.

V. CO-PO-PSOMAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3		2									3			
CO2	3	3	2	2									3			
CO3	3	3	2	2		2	2				3		3	2		

CO4	3	3	2	2		2							3			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexture section 1

Continuous Internal Evaluation (CIE): Refer Annexture section 1

Semester End Examination (SEE): Refer Annexture section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Computer Techniques and Models in Power Systems	K Uma Rao	2nd Edition, 2014	IK international publishing house
2	Modern Power System Analysis	D P Kothari and I J Nagrath	4th Edition, 2012	Tata McGraw Hill Publications

VII(b): Reference Books:

1	Elements of Power System Analysis	William D. Stevenson	4th Edition	McGraw Hill Publications
2	Power System Analysis	Hadi Sadat	3rd Edition	Tata McGraw Hill Publications
3	Computer Methods in Power System Analysis	Stagg & El-Abiad	2019	Medtech scientific international

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/@eeedepartment4878

https://onlinecourses.nptel.ac.in/ noc20_ee88/course

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminars, case studies, practical base activities.

Semester:	VI	Course Type:	IPCC		
Course Title: Control Systems					
Course Code:	**23EEI602**			**Credits:**	**04**
Teaching Hours/Week (L:T:P:O)			**3:0:2:0**	**Total Hours:**	**40(Theory)+ 12(Lab Slots)**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course the student will be able to

- Discuss the effects of feedback and types of feedback control systems and demonstrate the knowledge of mathematical modelling of control systems and components
- Determine transient and steady state time response of a simple control system and Discuss stability analysis using Root locus
- Investigate the performance of a given system in time and frequency domains and Discuss stability analysis using Bode plots and Nyquist plots
- Determine the controller or compensator configuration and parameter values relative to how it is connected to the controlled process given the design specifications.
- Determine the relation between state space and Transfer Function.

II. Teaching-Learning Process (General Instructions):

- Chalk & Talk Method,
- Presentations/Keynote
- Videos
- Case Studies/ Group Discussion

III. COURSE CONTENT

III(a). Theory PART

Module-1: Mathematical modelling of control systems **8 Hrs**

Open loop and Closed loop systems, Benefits of feedback, Transfer function models of linear time invariant systems, Mathematical models of electrical, mechanical and electromechanical systems.

Block diagram reduction, signal flow graphs using Mason gain formula.

Textbook: Chapter: sections: 1. Control Systems by Anand Kumar: Chapter: 1,2,3 sections:1.1 to 1.4, 2.1 to 2.9, 3.1 to 3.2.
2. Control Systems by M. Gopal: Chapter:1,3 Sections: 1.1 to 1.5, 3.1 to 3.4.

Pre-requisites (Self Learning) : Concepts of Differentiation, Integration and Basic Knowledge of control systems

RBT Levels: L1, L2, L3

Module-2: Time domain analysis and stability **8 Hrs**

Test Signals, Steady state errors, Time response of First order and second order systems- Dominant pole approximation of higher order systems, Concept of Stability and Characteristic equation, Routh Hurwitz criteria- Root-locus construction and interpretation, closed loop analysis using root locus.

Textbook: Chapter: sections: 1. Control Systems by Anand Kumar: Chapter: 4,5,6 sections:4.1 to 4.8, 5.1 to 5.7, 6.1 to 6.5.
2. Control Systems by M. Gopal: Chapter: 2,5,7 sections:2.1 to 2.9, 5.1 to 5.5,7.1 to 7.5

Pre-requisites (Self Learning): Concept of stability, Graphical Representations, Linear

equations.
RBT Levels: L1, L2, L3
Module-3: Frequency-domain analysis **8 Hrs**
Frequency responses and Frequency domain specifications, Bode plot, Nyquist stability criterion-Gain and phase margin. **Textbook: Chapter: sections: Control Systems by Anand Kumar: Chapter: 7, 8 sections:7.1 to 7.9, 8.1 to 8.8**
Pre-requisites (Self Learning) : Concepts of Frequency analysis, Order of systems, Graphical representation of Frequency domain.
RBT Levels: L1, L2, L3
Module-4: Compensation **8 Hrs**
Types of compensators, characteristics and effects of lead, lag, lag-lead compensators and P, PI and PID controllers. Servomotors and its applications. **Textbook: Chapter: sections: Control Systems by Anand Kumar: Chapter: 4, 9 sections: 4.9, 9.1 to 9.5**
Pre-requisites (Self Learning) : Bode plot, Root Locus , Poles and Zeros Placement.
RBT Levels: L1, L2, L3
Module-5: State Variable Analysis **8 Hrs**
Relation between state space and transfer functions, canonical forms, solution of state equation, Eigen values and stability analysis, Controllability and Observability. **Textbook: Chapter: sections: Control Systems by Anand Kumar: Chapter: 10 sections: 10.1 to 10.11**
Pre-requisites (Self Learning): Linear Equations solving, Mesh analysis, Matrix.
RBT Levels: L1, L2, L3

III(b). PRACTICAL PART

Sl. No.	Experiments
1	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor
2	Experiment to determine frequency response of a second order system
3	To design a passive RC lead compensating network and Lag compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response.
4	To design a passive Lag compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response.
5	Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function.
6	(a) To simulate a typical second order system and determine step response and evaluate time response specifications. (b) To evaluate the effect of additional poles and zeros on time response of second order system. (c) To evaluate the effect of pole location on stability

	(d) To evaluate the effect of loop gain of a negative feedback system on stability.
7	To simulate a second order system and study the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.
8	Comparative study of Bode, Nyquist and root locus with respect to stability.
Additional Experiments	
1	(a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response (b) To study the effect of open loop gain on transient response of closed loop system using root locus.
2	(a) To study the effect of open loop poles and zeros on root locus contour (b) To estimate the effect of open loop gain on the transient response of closed loop system using root locus.

Instructions for conduction of practical part: Experiments 7 to 11 must be done using MATLAB/SCILAB only.

IV. COURSE OUTCOMES

CO1	Understand the principles of open-loop and closed-loop control systems, the role of feedback, and their representation using block diagram algebra and signal flow graphs.
CO2	Evaluate the performance of the system using time-domain analysis and explore methods to enhance it.
CO3	Analyse the system performance using frequency domain analysis and techniques for improving the performance.
CO4	Interpret various controllers and compensators to improve system performance.
CO5	Realize the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1										2	2	3	
CO2	3	2	1		3								2	2	3	
CO3	3	3	2		3								2	2	3	
CO4	3	3	2		3								2	2	3	
CO5	3	2	2										2	2	3	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 2

Continuous Internal Evaluation (CIE): Refer Annexure section 2

Semester End Examination (SEE): Refer Annexure section 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Control Systems	Anand Kumar	2nd Edition, 2014	PHI
2	Control Systems, Principles and	M. Gopal	4th Edition, 2012	McGaw Hill

	Design			
3	Modern Control Systems	Richard C Dorf et al	11th Edition, 2008	Pearson
VII(b): Reference Books:				
1	Control Systems Engineering	Norman S. Nise	4th Edition, 2004	Wiley
2	Control Systems Engineering	S. Salivahanan et al	1st Edition, 2015	Pearson
VII(c): Web links and Video Lectures (e-Resources):				
• NPTEL :: Engineering Design - NOC:Control systems (NPTEL Link) • Control engineering - Course (nptel.ac.in) • (62) EEE, SJBIT - YouTube				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
• Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc				

Semester:	VI	Course Type:	PCCL		
Course Title: Power System Simulation Lab					
Course Code:	**23EEL603**			**Credits:**	**01**
Teaching Hours/Week (L:T:P:O)			**0:0:2:0**	**Total Hours:**	**12 Lab slots**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Practical**			**Exam Hours:**	**03**

III. Course Objectives: At the end of the course student will be able to write a program in MATLAB/ use MiPower software package to

- Explain the use of suitable standard software package for power system analysis.
- Explain formulation of bus admittance matrix for solving load flow problems.
- Obtain the power-angle characteristics of a synchronous machine and evaluate transient stability of single machine connected to infinite bus.
- Solve load flow problem for simple power systems.
- Perform fault studies for simple power systems.
- Solve unit commitment and optimal generation scheduling problems for thermal power plants.

II.COURSE CONTENT

Sl. No.	Experiments / Programs / Problems
1.	Determination of power angle diagrams, reluctance power, excitation emf and regulation for salient and non-salient pole synchronous machines
2.	Formation of Y_{bus} by inspection method (network without mutual coupling).
3.	Formation of Y_{bus} by singular transformation method with and without mutual coupling.
4.	Calculate bus currents, bus power, line flows & losses for a power system network with specified System Voltage.
5.	Evaluate transient stability of single machine connected to infinite bus.
6.	Conduct Load flow analysis using Gauss-Seidel method for a power system network with both PQ and PV buses.
7.	Conduct Load flow analysis using Newton-Raphson method and Fast decoupled flow method for a given power system network.
8.	Determination of fault currents and voltages in a single transmission line for Three phase Fault for a given power system network.
9.	Determination of fault currents, voltages and fault MVA in a single transmission line for i) Single Line to Ground Fault. ii) Line to Line Fault iii) Double Line to Ground Fault
10.	Determine Optimal Generation Scheduling for Thermal power plants.
	Additional Experiments
1	Generate unit commitment schedule for a system with three units using priority listing method. (priority based on least cost)
2	Formation of Jacobian matrix in polar coordinates, for a system having less than 4 buses.

Instructions for conduction of practical part: Experiment 1 to 5 are to be performed using

MATLAB software, Experiment 6 to 10 are to be performed using MiPower software package. (Additional Experiments are performed in MATLAB software).

III.COURSE OUTCOMES

CO1	Develop a MATLAB program to obtain the power angle characteristics of Synchronous machine and Evaluate transient stability.
CO2	Develop a MATLAB program to Formulate Y-bus matrices and calculate bus current, bus power and line flows.
CO3	Conduct fault analysis and solve problems on Load flow and Optimal generation scheduling using suitable software package.

IV.CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3		2	3				3	3			3		2	
CO2	3	3		2	3				3	3			3		2	
CO3	3	3	3	2	3	2	2		3	3	3		3			

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexture section 4

Continuous Internal Evaluation (CIE): Refer Annexture section 4

Semester End Examination (SEE): Refer Annexture section 4

VI. Learning Resources

VI(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Computer Techniques in Power System Analysis	J. Duncan Glover, Thomas Overbye	7th Edition, 2024	Cengage Learning
2	Modern Power System Analysis	D P Kothari and I J Nagrath	4th Edition, 2012	Tata McGraw Hill Publications

VI(b): Reference Books:

1	Power System Analysis	Hadi Sadat	3rd Edition	Tata McGraw Hill Publications

Web links and Video Lectures (e-Resources):

https://www.youtube.com/@eeedepartment4878

VII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conducting case studies on different faults, LFA methods.

Semester:	**VI**	**Course Type:**	**PEC**		
Course Title: Drives & Traction					
Course Code:	**23EEP621**			**Credits:**	**3**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**3 Hours**

I. Course Objectives: At the end of the course student will be able to

- Define electric drive, its parts, advantages and explain choice of electric drive.
- Select motor power ratings and control of DC motor using rectifiers.
- Analyse the performance of induction motor drives under different conditions.
- Understand in detail concepts of electrical heating & welding
- Comprehend the mechanics and energy consumption in electric traction systems:
- Evaluate motors used in electric traction and braking systems:

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit
- Peer presentation and learning

III. COURSE CONTENT

Module-1: Direct Current Motor Drives **8 Hrs**

Electrical Drives: Introduction, Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and ac Drives.

Direct Current Motor Drives:

Controlled Rectifier Fed DC Drives, Single Phase Fully Controlled Rectifier Control of DC Separately Excited Motor, Single Phase Half Controlled Rectifier Control of DC Separately Excited Motor, Three Phase Half Controlled Rectifier Control of DC Separately Excited Motor, Chopper Control of Separately Excited DC Motor,

Textbook: Chapter: sections: Fundamentals of Electrical drives by G K Dubey: Chapter 1 and 5: Section 1.1 to 1.8, 5.9 to 5.20

Pre-requisites (Self Learning): Fundamentals of Power System & Motors

RBT Levels: L1, L2

Module-2: Induction Motor Drives **8 Hrs**

Induction Motor Drives: Analysis and Performance of Three Phase Induction Motors, Starting, Braking, speed control, Variable Frequency Control from a Current Source, Voltage Source Inverter (VSI) Control, Current Source (CSI) Control, speed control of single-phase induction motors, starting methods & types of single-phase Induction Motors.

Textbook: Chapter: sections: Fundamentals of Electrical drives by G K Dubey: Chapter 6: Sections: 6.1,6.5,6.6,6.8,6.11,6.12,6.13,6.17,6.24.

Pre-requisites (Self Learning): Basics of converters & types

RBT Levels: L1, L2	
Module-3: Electric Heating & Welding	**8 Hrs**
Induction Heating: High frequency power source for induction heating, requirements, merits & applications Dielectric heating: Theory and principle, Properties of dielectric material, electrodes and its coupling methods, thermal losses, applications. **Electric Welding**: Classification, Sequence of operations, interval triggering and gating circuit, interval time counter, weld power circuit; resistance, spot, arc type welding, Energy storage welding system, Switch-Mode welding. **Textbook: Chapter: sections: Generation and utilization of Electrical energy by S. Siva Nagaraju: Chapter 4, 5 Section: 4.1 to 5.13.**	
Pre-requisites (Self Learning): Energy storage devices & dielectric materials	
RBT Levels: L1, L2, L3	
Module-4: Electric Traction	**8 Hrs**
Electric Traction Speed - Time Curves and Mechanics of Train Movement: Introduction, Systems of Traction, Systems of electric Traction, Speed - Time Curves for Train Movement, Mechanics of Train Movement, Train Resistance, Adhesive Weight, Coefficient of Adhesion, Specific Energy Consumption. Numerical. **Trams, Trolley Buses and Diesel – Electric Traction:** Tramways, The Trolley – Bus, DieselElectric Traction. **Textbook: Chapter: sections: Generation and utilization of Electrical energy by S. Sivanagaraju: Chapter 9: Section: 9.1 to 9.12.**	
Pre-requisites (Self Learning): Basics of tractions & its mechanics	
RBT Levels: L1, L2	
Module-5: Motors for Electric Traction and Braking system	**8 Hrs**
Motors for Electric traction: Introduction, Series and Shunt Motors for Traction Services, AC Series Motor, Three Phase Induction Motor and Linear Induction motor. System of track electrification, Electrical and Mechanical features of traction motors. **Braking:** Introduction, Regenerative Braking with Three Phase Induction Motors, Braking with Single Phase Series Motors, Mechanical braking, Magnetic Track Brake, Electro – Mechanical Drum Brakes. **Textbook: Chapter: section: Generation and utilization of Electrical energy by S. Sivanagaraju: Chapter 10: Section: 10.1 to 10.10**	
Pre-requisites (Self Learning): Basic Knowledge of DC motor and Induction motors.	
RBT Levels: L1, L2	

IV. COURSE OUTCOMES

CO1	Explain the components, advantages, and control techniques of DC motor drives, including rectifier-fed and chopper-controlled systems.
CO2	Analyze speed control, starting, braking, and inverter-based control of single-phase and three-phase induction motors.
CO3	Apply principles of electric heating and welding, including induction heating, dielectric heating, and various welding techniques.

CO4	Analyze electric traction systems, mechanics of train movement, and energy consumption in trams, trolley buses, and diesel-electric traction systems.
CO5	Evaluate motors used in electric traction and braking systems, emphasizing their mechanical features and braking mechanisms.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	2			1								3	2	
CO2	3	2			2								3	2	
CO3	3	2	3		1							1	3	2	
CO4	3	2		2								1	3	2	
CO5	3	2		1	1							1	3	2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Fundamentals of Electrical Drives	Gopal K Dubey	2nd Edition, 2011	Narosa.
2	Utilization of Electric Power & Electric Traction	J.B. Gupta	10th Edition, 2012	S.K. Kataria & Sons.
3.	Generation and utilizationof Electrical energy	S Sivanagaraju	1st Edition, 2010	Pearson.

VII(b): Reference Books:

1	Electric Motor & Drives: Modeling, Analysis and Control	R.Krishnan	2nd edition,2001	Tata McGraw Hill
2	Modern Electric Traction	H. Partab	3rd Edition, 2017	Dhanpat Rai & Co.

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.
https://nptel.ac.in/courses/108/104/108104140/#
https://www.youtube.com/watch?v=KgVFJnmJvKk&list=PLLy_2iUCG87D59-Bc8Jqfqt43LvPC0KgC
https://www.youtube.com/watch?v=mf_lKoXVRQo&list=PLLy_2iUCG87D59-Bc8Jqfqt43LvPC0KgC&index=6
https://www.youtube.com/watch?v=8Aqc44PG4Ws&list=PLLy_2iUCG87D59-Bc8Jqfqt43LvPC0KgC&index=19
www.irieen.com (Indian Railways Institute of Electrical Engineering, Nasik Road)
www.wr.railnet.gov.in/bctweb/ELECTRICAL.htm

www.scrailway.gov.in
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:
Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	PEC		
Course Title: Energy Storage System					
Course Code:	**23EEP622**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Explain fundamental principles of electricity and the significance of electrical energy storage (EES) in modern power systems.
- Identify and compare various energy storage technologies, including pumped hydro, batteries, and flywheels, along with their applications.
- Learn the modeling and control approaches for energy storage systems, focusing on grid-side and storage-side converters.
- Analyze current applications of energy storage in utility operations, consumer settings, and emerging technologies like smart grids and electric vehicles.
- Investigate future developments in energy storage, including innovative materials, recycling methods, and the potential of non-electrochemical storage.

II. Teaching-Learning Process (General Instructions):

- Chak and Talk
- Keynote presentation
- You tube videos

IV.COURSE CONTENT

Module-1: Introduction to Energy Storage System	**8 Hrs**

Characteristics of electricity, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable, Emerging needs for EES and the roles of electrical energy storage technologies, The Energy Problem, Increasing Population and Energy Consumption, The Greenhouse Effect, Energy Portability, The Purposes of Energy Storage, Types of Energy Storage , Sources of Energy.

Textbook: Chapter: Sections: The Electrical Energy Storage by IEC Market Strategy Board and new approach, Chapter: 1, Sections: 1.1 to 1.4

Pre-requisites (Self Learning): Basic understanding of electrical concepts and power systems.

RBT Levels: L1 and L2

Module-2: Energy Storage Technologies	**8 Hrs**

Pumped Hydroelectric Storage (PHS), Compressed Air Energy Storage (CAES), Conventional Batteries (Lead–Acid Batteries, Nickel–Cadmium Batteries, Sodium–Sulfur Batteries, Lithium-Based Batteries) and Flow Batteries(The Vanadium Redox Battery, The Zinc–Bromine Battery and The Polysulfide–Bromide Flow Battery), The Hydrogen-Based Energy Storage System (HESS), The Flywheel Energy Storage System (FESS), Superconducting Magnetic Energy Storage (SMES), The Supercapacitor Energy Storage System,

Text book: Chapter: Sections: Energy Storage In Power Systems, Chapter: 4 Sections: 4.2.1 to 4.2.7

Pre-requisites (Self Learning): Basic knowledge of energy storage systems and electrical engineering concepts.

RBT Levels: L1, L2 and L3

Module-3: Modelling and Control of Storage Technologies	**8 Hrs**

A General Approach Orientated to Simulation Objectives, The Modelling and Control of the Grid-Side Converter, The Modelling and Control of Storage-Side Converters and Storage Containers.

Textbook: Chapter: Sections: Energy Storage In Power Systems, Chapter: 6, Sections: 6.1 to 6.4

Pre-requisites (Self Learning): Basic knowledge of energy storage systems and electrical engineering concepts.

RBT Levels: L1, L2 and L3

Module-4: Applications of storage systems	**8 Hrs**

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.

Textbook: Chapter: Section: The Electrical Energy Storage by IEC Market Strategy Board, Chapter: 3 Sections: 3.1 to 3.3

Pre-requisites (Self Learning) Basic understanding of power systems, energy storage, and renewable energy technologies

RBT Levels: **L1 and L2**

Module-5: Future Trends	**8 Hrs**

Future of Energy Storage, Flexible and Stretchable Energy Storage Devices, Self-Charging Energy Storage Devices, Recovering Wasted Energy, Recycling Energy Storage Devices, New Chemistry for Electrochemical Cells, Non-Electrochemical Energy Storage, Concentration Cells, Pros and Cons of Concentration Cells, Future Performance and Limitations.

Text book: Chapter: Section: Energy Storage New Approach, Chapter: 12, Sections: 12.1 to 12.8

Pre-requisites (Self Learning): Fundamental knowledge of energy storage technologies and electrochemical principles.

RBT Levels: L1 and L2

V.COURSE OUTCOMES

CO1	Explain electricity characteristics and the role of electrical energy storage.
CO2	Classify and compare energy storage technologies on batteries and advanced systems.
CO3	Understand energy storage technologies and their control mechanisms.
CO4	Identify energy storage applications in utilities, smart technologies in electric vehicles.
CO5	Interpret emerging trends, recently developed devices, and recovery methods in energy storage.

V.CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2	2						2	2		
CO2	3	2	3			2	2						2	2		
CO3	3	3	3			2	2						2	2		
CO4	3	2				2	2						2	2		
CO5	3	2				2	2						2	2		

VII.Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VIII.**Learning Resources**

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	The Electrical Energy Storage	IEC Market Strategy Board	2011	IEC White Paper
2	Energy Storage in Power Systems	Francisco Díaz González, Andreas Sumper, Oriol Gomis Bellmunt	2016	Wiley
3	Energy Storage	Ralph Zito and Haleh Ardebili	2nd Edition, 2019	Wiley

VII(b): Reference Books:

1	Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report	Jim Eyer, Garth Corey	Feb 2010	Sandia National Laboratories
2	Energy Storage Benefits and Market Analysis	James M. Eyer, Joseph J. Iannucci and Garth P. Corey	2004	Sandia National Laboratories

VII(c): Web links and Video Lectures (e-Resources):

- https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118991978.hces212
- https://www.pewtrusts.org/~/media/.../energy_storage-backs_up_power_supply.pdf
- https://energy.mit.edu/wp-content/uploads/2018/04/Energy-Storage-for-the-Grid.pdf
- nptel.ac.in/courses/112105221/56
- nptel.ac.in/courses/108108036/9
- https://nptel.ac.in/courses/108102047/7

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Case Study, Assignments, Quiz, Mini projects and Industrial visits

Semester:	VI	Course Type:	PEC		
Course Title: Embedded Systems					
Course Code:	23EEP623			**Credits:**	3
Teaching Hours/Week (L: T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- To understand the concepts of Embedded system design such as ROM variants, RAM, SOC
- To learn the technological aspects of Embedded system such as signal conditioning, Sample & Hold.
- To understand the design trade-offs.
- To study about the software aspects of Embedded system.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos

III. COURSE CONTENT

III(a). Theory PART

Module-1: Concept of Embedded System Design	**8 Hrs**

Components, classification, skills required. Processor Embedded in a system, Embedded Hardware Units, Embedded Software in a system, Embedded Memories ROM variants, RAM, Examples of Embedded System, Design Process and Design examples.

Textbook: Chapter: sections: Embedded Systems- Architecture, Programming and Design by Raj Kamal: Chapter 1: Sections: 1.1.1,1.1.2,1.11,1.12,1.2, 1.3, 1.3.5, 1.4, 1.5, 1.10

Pre-requisites (Self Learning): Hardware Components, Memories

RBT Levels: L1, L2

Module-2: Technological Aspects of Embedded System	**8 Hrs**

Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, Sample & hold, multiplexer interface Internal ADC interfacing (excluding 6805 & 6812). Data Acquisition System and Signal conditioning using DSP

Textbook: Chapter: sections: Embedded Microcomputer systems: Real time interfacing by Valvano J.W, Chapter 11, Sections: 11.1 to 11.7

Pre-requisites (Self Learning): Analog to Digital Converters, Digital to Analog Converters

RBT Levels: L1, L2

Module-3: Design Trade Offs Due to Process Incompatibility, Thermal Considerations	**8 Hrs**

Issues in embedded system design. Design challenge, Embedded processor technology, IC Technology(refer Textbook 1), design technology, trade-offs. Challenges in Embedded system design: Optimizing design metrics (refer Textbook 2), Thermal considerations.

Textbook: Chapter: sections:

1) **Embedded System Design: A Unified Hardware/ Software Approach by Frank Vahid and Tony Givargis, Chapter 1, Sections: 1.1 to 1.6**
2) **Embedded Systems- Architecture, Programming and Design by Raj Kamal, Chapter 1, sections: 1.8.3**
3) **Resources.system-analysis.cadence.com/blog/msa2020/sideline/thermal-challenges-embedded-system**

Pre-requisites (Self Learning): Design challenges

RBT Levels: L1, L2

Module-4: Interrupts and Survey of Software Architectures	**8 Hrs**

Multi process and threads in an application, Task, Task states, shared data problem, protect shared data, Intern process communication, semaphore communication, Round Robin, Round Robin with interrupts, function queue-scheduling architecture, Real Time Operating Systems,

Textbook: Chapter: sections: An Embedded Software Primer, David E Simon, Chapter: 4, section 4.1 to 4.4, Chapter 5, sections: 5.5 to 5.5, Chapter 6, sections: 6.1 to 6.3

Pre-requisites (Self Learning):
Task, semaphore, operating system

RBT Levels: L1, L2

Module-5: Subsystem interfacing	**8 Hrs**

Serial I/O devices, Parallel port interfaces, Serial Communication devices, Parallel device ports Input switches, Key boards and Memory interfacing.

Textbook: Chapter: sections: Embedded Systems- Architecture, Programming and Design by Raj Kamal, Chapter 3, sections: 3.1 to 3.10

Pre-requisites (Self Learning): Input and out devices, memory mapping

RBT Levels: L1, L2

IV. COURSE OUTCOMES

CO1	Understand about the components and interfaces of embedded systems
CO2	Enumerate about trade-offs and challenges of embedded systems
CO3	Apply software aspects and programming to design embedded systems

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3													2	
CO2	3	3	1									1			2	
CO3	3	3	1												2	

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Embedded Systems-Architecture, Programming and Design	Raj Kamal	Fourth Edition, 2020	Tata McGraw Hill
2	Embedded Microcomputer systems: Real time interfacing	Jonathan W. Valvano	Second Edition, 2014	Thomson-Engineering Publishers

VII(b): Reference Books:

1	Embedded System Design: A Unified Hardware/ Software Approach	Frank Vahid and Tony Givargis	Third Edition, 2009	John Willey and Sons
2	An Embedded Software Primer,	David E Simon	Twelfth Edition, 2005	Pearson Education

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.
1. nptel.ac.in/courses/108102045
2. archieve.nptel.ac.in/courses/106/105/106105193

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	PEC		
Course Title: Smart Grid					
Course Code:	23EEP624			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- To understand the basic concept of smart grid, attributes, over view of the perfect power system configuration of Smart Grid
- To know about DC power delivering systems, data centres and information technology loads
- To educate the importance of Technology Alternatives in smart Grid
- To understand the Dynamic energy systems in Smart Grid
- To describe the overview of Demand side planning and evaluation.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos

III. COURSE CONTENT

Module-1: Smart Grid to Evolve a Perfect Power System **8 Hrs**

Introduction: Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, attributes of the smart grid.

Smart Grid to Evolve a Perfect Power System: Introduction, overview of the perfect power system configurations, device level power system, building integrated power systems, distributed power systems, fully integrated power system.

Textbook: Chapter: sections: The Smart Grid, Enabling Energy Efficiency and Demand Side Response by Clark W Gellings, Chapter 1,4, Sections: NA, pages: 1 to 23, Pages 77 to 88

Pre-requisites (Self Learning): Power System, Electric transportation

RBT Levels: L1, L2

Module-2: DC Distribution & Intelligrid Architecture for the Smart Grid **8 Hrs**

DC Distribution and Smart Grid: AC Vs. DC sources, benefits of and drives of DC power delivery systems, powering equipment and appliances with DC, data centers and information technology loads, potential future work and research

Intelligrid Architecture for the Smart Grid: Introduction, launching intelligrid, intelligrid today, smart grid vision based on the intelligrid architecture, Barriers to achieve this vision, enabling technologies.

Textbook: Chapter: sections: The Smart Grid, Enabling Energy Efficiency and Demand Side Response by Clark W Gellings, Chapter: 5,6 Sections: NA, pages: 93 to 109, pages: 113 to 128

Pre-requisites (Self Learning): Distribution System, Data centres

RBT Levels: L1, L2	
Module-3: Dynamic Energy Systems Concept	**8 Hrs**
Smart energy efficient end use devices, smart distributed energy resources, advanced whole building control systems, integrated communications architecture, energy management, role of technology in demand response, current limitations to dynamic energy management, distributed energy resources, overview of a dynamic energy management, key characteristics of smart devices, key characteristics of advanced whole building control systems, key characteristics of dynamic energy management system **Textbook: Chapter: sections: The Smart Grid, Enabling Energy Efficiency and Demand Side Response by Clark W Gellings, Chapter 7, Sections: NA Pages: 131 to 151**	
Pre-requisites (Self Learning): Energy Management, demand response	
RBT Levels: L1, L2	
Module-4: Efficient Electric End Use Technology Alternatives	**8 Hrs**
Existing technologies ,lighting, space conditioning, indoor air quality, domestic water heating, hyper efficient appliances, ductless residential heat pumps and air conditioners, variable refrigerant flow air conditioning, heat pump water heating, hyper efficient residential appliances, data center energy efficiency, LED street and area lighting, industrial motors and drives, equipment retrofit and replacement, process heating, cogeneration, thermal energy storage, industrial energy management programs, manufacturing process, electro -technologies, residential, commercial and industrial sectors. **Textbook: Chapter: sections: The Smart Grid, Enabling Energy Efficiency and Demand Side Response by Clark W Gellings: Chapter 11, Sections: NA, Pages: 221 to 242**	
Pre-requisites (Self Learning): Energy efficient, Different electrical loads	
RBT Levels: L1, L2	
Module-5: Demand side planning & Evaluation	**8 Hrs**
Demand side planning: Introduction, Selecting Alternatives, Issues Critical to the Demand-side Issues Critical to the Demand-side, The Utility Planning Process, Demand-side Activities, Alternatives that Are Most Beneficial. **Demand-Side Evaluation:** Levels of Analysis. General Information Requirements, Context, Transferability, Data Requirement, Cost/Benefit Analysis, Program Interaction. **Textbook: Chapter: sections: The Smart Grid, Enabling Energy Efficiency and Demand Side Response by Clark W Gellings: Chapter 12,13, Sections: NA, Pages: 245 to 258 & Pages: 259 to 286**	
Pre-requisites (Self Learning): Demand Side response, Cost/Benefit Analysis	
RBT Levels: L1, L2	

IV. COURSE OUTCOMES

CO1	Explain the concept of Smart electricity grid , benefits and drivers of DC power delivery system, Intelligrid architecture for the smart grid.
CO2	Describe the smart energy efficient electric end-use devices for whole building control system, dynamic energy management system, electro -technologies.
CO3	Discuss demand side planning and evaluation methods.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											3			

CO2	3	2											3			
CO3	3	2	2										3			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	The Smart Grid, Enabling Energy Efficiency and Demand Side Response	Clark W Gellings	3rd Edition, 2013	CRC Press,
2	Smart Grid :Fundamentals of Design and Analysis	James Momoh	First Edition, 2012	Wiley IEEE Press

VII(b): Reference Books:

1	Smart Grid :Technology and Applications	Janaka Ekanayake et al	First Edition, 2012	Wiley

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.
https://onlinecourses.nptel.ac.in/noc23_ee60/preview
https://onlinecourses.nptel.ac.in/noc21_ee68/preview
https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee42/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	OEC		
Course Title: Alternate Energy Sources					
Course Code:	23EEO611			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives: At the end of the course student will be able to

- To Apply the knowledge of basic concepts of DC machines and AC machines analogy
- To discuss the substation equipment, their location in a substation and development of a layout for substation.
- To explain development of sectional views of Transformers, DC machine and alternators using the design data, sketches.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Animations

III. COURSE CONTENT

Module-1: Introduction **8 Hrs**

Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.
Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications"

Textbook: Chapter: sections: Nonconventional Energy Resources ShobhNath Singh: Chapter 1 & 2, Sections: 1.5 to 1.7, 2.1 to 2.5

Pre-requisites (Self Learning): Renewable energy resources

RBT Levels: L1, L2, L3

Module-2: Solar Thermal Energy, Solar Cells **8 Hrs**

Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.
Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems.

Textbook: Chapter: sections: Nonconventional Energy Resources ShobhNath Singh: Chapter:3 & 4, Sections: 3.1 to 3.5, 3.8 to 3.10, 3.12 to 3.17, 4.1 to 4.8

Pre-requisites (Self Learning): Solar energy

RBT Levels: L1, L2	
Module-3: Hydrogen Energy, Geothermal Energy & Solid Waste	**8 Hrs**
Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy. **Geothermal Energy:** Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects. **Solid waste and Agricultural Refuse:** Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics**.** **Textbook: Chapter: sections: Nonconventional Energy Resources ShobhNath Singh: Chapter 5, 6, 7 & 8, Sections: 5.1 to 5.8, 6.1 to 6.5, 7.1 to 7.7, 8.1 to 8.6**	
Pre-requisites (Self Learning): Basic knowledge of Nonconventional Energy	
RBT Levels: L1, L2	
Module-4: Biogas Energy & Tidal Energy	**8 Hrs**
Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics. **Tidal Energy:** Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy. **Textbook: Chapter: sections: Nonconventional Energy Resources ShobhNath Singh: Chapter 9, 10, & 11, Sections: 9.1 to 9.14, 10.1 to 10.7, 11.1 to 11.10**	
Pre-requisites (Self Learning): Basic knowledge of Nonconventional Energy	
RBT Levels: L1, L2	
Module-5: Sea Wave Energy & Ocean Thermal Energy	**8 Hrs**
Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power. **Ocean Thermal Energy:** Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC. **Textbook: Chapter: sections: Nonconventional Energy Resources ShobhNath Singh: Chapter 12 & 13, Sections: 12.1 to 12.7, 13.1 to 13.8**	
Pre-requisites (Self Learning): Basic knowledge of Nonconventional Energy	
RBT Levels: L1, L2	

IV. COURSE OUTCOMES

CO1	Discuss causes of energy scarcity and it's solution, energy resources and availability of renewable energy.
CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, it's characteristics and their applications.

CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO5	Discuss and summarize production of energy from biomass, biogas, tidal energy resources, sea wave energy and ocean thermal energy.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3					3	3									
CO2	3	2				2	2									
CO3	3					2	2									
CO4	3					3	3									
CO5	3					3	3									

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Nonconventional Energy Resources	ShobhNath Singh	1st Edition, 2015	Pearson

VII(b): Reference Books:

1	Nonconventional Energy Resources	B.H. Khan	3rd Edition,	McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/@eeedepartment4878
https://nptel.ac.in/courses/103103206
https://archive.nptel.ac.in/courses/103/107/103107157/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	OEC		
Course Title: Fundamentals of Electric Vehicles					
Course Code:	**23EEO612**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand the importance of Electric vehicles and its advantage to user and environment.
- Know different components and subsystems of vehicles.
- Select and design the battery/energy storage subsystem.
- Design and analyse the power electronic converter to suit the application.
- Develop vehicle propulsion subsystem for EV

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit
- Peer presentation and learning

III. COURSE CONTENT

Module-1: Electric Vehicles Basics **8Hrs**

National Policy for adoption of EVs, EV scenario in India (Review only, no question to be asked)

History, Basics of Electric Vehicles, Components of Electric Vehicle, General Layout of EV, EV classification: Battery Electric Vehicles (BEVs), Hybrid EVs, Fuel-Cell Electric Vehicles (FCEVs), Advantages & Disadvantages of EV, Roadway fundamentals, Laws of motion.

Textbook: Chapter: sections: Electric & Hybrid Vehicles – Design Fundamentals, Iqbal Hussain, Chapter 1, 2, Sections: 1.1 to 1.9 and 2.1, 2.2, and 2.4

Pre-requisites (Self Learning): Laws of forces, Relation between Force- energy-power, IC engine vehicle working-basics, Disadvantages of convention vehicles

RBT Levels: L1, L2

Module-2: Energy Sources for EVs & HEVs **8Hrs**

Power and Energy management strategies and its general architecture of EV and HV, various battery sources, energy storage, battery-based energy storage and simplified models of battery, Battery Management Systems (BMS), fuel cells working, Super capacitor & Ultra capacitor-based energy storage, Compressed air storage, Selection of the energy storage technology

Textbook: Chapter: sections: Electric & Hybrid Vehicles – Design Fundamentals, Iqbal Hussain, Chapter 4 & 5, Sections: 4.1,4.2, 4.4, 4.5, 4.6, 5.1, 5.2, 5.4

Pre-requisites (Self Learning): Battery Parameters, working of flywheel

RBT Levels: L1, L2, L3

Module-3: Electronics and Safety in EVs.	**8Hrs**
Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self-drive Cars. **Textbook: Chapter: sections: Electric & Hybrid Vehicles – Design Fundamentals, Iqbal Hussain, Chapter: 7 & 8, Sections: 7.1 to 7.3 & 8.1 to 8.5**	
Pre-requisites (Self Learning): Energy and power concepts, working of Power electronic devises. Basic amplifier and chopper circuits	
RBT Levels: L1, L2, L3	
Module-4: Electric Propulsion Subsystem (Motors)	**8Hrs**
Various types of motors, selection and size of motors, Induction motor drives and control characteristics, Permanent magnet motor drives and characteristics, Brushed & Brushless DC motor drive and characteristics. **Textbook: Chapter: sections: Electric & Hybrid Vehicles – Design Fundamentals, Iqbal Hussain, Chapter: 6, Sections 6.1 to 6.6**	
Pre-requisites (Self Learning): Types and Working of AC and DC motors	
RBT Levels: L1, L2, L3	
Module-5: Battery Charging- infrastructure and converters	**8Hrs**
Type of Charging station, Components of charging station. Charging methods for battery, Termination methods, charging from grid, High-frequency transformer based isolated charger topology, Transformer less topology. **Textbook: Chapter: sections: 1. Electric & Hybrid Vehicles – Design Fundamentals, Iqbal Hussain, Chapter: 13, Sections: 13.1 to 13.3** **2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals- Mehrdad Ehsani, Yimin Gao, Ali Emadi, Chapter:10, Sections 10.1 to 10.11**	
Pre-requisites (Self Learning): Single line diagram, Power electronic converters, Control Circuit.	
RBT Levels: L1, L2, L3	

IV. COURSE OUTCOMES

CO1	Understand types of EV and utilize the concepts of kinetics, dynamics, performance parameters and characteristics of vehicles.
CO2	Analyse the different energy sources and battery charging methods and its infrastructure.
CO3	Discuss the role of power electronics & safety in EVs.
CO4	Explain the construction and working principle of various motors used in electric vehicles.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1									1				
CO2	3	2	2									1				
CO3	3	2	2									1				
CO4	3	2	1									1				

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Electric & Hybrid Vehicles – Design Fundamentals	Iqbal Hussain	Second Edition,2011	CRC Press

VII(b): Reference Books:

1	Electric Vehicle Technology Explained	James Larminie	First Edition,2003	John Wiley & Sons
2	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals	Mehrdad Ehsani, Yimin Gao, Ali Emadi	Second Edition,2010	CRC Press
3	Electric Vehicle Battery Systems	Sandeep Dhameja	First Edition ,2000	Newnes

VII(c): Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/108103009/
- https://nptel.ac.in/courses/108/102/108102121/
- https://studio.youtube.com/channel/UCI-KMtxELJrCs-D3lW1hEBA/videos/upload?filter=%5B%5D&sort=%7B%22columnType%22%3A%22date%22%2C%22sortOrder%22%3A%22DESCENDING%22%7D

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	OEC		
Course Title: Micro & Nano electronics					
Course Code:	**23EEO613**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Understand Lithography and Photolithography Fundamentals
- Explore Etching and Deposition Techniques
- Apply Fabrication Concepts to Silicon and Practical Applications
- Understand Nanoelectronics and Quantum Mechanics
- Master Quantum Mechanics and Its Applications

II. Teaching-Learning Process (General Instructions):

- Chalk & Talk Method,
- Presentations/Keynote
- Videos
- Case Studies/ Group Discussion/Blended mode

III. COURSE CONTENT

Module-1: Lithography	**8Hrs**

Introduction, Historical Note: Lithography's Origins, Photolithography Overview Critical Dimension, Overall Resolution, Line-Width, Lithographic Sensitivity and Intrinsic Resist Sensitivity (Photochemical Quantum Efficiency), Resist Profiles, Contrast and Experimental Determination of Lithographic Sensitivity Resolution in Photolithography Photolithography Resolution Enhancement Technology.

Textbook: Chapter; Sections: Fundamentals of microfabrication the science of miniaturisation ,Marc J Madou ,2nd edition, Chapter: 1, Sections: NA, Pages: 1- 41

Pre-requisites (Self Learning) : Basics of Physics, Resolution, sensitivity.

RBT Levels: L1, L2

Module 2: Dry Etching Technology	**8Hrs**

Introduction, Dry Etching: Definitions and Jargon, Plasmas or Discharges Physical Etching: Ion Etching or Sputtering and Ion-Beam Milling, Plasma Etching (Radical Etching) Physical/Chemical Etching.

Textbook: Chapter: Sections: Fundamentals of microfabrication the science of miniaturisation, Marc J Madou, 2nd edition, Chapter: 2, Sections: NA, Pages: 77- 101

Pre-requisites (Self Learning): Basics of Physics, Chemistry for fabrication.

RBT Levels: L1, L2

Module 3: Additive Technology	**8Hrs**

Introduction, Silicon Growth, Doping of Si, Oxidation of Silicon, Physical Vapor Deposition , Chemical Vapor Deposition, Silk-Screening or Screen-Printing , Sol-Gel Deposition Technique , Doctors' Blade or Tape Casting, Plasma Spraying, Deposition and Arraying Methods of Organic Layers in BIOMEMS, Thin versus Thick Film Deposition , Selection Criteria for Deposition Method.

Textbook: Chapter: Sections: Fundamentals of microfabrication the science of miniaturisation ,Marc J Madou 2nd edition, Chapter: 3, Sections:NA, Pages: 123- 170

Pre-requisites (Self Learning): semiconductor Physics, chemistry, micro electro mechanical systems(MEMS).

RBT Levels: L1, L2

Module-4: Fundamental of nanoscopic physics	**8Hrs**

Introduction to nano electronics- Top and bottom down approach, Why nano electronics, nano technology potential.
Classical particles, classical waves and quantum particles – comparison of classical and quantum systems, origin of quantum mechanics, Light as a wave and as a particle. Electrons as particles and waves. Wave packets and uncertainty.

Textbook: Chapter: Sections: Fundamentals of Nano electronics, George W. Hanson : Chapter: 1 ,2 Sections:1.1-1.6 & 2.1 -2.7

Pre-requisites (Self Learning): Basic Physics, electromagnetics.

RBT Levels: L1, L2 and L3

Module-5: Quantum mechanics of Electrons	**8Hrs**

General postulates of quantum mechanics- operators, Eigen values and Eigen functions, Hermitian operators, Operators of quantum mechanics, Measurements probability. Time dependent Schrodinger Equation. Analogies between quantum mechanics and classical electro magnetics. Probabilistic current density, multiple particle systems, spin and angular momentum.

Textbook: Chapter: Section: Fundamentals of Nano electronics, George W. Hanson, Chapter:3, sections: 3.1-3.6

Pre-requisites (Self Learning): Basic Physics, electromagnetics, mathematics and wave functions

RBT Levels: L1,L2, and L3

IV. COURSE OUTCOMES

CO1	Understand the fundamentals of lithographic processes, including resolution, line-width control, sensitivity, and enhancement technologies
CO2	Comprehend dry etching concepts like plasmas, ion etching, sputtering, and hybrid methods, and master silicon growth, doping, and oxidation processes
CO3	Compare deposition methods, thin vs. thick films, and use lithography, etching, and silicon fabrication for MEMS and semiconductors
CO4	Demonstrate an understanding of nanoelectronics concepts, quantum mechanics principles, and their applications in modern technology.
CO5	Apply quantum mechanics concepts to analyse multiple particle systems, spin, angular momentum, and current density in nanoelectronics systems

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				1						1				

CO2	3	2				1										
CO3	3	2				1										
CO4	3	2				1										
CO5	3	2										1				

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Fundamentals of microfabrication the science of miniaturisation	Marc J Madou	2nd edition, 2002	CRC Press
2	Fundamentals of Nano electronics	George W. Hanson	1st edition, 2008	Pearson

VII(b): Reference Books:

1	Nanoelectronics Materials, Devices, Application	Robert Puers, Livio Baldi, Marcel Van de Voorde, and Sebastiaan E. van Nooten	1st Edition , Volume 1, 2017	Wiley
2	Nanoelectronics Fundamentals Materials, Devices and System	Hassan Raza	1st Edition, 2019	Springer

VII(c): Web links and Video Lectures (e-Resources):

https://youtu.be/lW0QMvmeVGs

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Industry visit, Self-study activities, GD, miniature projects

Semester:	VI	Course Type:	OEC		
Course Title: Energy conservation and Audit					
Course Code:	**23EEO614**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:0**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course student will be able to

- Learn about different energy sources and why they are important.
- Understand ways to make electrical systems more energy efficient.
- Discuss how energy audits help find ways to save energy.
- Learn simple ways to save energy in buildings.
- Understand how demand-side management can reduce energy use and support sustainability.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk
- Power point presentation
- You tube videos

III. COURSE CONTENT

Module-1: Energy Scenario	**8 Hrs**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Textbook: Chapter: Sections: Guidebooks for National Certification Examination for Energy Manager Energy Auditors Book-1 General Aspects, Chapter: 01 & 02, Sections: 1.1 to 1.15 & 2.2

Pre-requisites (Self Learning): Basic understanding of energy types, environmental impact, and the importance of energy conservation

RBT Levels: L1 and L2

Module-2: Energy Efficiency in Electrical Systems	**8 Hrs**

Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, energy efficient motors, soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Electronic ballast, Energy efficient lighting and measures of energy efficiency in lighting system.

Textbook: Chapter: Section: Energy Efficiency in Electrical Systems, Chapter: 10, Sections: 10.1 to 10.8

Pre-requisites (Self Learning): Familiarity with basic electrical concepts, including power, load management, and common electrical components like transformers and motors.

RBT Levels: L1, L2 and L3

Module-3: Energy Efficiency in Industrial Systems	**8 Hrs**

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC.
Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Textbook: Chapter: sections: Guide books for National Certification Examination for Energy Manager Energy Auditors Book-3 General Aspects, Chapter: 3,5, Sections: 3.2 to 3.7, 5.2, 5.3,5.5, and 5.7

Pre-requisites (Self Learning) Fundamentals related to Fluid mechanics, compressors, HVAC efficiency

RBT Levels: **L1 and L2**

Module-4: Energy auditing	**8 Hrs**

Definition, energy audit, need, types of energy audit and approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.
Textbook: Chapter: Sections: Guide books for National Certification Examination for Energy Manager Energy Auditors Book-1 General Aspects, Chapter: 4, Sections: 4.1 to 4.12

Pre-requisites (Self Learning) Familiarity with basic electrical concepts, including power, load management, and common electrical components like transformers and motors.

RBT Levels: L1, L2 and L3

Module-5: Energy conservation in buildings	**8 Hrs**

Introduction, Energy conservation building codes, ECBC guidelines on service hot water, lightning, and electric power. Building UPS and energy management systems, Energy efficiency measure in building, commercial and industrial buildings, barriers in adopting energy efficiency in residential buildings.

Textbook: Chapter: Section Energy Efficiency in Electrical Utilities Book 03 & Energy management conservation and audit, Chapter: 9,10, Sections: 9.4, 9.5, 9.7, 10.1, 10.3, 10.7 to 10.9, 10.11 & 10.13

Pre-requisites (Self Learning) Basic understanding of energy demand, conservation methods,

RBT Levels: L1 and L2

IV. COURSE OUTCOMES

CO1	Understand the energy scenario, policies, and conservation importance.
CO2	Interpret electrical systems for energy efficiency, including transformers, motors, and lighting systems.
CO3	Explain energy conservation techniques and efficiency measures in residential, commercial, and industrial buildings.
CO4	Apply energy auditing methods to optimize energy conservation.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2				2	2									
CO2	3	2				2	2									
CO3	3	2				2	2									
CO4	3	2	2			2	2									
CO5	3	2				2	2									

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Guide books for National Certification Examination for Energy Manager Energy Auditors-1& 3	Bureau of energy efficiency	4th Edition 2015	Bureau of energy efficiency
2	Generation of Electrical Energy	By Gupta B.R.	7th Edition, 2017	S Chand

VII(b): Reference Books:

1	Energy Management	W.R. Murphy &G. Mckey Butterworths	2007	New Age International Publisher
2	Handbook on Energy Audit and Management,	Amit kumar Tyagi	--	TERI (Tata Energy Research Institute
3	Energy conversion systems,	Rakosh Das Begamudre,	10th Edition 2000	New Age International Publishers
4	Energy Management Conservation and Audits	Anil Kumar Om Prakash Prashant Singh Chauhan Samsher	First edition, 2020	CRC Press

VII(c): Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108/106/108106139
2. https://nptel.ac.in/courses/108/103/108103140
3. https://nptel.ac.in/courses/108/105/108105138
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Case Study, Assignments, Quiz, Mini projects and Industrial visits

Semester:	VI	Course Type:	ETC		
Course Title: Artificial Intelligence in Power System					
Course Code:	**23EEE641**			**Credits:**	**03**
Teaching Hours/Week (L: T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course, students will be able to

- Provide insight into fundamentals of Artificial Intelligence Techniques to the students.
- Understand the knowledge system types and its uses.
- Analyse the uses of expert system and its applications
- Learn different AI languages and their applications
- Convey application of Artificial Intelligence techniques in power system.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Field Visit
- Peer presentation and learning

III. COURSE CONTENT

Module-1: Introduction to Artificial Intelligence	**8Hrs**

What is AI? Definitions, history and evolution, essential abilities of intelligence, AI applications; Problem solving: problem characteristics, problem search strategies, forward and backward reasoning, AND-OR graphs, game trees, search methods- informed and uninformed search, breadth first search and depth first search methods.

Textbook: Chapter: sections: Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson: Chapter 1, Section 1.1 to 1.5

Pre-requisites (Self Learning): Basics of Artificial Intelligence, Search techniques in AI.

RBT Levels: L1, L2

Module-2: Knowledge representation	**8Hrs**

Definition and importance of knowledge, knowledge-based systems, representation of knowledge, Knowledge organisation, Knowledge manipulation, acquisition of knowledge.

Textbook: Chapter: sections: Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson: Chapter 2, Section 2.1 to 2.8

Pre-requisites (Self Learning): Importance of Knowledge Systems

RBT Levels: L1, L2, L3

Module-3: Formalized Symbolic Logics	**8Hrs**

Introduction, Syntax and semantics for proposition logic, conversion to clausal forms, Inference rules, The resolution principle.

Textbook: Chapter: sections: Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson: Chapter 4, Section 4.1 to 4.8

Pre-requisites (Self Learning): Logical Thinking.

RBT Levels: L1, L2, L3

Module-4: Expert systems	**8Hrs**

Basic components, forward and backward chaining, ES features, ES development, ES categories, ES tools and examples from electric drive systems.

Textbook: Chapter: sections :1. Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson: Chapter 15, Section 15.1 to 15.7
2. https://www.mdpi.com/books/reprint/5264-ai-applications-to-power-systems

Pre-requisites (Self Learning): Expert System basics.

RBT Levels: L1, L2, L3

Module-5: AI languages	**8Hrs**

LisP and ProLog - Introduction, sample segments, LisP primitives, list manipulation functions, function predicates, variables, iteration and recursion, property lists, sample programs for examples from electric power systems.

Textbook: Chapter: sections: 1. Introduction to Artificial Intelligence and Expert Systems: Dan W Patterson: Chapter 3, Section 3.1 to 3.9
2. https://www.mdpi.com/books/reprint/5264-ai-applications-to-power-systems

Pre-requisites (Self Learning): AI Languages

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Explain and apply fundamental techniques of Artificial Intelligence.
CO2	Develop a clear understanding of different types of knowledge systems & expert system.
CO3	Analyse and evaluate the uses of expert systems.
CO4	Gain proficiency in AI programming languages.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1									1	1	2		
CO2	3	2	2									1	1	3		
CO3	3	2	2									1	1	3		
CO4	3	2	2									1	1	3		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Introduction to Artificial Intelligence and Expert Systems	D.W.Patterson	2009	PHI
VII(b): Reference Books:				
1	Artificial Intelligence	Rich, Elaine, Kevin Knight	3rd Edition, 2008.	TMH
VII(c): Web links and Video Lectures (e-Resources):				
• https://onlinecourses.nptel.ac.in/noc22_cs56/preview • https://onlinecourses.nptel.ac.in/noc24_cs88/preview				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc				

Semester:	VI	Course Type:	ETC		
Course Title: EV Battery Charging Methods & Topologies					
Course Code:	23EEE642			**Credits:**	3
Teaching Hours/Week (L: T:P:O)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3 Hours

I. Course Objectives: At the end of the course student will be able to

- Learn the fundamentals of Battery storage system and its necessity.
- To understand the importance and necessity of BMS for EVs and HEVs.
- Develop a deep understanding of EV Charging Standards & Infrastructure requirement.
- Ability to analyze different fast charging techniques used for electric vehicle application.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- Power point presentation / keynotes
- Videos
- Self-Paced courses using MATLAB software.

III. COURSE CONTENT

Module-1: Energy Storage for EV and HEV	**8 Hrs**

Energy Storage for EV and HEV: Introduction, definition of Cell, Batteries, Battery packs, Battery Basics, Classification of Batteries, Batteries used for EV and HEVs, Lead-acid (Pb-acid), Lithium-ion (Li-ion) batteries, Battery Parameters, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation.

Textbook: Chapter: sections: Electric and Hybrid Electric vehicles Design Fundamentals by Iqbal Husain, Chapter 3, sections: 3.1 to 3.7.

Pre-requisites (Self Learning): Engineering Chemistry, Basic Electrical Engineering

RBT Levels: L1, L2

Module-2: Battery Management System (BMS)	**8 Hrs**

Battery Management System (BMS): BMS Definition, Functionality, CCCV Chargers, Regulators, Meters, Monitors, Balancers, Protectors, Functionality Comparison, Technology, Simple (Analog), Sophisticated (Digital), Technology Comparison, Topology, Centralized, Modular Master-Slave, Distributed, Topology Comparison. BMS Functions: Measurement of Voltage, current, temperature

Textbook: Chapter: sections: Battery Management Systems for Large Lithium-Ion Battery Packs by Davide Andrea, chapter 2 & 3, sections: 2.1 to 2.3, 3.1.

Pre-requisites (Self Learning): Engineering Chemistry, Basic Electrical Engineering and Basic Electronics.

RBT Levels: L1, L2, L3

Module-3: Charging, Standards & Infrastructure	**8 Hrs**

Charging, Standards & Infrastructure: Introduction, Infrastructure, charging time, cost, standardization, charging methods, charging models, communication system, EU System, charging plugs, Vehicle to grid technology, Tesla power wall.
Introduction to wireless power transfer, Stationary WPT, Dynamic WPT, Solar charging case study.

Textbook: Chapter: sections: Electric and Hybrid Electric Vehicle by Tom Denton, Chapter:7, Sections: 7.1 to 7.3

Pre-requisites (Self-Learning): Engineering Chemistry, Basic Electrical Engineering and Basic Electronics.

RBT Levels: L1, L2, L3

Module-4: Electric vehicle Battery Fast Charging	**8 Hrs**

Electric vehicle Battery Fast Charging: Introduction to On-board & off-board charging, The Fast-Charging Process, Fast Charging Strategies, The Fast Charger Configuration, Using Equalizing/Leveling Chargers, Inductive Charging—Making Recharging Easier, Range Testing of Electric Vehicles Using Fast Charging, Electric Vehicle Speedometer Calibration.

Textbook: Chapter: sections: Electric vehicle battery systems by Sandeep Dhameja: Chapter: 5, sections: NA, Page No.: 95 to 114.

Pre-requisites (Self Learning): Engineering Chemistry, Basic Electrical Engineering.

RBT Levels: L1, L2, L3

Module-5: Electric vehicle Battery Performance	**8 Hrs**

Electric vehicle Battery Performance: The Battery Performance Management System, BPMS Thermal Management System, The BPMS Charging Control, High-Voltage Cabling and Disconnects, Safety in Battery Design, Battery Pack Safety— Electrolyte Spillage and Electric Shock, Charging Technology, Electrical Insulation Breakdown Detection, Electrical Vehicle Component Tests, Building Standards, Ventilation

Textbook: Chapter: sections: Electric vehicle battery systems by Sandeep Dhameja, Chapter: 7, sections: NA, Page No: 133 to 159.

Pre-requisites (Self Learning): Engineering Chemistry, Basic Electrical Engineering and Basic Electronics.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Discuss the basics of battery, working principle, types and the selection of storage devices for EV and HEV applications.
CO2	Understand the fundamentals and importance of BMS for EV and HEVs.
CO3	Discuss the necessity and importance of Safe charging, standards and infrastructure.
CO4	Discuss and Analyze the EV battery performance, thermal management and charging techniques.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	1				1	2					1		2	2
CO2	3	1				1	2					1		2	2

CO3	3	2				1	2					1		2	2
CO4	3	2				1	2					1		2	2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure Section 1

Continuous Internal Evaluation (CIE): Refer Annexure Section 1

Semester End Examination (SEE): Refer Annexure Section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Electric and Hybrid Electric vehicles Design Fundamentals	Iqbal Husain	2003-T&F E-book	CRC Press
2	Electric vehicle battery systems	Sandeep Dhameja,	2002	Newnes Publishing, 2002
3	Battery Management Systems for Large Lithium-Ion Battery Packs.	Davide Andrea.	1st 2010	Artech House 2010.
4	Electric and Hybrid Electric vehicles	Tom Dentom	1st 2016	Taylor & Francis
VII(b): Reference Books:				
1	Battery Management Systems Design by Modelling	Henk. Jan Bergveld Wanda S. Kruijt Peter H.L. Notte	2002	Springer-Science Business Media.

VII(c): Web links and Video Lectures (e-Resources):

1. www.coursera.org/learn/battery-management-systems
2. https://www.youtube.com/watch?v=81b75GLyJzo

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	VI	Course Type:	ETC		
Course Title: Electronics Circuits using Verilog					
Course Code:	**23EEE643**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course, Students will be able to

- Introduce students to the basics of Verilog HDL, including its evolution, syntax, and modeling techniques for digital circuit design.
- Enable students to design and implement digital circuits using different modeling styles such as gate-level, dataflow, and behavioral modeling.
- Teach students to interpret time and delay simulations, use Verilog constructs for verification, and apply testbenches for functional validation.
- Equip students with the knowledge to perform logic synthesis, understand its impact on circuit optimization, and verify synthesized gate-level designs.
- Foster hands-on learning through simulation tools, coding exercises, and project-based applications to reinforce Verilog HDL design principles.

II. Teaching-Learning Process (General Instructions):

Chalk and talk, PPT presentations, field visits, video lectures.

III. COURSE CONTENT

Module-1: Overview of Digital Design with Verilog HDL **8 Hrs**

Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL, trends in HDLs.
Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block.

Textbook: Chapter: sections: Verilog HDL: A Guide to Digital Design and Synthesis: Samir Palnitkar, Chapter1 and 2, sections 1.1 to 1.6, 2.1 to 2.8

Pre-requisites (Self Learning): A working knowledge of Verilog

RBT Levels: L1, L2, L3

Module-2: Basic Concepts **8 Hrs**

Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives.
Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing.

Textbook:Chapter:sections: Verilog HDL: A Guide to Digital Design and Synthesis:Samir Palnitkar, Chapter 3 and 4, sections: 3.1 to 3.5, 4.1 to 4.8

Pre-requisites (Self Learning): The ability to navigate a file system and use a text editor

RBT Levels: L1, L2, L3

Module-3: Gate-Level Modeling **8 Hrs**

Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays.
Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types.

Textbook: Chapter: sections: Verilog HDL: A Guide to Digital Design and Synthesis: Samir Palnitkar, Chapter 5 and 6, sections: 5.1 to 5.6, 6.1 to 6.8

Pre-requisites (Self Learning): A basic understanding of digital hardware design and verification

RBT Levels: L1, L2, L3

Module-4: Behavioral Modeling	**8 Hrs**

Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.
Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions.

Textbook: Chapter: sections: Verilog HDL: A Guide to Digital Design and Synthesis: Samir Palnitkar, Chapter 7 and 8, sections: 7.1 to 7.10, section 8.1 to 8.9

Pre-requisites (Self Learning): A basic understanding of digital hardware design and verification

RBT Levels: L1, L2, L3

Module-5: Useful Modeling Techniques	**8 Hrs**

Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks.
Logic Synthesis with Verilog: Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow, Verification of Gate-Level Netlist.

Textbook: Chapter: sections: Verilog HDL: A Guide to Digital Design and Synthesis: Samir Palnitkar, Chapter 9 and 10, sections: 9.1 to 9.8, 10.1 to 10.8

Pre-requisites (Self Learning): A basic understanding of digital hardware design and verification.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

CO1	Understand and explain different Verilog and HDL constructs
CO2	Analyze different level of obstruction in Verilog
CO3	Interpret time and delay simulation.
CO4	Determine Logical synthesis and its impact in verification

V. CO-PO-PSOMAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2	2								2			3	
CO2	3	2	2	2								2			3	
CO3	3	3	2	2								2			3	
CO4	3	3	2	2								2			3	

VI. Assessment Details (CIE & SEE)

General Rules: Refer appendix section 1

Continuous Internal Evaluation (CIE): Refer appendix section 1

Semester End Examination (SEE): Refer appendix section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Samir Palnitkar	"Verilog HDL: A Guide to Digital Design and Synthesis",	Second Edition.	Pearson Education,

VII(b): Reference Books:

1	Donald E. Thomas, Philip R	'The Verilog Hardware Description Language",	Fifth edition.	Moorby, Springer Science Business Media, LLC,
2	Michael D. Ciletti,	"Advanced Digital Design with the Verilog HDL"	Second edition.	Pearson (Prentice Hall),

VII(c): Web links and Video Lectures (e-Resources):

https://www.youtube.com/@eeedepartment4878
Digital Design with Verilog - Course
NPTEL: Hardware Modelling using Verilog [Full Course] - YouTube

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Seminars, assignments, quiz, industry visits, Project Based

Semester:	VI	Course Type:	ETC		
Course Title: IOT & its Applications					
Course Code:	**23EEE644**			**Credits:**	**03**
Teaching Hours/Week (L:T:P:O)			**3:0:0:@**	**Total Hours:**	**40**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Theory**			**Exam Hours:**	**03**

I. Course Objectives: At the end of the course, students will be able to

- Understand the concepts of Internet of Things and able to build IoT applications
- To Understand the vision of IoT from a global context

II. Teaching- Learning Process (General Instructions):

- Chalk and talk method.
- Power point presentation/keynotes
- Videos
- Project based

III.COURSE CONTENT

Module-1: Introduction to Internet of Things (IoT) **8Hrs**

What is IoT? IoT terms and Basic definitions, Disambiguation of IoT vs IoE vs M2M vs others, Characteristics of IoT, IoT Ecosystem: what is an IoT Ecosystem? Enabling Technologies if IoT: Sensors, Edge devices, Embedded systems, Communications, Wireless sensor Networks, Communications, Wireless sensor Networks, cloud computing, Digital Twin, Big data analytics. Applications of IoT, Vision of IoT

Textbook: Chapter: Sections: Internet of Things by Srinivasa K G and Siddesh G M: Chapter 1, Sections: 1.1: 1.1.1 to 1.1.4, 1.2: 1.2.1 to 1.2.5

Pre-requisites (Self Learning): Basic knowledge in Programming.

RBT Levels: L1, L2

Module-2: IoT Network Architecture **8Hrs**

Level 1 Physical Devices and Controllers, Level 2: Connectivity, Communication model in IoT, Protocols in IoT, Communication APIs for IoT, Level 3 Edge (Fog) computing, Level 4 Data Accumulation. Level 5 Data Abstraction, Level 6 Application, Level 7 Collaboration and Processes, Security in the IoT

Textbook: Chapter: Sections: Internet of Things by Srinivasa K G and Siddesh G M, Chapter: 1, sections:1.3: 1.3.1 to 1.3.8

Pre-requisites (Self Learning): Basics of Computer Networking

RBT Levels: L1, L2 and L3

Module-3: Transducers, Sensors and Actuators **8Hrs**

Introduction to Transducers: Workflow of Transducer in a system, Classification of Transducers
Introduction to Sensors: Workflow of a Sensor in a typical system, Classification of Sensors: Analog Sensors, Digital Sensors, Comparison between Analog signal and Digital signal Sampling DAC and ADC conversion: Digital to Analog converters (DAC), Analog to Digital Converters (ADC), Types of Sensors
Introduction to Actuators: Classification of Actuators, Examples

Textbook: Chapter: Sections: Internet of Things by Srinivasa K G and Siddesh G M, Chapter:

2, sections: 2.1 to 2.4
Pre-requisites (Self Learning): Basic Knowledge of Sensors and Transducers
RBT Levels: L1, L2
Module-4: Wireless Sensor Networks and their Technologies **8Hrs**
Wireless Sensor Networks and its Technologies: History of WSN, Architecture of WSN, Network topologies in Wireless sensor Networks, Issues and challenges of WSN, Security in WSN, Participating Wireless Sensing Technologies, Bluetooth, Case studies of Blue tooth applications, Wi- Fi, Zigbee, Case studies of Zigbee Applications **Textbook: Chapter: Sections: Internet of Things by Srinivasa K G and Siddesh G M, Chapter :2, sections: 2.6.1 to 2.6.6**
Pre-requisites (Self Learning): Programming Knowledge in networking Domain
RBT Levels: L1, L2 and L3
Module-5: Application Building with IoT **8Hrs**
Various applications of IoT: Introduction, Home automation, Smart Cities, Environment, Retail, Logistics, Agriculture, Health and Lifestyle **IoT Laboratory**: Pedestrians light + interactive pushbutton, Temperature and LCD Display, use a piezo-electric buzzer to make buzzing sound **Textbook: Chapter: Sections: Internet of Things by Srinivasa K G and Siddesh G M, Chapter: 4, sections: 4.1 to 4.8**
Pre-requisites (Self Learning): Basics of Computer Networking
RBT Levels: L1, L2 and L3

IV.COURSE OUTCOMES

CO1	Discuss the various IoT protocols with detailing of their elements and overall functioning within IoT systems for efficient communication.
CO2	Demonstrate the architecture and functioning of IoT systems including Transducers, sensors and Actuators
CO3	Study of basic IoT applications on Wireless Sensor Technologies
CO4	Understand the benefits of IoT technologies for automating the various real-life challenges in various application areas.

V.CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3
CO1	3	3				1						1			3
CO2	3	3				2						1			3
CO3	3	3				2						1			3
CO4	3	3				2	2					1			3

VI. Assessment Details (CIE &SEE)

General Rules: Refer Annexure section 1

Continuous Internal Evaluation (CIE): Refer Annexure section 1

Semester End Examination (SEE): Refer Annexure section 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Internet of Things	Srinivasa K G and Siddesh G M	2017	Centage Learning India Pvt. Ltd, Delhi
VII(b): Reference Books:				
1	IoT Fundamentals: Networking Technologies, Protocols and Use cases for the IOT	David Hanes and Gonzalo Salgueiro	2nd Edition,2019	Pearson India Education Services Pvt. Ltd.,
2	"The Internet of Things: How Smart T Vs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World"	Michael Miller	2015	Pearson Education
3	"Rethinking the Internet of Things: A Scalable Approach To Connecting Everything"	Francisda Costa	1stEdition,2013	Apress Publications

VII(c):WeblinksandVideoLectures(e-Resources):

1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. https://www.iotworldtoday.com/
3. https://aws.amazon.com/iot/
4. https://www.cisco.com/c/en_in/solutions/internet-of-things/overview.html
5. https://www.arduino.cc/
6. Introduction To Internet Of Things - Course

VIII: Activity Based Learning /Practical Based Learning/ Experiential learning:

Practical skills should be performed by students based on domains

Semester:	VI	Course Type:	PRJ		
Course Title: Major Project - Phase I					
Course Code:	**23EEPRJ1**			**Credits:**	**02**
Teaching Hours/Week (L: T:P:O)			**0:0:4:0**	**Total Hours:**	**50**
CIE Marks:	**50**	**SEE Marks:**	**50**	**Total Marks:**	**100**
SEE Type:	**Practical**			**Exam Hours:**	**03**

I. Course Objectives:

- To encourage independent learning and the innovative attitude of the students.
- To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team working.
- To expand intellectual capacity, credibility, judgment and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To install responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

II. Teaching-Learning Process (General Instructions):

- Project Based Learning

III. COURSE CONTENT

Instructions for conduction of practical part:

- Students can select appropriate projects with the approval of the guide. 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 single discipline or a multidisciplinary project can be assigned to an students' group having two or not more than 4 students.
- 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**.**

CIE procedure for Project Work:

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

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

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the COE. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

IV. COURSE OUTCOMES

CO1	Apply the fundamental knowledge of mathematics, science and engineering principles in design of solutions or system components
CO2	Identify, select, apply a suitable engineering/IT tool in modelling/data interpretation/analytical studies, conduct experiments leading to a logical solution
CO3	Design multidisciplinary engineering solutions to complex problems addressing societal and environmental concerns
CO4	Communicate effectively to a diverse audience and develop technical reports and publications.
CO5	Work as a team member/leader to manage projects and costs in a diversified environment.

V. CO-PO-PSO MAPPING

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3	3										2	2	2	
CO2	3	3			3								3	3	3	
CO3	3	3	3	3		3	3						3	3	3	
CO4										3			3	3	3	
CO5						3			3	3	3		2	2	2	

VI. Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE):

Semester End Examination (SEE):

VII: Web links and Video Lectures (e-Resources): NA

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Practical Based Learning

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ANNEXURE

CIE & SEE evaluation for Autonomous Scheme 2023 – UG

Note: Revised as per approvals of 4th Academic Council Meeting held on 05/02/2025

S. #	Course Type /Credits	Continuous Internal Evaluation (CIE)																					Semester End Examination (SEE)									Min. pass % (CIE + SEE)
		Total CIE marks	Min. Eligty.	I. Theory Component									II. Practical Component									Total CIE marks	Dur. In hrs.	Theory			Practical			Total SEE marks	
						A. Unit test			B. Formative Assessments			Tot. Theory marks (I)			C. Weekly Evaluation		D. Internal Test			E. Prj	Tot. marks (II)				Max. conducted marks	Max. considered marks	min. pass %	Max. conducted marks	Max. considered marks	min. pass %		
				Marks	Min. Eligty.	Nos.	Marks / Each	Tot.	Nos.	Marks / Each	Tot.		Marks	Min. Eligty.	Each week	Tot. marks	Nos.	Marks / Each	Total marks	Marks												
1	BSC/ESC/PCC/ETC /PEC/OEC (3 or 4 Credit courses)	50	40%	50	40%	2	50	50 (avg. of 2)	2	50	50 (avg. of 2)	50 (avg. of A & B)	--	--	--	--	--	--	--	--	--	50 (I)	03	100	50	35%	--	--	--	50	40%
2	IBSC/IESC/IPCC/ ETC (4 Credit courses)	50	40%	50	40%	2	50	50 (avg. of 2)	2	50	50 (avg. of 2)	50 (avg. of A & B)	50	40%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (Avg. of I & II)	03	100	50	35%	--	--	--	50	40%
3	IESC - CAED (4 credit course)	50	40%	--	--	--	--		--	--		--	50	40%	50	50 (Avg. of all)	1	50	50	--	50 (Avg. of C & D)	50	03	--	--	--	100	50	35%	50	40%
4	PCCL (1 Credit courses)	50	40%	--	--	--	--		--	--		--	50	40%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (II)	03	--	--	--	100	50	35%	50	40%
5	AEC- IDT, Skill Development courses (1 credit course)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	35%	--	--	--	50	40%
6	HSMC- CIP, Env studies, SFH, UHV (1 credit course)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	35%	--	--	--	50	40%
7	HSMC - English, Kannada (No credits)	50	40%	50	40%	1	50		1	50		50 (Avg. of 2)	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	40%
8	NCMC - Personality Development courses, PE, Yoga, NCC, NSS, IKS (No credits)	50	40%	50	40%	--	--		1	50		50	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	40%

 # Formative (Successive) Assessments: Assignments/quiz/ seminars/field survey and report presentation/course project/group discussions/etc. based on the faculty & dept. planning. **# Practical Conduction:** The conduction of each experiment/program per week should evaluate for 50 Marks and average of all shall be taken. **# In case of Integrated course,** minimum eligibility shall be attained as prescribed in both the theory and practical components.
 # Self Learning Courses (SLC) Courses, Internship, Mini project & Major Project: Rubrics & Methodology shall be defined seperately

Academic Dean 10/2/25

Principal 10.2.2025

Academic Director 10/2/25

ANNEXURE

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CIE and SEE guidelines for Autonomous Scheme 2023 –ಆ೬

Note: Revised as per approvals of 4th Academic Council Meeting held on 05/02/2025

Continuous Internal Evaluation (CIE)	Semester End Examination (SEE)	Final Passing requirement
1. BSC/ESC/PCC/ ETC/PEC/OEC – Theory Course (03 & 04 Credit courses)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component (I): **I. Theory component:** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) There are 02 tests each of 50 marks conducted during 8th week & 15th week, respectively. ii) The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. iii) The student must answer 2 full questions (one from 1st & 2nd questions and another from 3rd & 4th question).	**Semester-End Examination:** The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). Duration of 03 hours and total marks of 100. i) The question paper will have ten questions. Each question is set for 20 marks. ii) There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. iii) The students have to answer 5 full questions, selecting one full question from each module. iv) Marks scored shall be proportionally reduced to 50 marks.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

Academic Dean 10/2/25

Principal 10.2.2025

Academic Director 10/2/25

iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcomes defined for the course. **B. Formative assessments:** i) 02 formative assessments each of 50 marks shall be conducted by the course coordinator based on the dept. planning during random times. ii) One formative assessment shall be completed before 5th week and second shall be completed before 12th week. iii) The syllabus content for the formative assessment shall be defined by the course coordinator. iv) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. v) The assignment QP or Quiz QP shall indicate marks of each question and the relevant COs & RBT levels. vi) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean. **The final CIE marks will be 50:** CIE = Avg. {Avg. of two tests + Avg. of two FA} **The documents of all the assessments shall be maintained meticulously.**		
2. IBSC/IESC/IPCC– Integrated with Theory & Practical (04 credit courses), ETC (if offered as integrated course)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). Minimum eligibility of 40% marks shall be attained separately in both the theory component and practical component. CIE will be conducted by the department and it will have 02 component: I. Theory Component. II. Practical Component. **I. Theory Component:** Theory component will consist of A. Internal Assessment Test (IAT). B. Formative assessments (FA).	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Only theory SEE for duration of 03 hours and total marks of 100. i) The question paper will have ten questions. Each question is set for 20 marks. ii) There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

A. Internal Assessment Test: i) There are 02 tests each of 50 marks conducted during 8th week & 15th week, respectively. ii) The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. iii) It is suggested to include questions on laboratory content in the Internal Assessment test Question papers. iv) The student must answer 2 full questions (one from 1st & 2nd questions and another from 3rd & 4th question). v) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. **B. Formative assessments:** i) 02 formative assessments each of 50 marks shall be conducted by the course coordinator based on the dept. planning during random times. ii) One formative assessment shall be completed before 5th week and second shall be completed before 12th week. iii) The syllabus content for the formative assessment shall be defined by the course coordinator. iv) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. v) The assignment QP or Quiz QP shall indicate marks of each question and the relevant COs & RBT levels. vi) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean. **II. Practical Component:** **C.** Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/programs shall be taken. (rubrics will be published by the concerned committee) **D.** One laboratory Internal Assessment test will be conducted during the 14th week for 50 marks. (rubrics will be published by the concerned committee) **E.** If the course project / mini project is involved in the laboratory component. **The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean.	iii) The laboratory content must be included in framing the theory question papers. iv) The students have to answer 5 full questions, selecting one full question from each module. v) Marks scored shall be proportionally reduced to 50 marks. **No Practical SEE for Integrated Course.** **Note:** CAED Course shall not be considered here. It shall be considered as in sl. No. 3 in the next row	

10/2/25

Academic Dean

13.2.2025

Principal

10/2/25

Academic Director

Note:

i) If component 'E' is involved in the course, either component 'D' or 'E' along with component 'C' shall be considered for average of item II.

ii) Otherwise, components 'C' & 'D' shall be considered for average of item II.

The final CIE marks will be 50:

CIE= Avg. {**I** [Avg. of two tests + Avg. of two FA] + **II** [Avg. of (C & (D or E))]}

The documents of all the assessments shall be maintained meticulously.

Note: CAED Course shall not be considered here, it shall be considered as in sl. no. 3 in the next row.

3. IESC: CAED Course (4 credits)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).

i) CIE shall be conducted for max. marks of 100 and shall be scaled down to 50 marks

ii) CIE component should comprise of both Manual and computer drafting i.e. 50% manual and 50% computer drafting out of total 100 marks

iii) CIE component should comprise of Continuous evaluation of drawing work of students as and when the modules are covered based on below detailed weightage.

Module	Module Max. Marks	Evaluation Weightage in marks	
		Computer display and print out	Manual Sketching
Module 1	20	10	10
Module 2	20	10	10
Module 3	20	10	10
Module 4	20	10	10
Module 5	20	10	10
TOTAL	**100**	**50**	**50**

The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks).

Semester-End Examination:

SEE for duration of 03 hours and total marks of 100.

i) SEE shall be conducted and evaluated for maximum marks of 100 and shall be scaled down to 50 marks.

ii) Question paper shall be made available for each batch as per schedule.

iii) Evaluation shall be carried jointly by both the internal & external examiners.

iv) Scheme of Evaluation: To be defined by both the examiners jointly.

v) Maximum 3 questions shall be set as per the following pattern.

The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

Academic Dean

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iv) At least one Test covering all the modules is to be conducted for 100 marks during 14th week and the same is to be scaled down to **25 Marks.**

v) Assignments = **10 Marks from each module. (50 marks scaled down to 25 Marks)**

vi) The final CIE 50 marks = Test (25 marks) + Assignment (25 marks).

From Module	Marks Allotted
Module 01 (Choice between Lines or Planes)	30
Module 02 (Compulsory question)	40
Module 03 or Module 04 or Module 05	30
TOTAL	**100**

Q. No.	Manual Sketching	Computer display and print out	TOTAL MARKS
1	15	15	30
2	20	20	40
3	15	15	30
TOT.	**50**	**50**	**100**

4. PCCL: Laboratory course (01 credit course)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50).

CIE will be conducted by the department and it will have only 01 component:

I. Theory Component. (Not required for Laboratory course)

II. Practical Component.

II. Practical Component:

C. Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/program shall be taken (rubrics will be published by the concerned committee).

D. One laboratory Internal Assessment test will be conducted for 50 marks (rubrics will be published by the concerned committee).

E. If the course project / mini project is involved in the laboratory component. **The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean.

The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks).

Semester-End Examination:

Only laboratory SEE will be conducted jointly by the internal examiner and external examiner appointed by COE as per the scheduled timetable for duration of 03 hours.

i) The examination shall be conducted for 100 marks and shall be reduced to 50 marks proportionately.

ii) All laboratory experiments/programs are to be included for practical examination.

iii) Breakup of marks (Rubrics) and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners (OR) based on the course

The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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Note: **i)** If component 'E' is involved in the course either component 'D' or 'E' along with component 'C' shall be considered for average of item II. **ii)** Otherwise, components 'C' & 'D' shall be considered for average of item II. **The final CIE marks will be 50** = Avg. of (C & [D or E]) **The documents of all the assessments shall be maintained meticulously.**	requirement evaluation rubrics shall be decided jointly by examiners. iv) Students can pick one question (experiment/program) from the questions lot prepared by the internal /external examiners jointly. v) Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. vi) General rubrics suggested for SEE: writeup-20%, Conduction procedure and results-60%, Viva-voce 20% of maximum marks. vii) Change of experiment is allowed only once and shall be assessed only for 85% of the maximum marks.	

5. AEC: Ability Enhancement Courses (01 credit courses)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The question paper will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. i) Multiple choice Question paper. ii) The students have to answer all questions.	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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B. Formative assessments: i) 01 formative assessment of 50 marks shall be conducted by the Course coordinator based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**		

6. HSMC: (01 credit course)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative Assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The question paper will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc.	The minimum passing mark for SEE is 35% of the maximum marks (18 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. i) Multiple choice Question paper. ii) The students have to answer all questions	The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

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iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**		
7. HSMC: (0 credit courses)		
The weightage is only for Continuous Internal Evaluation (CIE).		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test (IAT). B. Formative assessments (FA). **A. Internal Assessment Test:** i) 01 test of 50 marks conducted during 15th week. ii) The QP will be of Multiple-Choice Questions (MCQ). iii) The student must answer all questions. iv) IAT QP shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during 12th week. ii) The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50:** CIE = Avg. of 02 events (01 IAT and 01 FA). **The documents of all the assessments shall be maintained meticulously.**	No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 40% (20 marks out of 50) in the CIE.

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8. NCMC: (0 credit course)		
The weightage is only for Continuous Internal Evaluation (CIE).		
Continuous Internal Evaluation: The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of only 01 assessment A. Internal Assessment Test (not required for NCMC course). B. Formative Assessment (FA). **B. Formative assessments:** i) 01 formative assessment of 50 marks shall be conducted by the faculty based on the dept. planning during random times during 12th week. ii) The formative assessments include Quiz/Assignments/seminars/case study/field survey/ report presentation/course project/etc. iii) The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. iv) The rubrics required for the other type of formal assessments shall be defined by the departments along with mapping of relevant COs & POs. **The final CIE marks will be 50.** **The documents of all the assessments shall be maintained meticulously.**	No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 40% (20 marks out of 50) in the CIE.

Academic Dean
Dr. Babu N V

Principal
Dr. K V Mahendra Prashanth

Academic Director
Dr. Puttaraju

Academic Dean

Principal 10.2.2025

Academic Director

|| Jai Sri Gurudev ||
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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

Program Outcomes (POs)- Graduate Attributes

Engineering Graduates will be able to:

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

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

3. **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.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **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.

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

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

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

9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **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.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one9s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **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

|| Jai Shree Gurudev ||
Sri Adichunchanagiri Shikshana Trust ®

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Accredited by NAAC with A+

Recognized by UGC, New Delhi with 2(f) and 12(B)

Certified by ISO 9001 – 2015

ATAL Ranking:
Band Performer

Band of 151 to 300 in
Innovation Category