BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi)

Avalahalli, Yelahanka, Bengaluru 560064

Bachelor of Engineering

Department of Electrical & Electronics Engineering

Approved in the BoS meeting held on 23.08.2024

VII and VIII Semester Scheme and Syllabus
2021 Scheme - Autonomous

Vision and Mission of the Department

Vision of the Department:

To emerge as one of the finest Electrical & Electronics Engineering Departments facilitating the development of competent professionals, contributing to the betterment of society.

Mission of the Department:

Create a motivating environment for learning Electrical Sciences through teaching, research, effective use of state of the art facilities and outreach activities.

Program Educational Objectives (PEOs)

Graduates of the program will,

PEO1	Have successful professional careers in Electrical Sciences, and Information Technology enabled areas and be able to pursue higher education.
PEO2	Demonstrate ability to work in multidisciplinary teams and engage in lifelong learning.
PEO3	Exhibit concern for environment and sustainable development.

After the successful completion of the course, the graduate will be able to,

PO1: Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: 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.
PO3: 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.
PO4: 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.
PO5: 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.
PO6: The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: 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.
PO11: Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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.

Program Specific Outcomes (PSOs)

The Graduates of the Program will be able to

PSO1:	**Analyze and design electrical power systems.**
PSO2:	**Analyze and design electrical machines.**
PSO3:	**Analyze and design power electronic controllers for industrial drives.**
PSO4:	**Analyze and design analog and digital electronic systems.**

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BMS Institute of Technology and Management
(An Autonomous Institution, Affiliated to VTU Belagavi)
Avalahalli, Doddaballapur Main Road, Bengaluru, Karnataka – 560064

Ref.: BMSIT&M/Exam/2023-24/ 103 **Date:** 21.09.2024

CONTINUOUS INTERNAL EVALUATION
AND
SEMESTER END EXAMINATION PATTERN
(Applicable to UG students of 2021 Batch, effective from the Academic year 2024-25 onwards)

The UG students admitted during 2021-22 are hereby informed to note the following with reference to Continuous Internal Evaluation and Semester End Examination pattern:

The weightage for Continuous Internal Evaluation (CIE) is 50%, and for Semester End Examinations (SEE), it is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 out of 50), while for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50). A student will be declared to have passed the course if they secure at least 40% (40 out of 100) in the combined total of the CIE and SEE.

The details below summarize the CIE and SEE Pattern for the courses of 2021 scheme of various credits:

4 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs to be conducted for **40 Marks** (90 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 Marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of **10 Marks**, total **20 Marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks (3 hours).
- **Question Paper Pattern:**
  - **Part - A:** Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.
  - **Part - B:** There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question.**

- **SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.**

3 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs to be conducted for **40 Marks** (90 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 Marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of **10 Marks**, total **20 Marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks (3 hours).
- **Question Paper Pattern:**
  - **Part - A:** Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.
  - **Part - B:** There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question.**

- **SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.**

2 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 2 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of 10 marks, total **20 marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE Marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks (2 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 100 questions each of 01 marks. The same is scale down to 50 marks. Minimum SEE Marks: 40% (i.e. 20 Marks out of 50)

1 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Internal Assessment (IA) Tests:** 2 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 2 tests will be 80 and the same can be scale down to **30 marks.**
- **Alternate Assessment Tool (AAT):** 2 AATs each of 10 marks, total **20 marks.** Any Two AATs can be used from the list. If it is project based, one AAT shall be given.
- **Total CIE marks** = 30 + 20 = **50 Marks**
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for **50 Marks** (1 hours).
- **Question Paper Pattern:**
  - o The pattern of the question paper is MCQ.
  - o SEE question paper will be set for 50 questions each of 01marks. The same is scale down to **50 Marks**.

1 CREDIT LABORATORY COURSE / PROFESSIONAL CORE LABORATORY / ABILITY ENHANCEMENT COURSE

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- **Cumulative Assessment (CA)** of each experiment is 20 Marks (Conduction 10 marks + Records 5 marks +Viva 5marks). The average of all the experiments to be taken for **20 Marks.**
- **Open Ended Experiments (OE) 10 Marks.**
- **2 IAs Test** to be conducted for 100 marks. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.: 60 marks and Viva: 20 marks. The average of 2 IA marks is scale down to **20 Marks**.
- **CIE marks** =20 (CA) +10 (OE) + 20 (IA test) = **50 Marks**.
- Student has to score a minimum of **20 Marks** (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

- SEE is conducted for 100 Marks.
- Examinations to be conducted jointly by Two examiners.
- All the experiments are to be included for practical examination.
- General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks.

Learning Activities for AATs:

A faculty member may choose the following AATs based on the needs of the course:

1. Course project
2. Literature review
3. MOOC
4. Case studies
5. Tool exploration
6. GATE-based aptitude test
7. Open book tests
8. Industry integrated learning
9. Analysis of Industry / Technical / Business reports
10. Programming assignments with higher Bloom level
11. Group discussions
12. Industrial / Social / Rural projects

CoE 21/09/2024

Dean AA 21.09.24

Principal 21/9/2024

Copy To:

1. The Vice-Principal, Deans, HoDs, and Associate HoDs
2. All faculty members and students of 2021 batch.
3. Examination Section

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute affiliated to VTU)

Scheme of Teaching and Examination: Effective from AY 2021– 22

Choice Based Credit System (CBCS)

UG PROGRAM: ELECTRICAL & ELECTRONICS ENGINEERING (EEE)										Semester: VII				
Sl. No.	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours/ week				Credits	Examination			
					L	T	P	PW		Duration in Hours	CIE Marks	SEE Marks	Total Marks
1	HS	21HSS71	Research Methodology	EE	2	0	0	0	2	2	50	50	100
2	AEC	21EEL72	Relay and High Voltage Laboratory	EE	0	0	2	0	1	2	50	50	100
3	PE	21EE73X	Professional Elective III	EE	3	0	0	0	3	3	50	50	100
4	PE	21EE74X	Professional Elective IV	EE	3	0	0	0	3	3	50	50	100
5	OE	21EE75X	Open Elective II	EE	3	0	0	0	3	3	50	50	100
6	PW	21EEP76	Project Work Phase I	EE	0	0	0	10	5	-	100	-	100
			TOTAL		12	0	2	10	17		350	250	600

Professional Elective - Group III	
Course Code	Course Title
21EE731	Utilization of Electrical Power
21EE732	Energy Auditing and Demand Side Management
21EE733	VLSI Circuits and Design
21EE734	Renewable Energy Systems
21EE735	Battery Management System

Professional Elective - Group IV	
Course Code	Course Title
21EE741	Industrial Drives and Applications
21EE742	Computer Techniques in Power Systems
21EE743	Testing and Commissioning of Electrical Equipment
21EE744	Digital Signal Processing
21EE745	Programmable Logic Controllers

Open Elective (OE) - Group II	
Course Code	Course Title
21EE751	Artificial Intelligence in Power Systems
21EE752	Electrical Safety and Troubleshooting
21EE753	Smart Lighting Systems
21EE754	Battery Management System

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Scheme of Teaching and Examination: Effective from AY 2021– 22

Choice Based Credit System (CBCS)

UG PROGRAM: ELECTRICAL & ELECTRONICS ENGINEERING (EEE) | **Semester: VIII**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week				Credits	Examination			
					L	T	P	PW		Duration in Hours	CIE Marks	SEE Marks	Total Marks
1	PE	21EE81X	MOOC Professional Elective Courses	EE	-	-	-	-	3	3	30	70	100
2	INT	21INT82	Research / Industrial Internship	EE	0	0	0	14	7	3	50	50	100
3	PW	21EEP83	Project Work Phase II	EE	0	0	0	20	10	3	100	100	200
TOTAL					0	0	0	34	**20**	-	**200**	**200**	**400**

MOOC Professional Elective Courses: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students during the VI semester only. Students are required to choose only the courses which are suggested by the respective BoS. Duration of the online course should be of a minimum of 12 weeks. Students can able to complete the specified online courses with a qualifying certificate issued by the competent authority. The online courses can be completed anytime starting from VI semester onwards and the credits will be considered during the VIII semester only. The courses are to be offered on the **SWAYAM – NPTEL platform only**. The credits earned for this course will not be considered for claiming the credits under the Honors Degree programme.

Sl.No	Course Name	Course Code	NPTEL Course ID
1	Design of Photovoltaic Systems	21EE81A	https://onlinecourses.nptel.ac.in/noc24_ee109/preview
2	Smart Grid: Basics to Advanced Technologies	21EE81B	https://onlinecourses.nptel.ac.in/noc24_ee148/preview
3	Electromagnetic Theory	21EE81C	https://onlinecourses.nptel.ac.in/noc24_ee137/preview
4	Power Electronics Applications in Power Systems	21EE81D	https://onlinecourses.nptel.ac.in/noc24_ee130/preview
5	Machine Learning and Deep Learning-Fundamentals & Applications	21EE81E	https://onlinecourses.nptel.ac.in/noc24_ee146/preview
6	Digital Image Processing	21EE81F	https://onlinecourses.nptel.ac.in/noc24_ee133/preview
7	Hands-on Circuits and PCB Design with CAD software	21EE81G	https://onlinecourses.nptel.ac.in/noc24_ee127/preview
8	Microelectronics: Devices to Circuits	21EE81H	https://onlinecourses.nptel.ac.in/noc24_ee139/preview
9	Solar Energy Engineering and Technology	21EE81I	https://onlinecourses.nptel.ac.in/noc24_ge51/preview
10	Numerical Methods for Engineers	21EE81J	https://onlinecourses.nptel.ac.in/noc24_ge46/preview
11	Organizational Behaviour	21EE81K	https://onlinecourses.nptel.ac.in/noc24_mg87/preview
12	Getting Started with Competitive Programming	21AM81D	https://onlinecourses.nptel.ac.in/noc23_cs103/preview

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER - VII

RESEARCH METHODOLOGY (2:0:0)2

Common to all Branches

(Effective from the academic year 2024-25)

Course Code	**21HSS71**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:0	SEE Marks	50
Total Number of Lecture Hours	26	Exam Hours	02

Course objectives:

This course will enable students to

1. Give an overview of the research methodology, research problem.
2. Gain knowledge on research design.
3. Design of sampling survey and measurement & scaling.
4. Understand data collection and data preparation.
5. Familiarize interpretation and writing research reports.

Module – 1

Introduction: Importance of Research and Development (R&D) for development of Nation, Introduction to research and research methodology.
Meaning of Research, objectives of Research, Types of research, Research Approaches, Significances of Research, Research Process, Criteria of Good Research.

Defining the Research Problem: What is a Research Problem? Selecting the Research Problem, Necessity of Defining the Problem, Techniques Involved in Defining a problem. **(6 Hours)**

Module – 2

Research Design: Meaning of Research Design, need for Research design, Feature of a Good design, Important concepts relating to Research Design: Dependent, independent and extraneous variable, Control, Confounded relationship. Research Design in case of exploratory research studies, in case of descriptive and diagnostic research studies Basic Principles of Experimental Designs.

(5 Hours)

Module – 3

Design of sampling survey: Sample Design: Objective, sampling units and frame, size of sample, parameter of interest, selection of proper sample design, pilot survey and budgetary constraints. Sampling errors, non-sampling errors, Sample survey vs. census survey, on-probability samplings.

Measurement and scaling: Quantitative and qualitative data, Classification of measurement scales. Goodness of measurement scales: Techniques of developing measurement tools, scaling, Scale classification bases, scaling techniques. **(5 Hours)**

Module – 4

Data Collection: Experiments and Surveys, collection of primary data: observation method, Interview method. Collection of data through questionnaires, Collection of data through schedules. Collection of secondary data. Selection of appropriate method for data collection, case study method.

Data Preparation: Questionnaire checking, editing, coding, tabulation, data cleaning, data adjusting, problems in preparation process, missing values and outliers, type of analysis.

(5 Hours)

Module – 5

Interpretation and Report Writing
Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of Research Report, Types of Reports: Technical report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research. **(5 Hours)**

Course outcomes:
The students will be able to:
CO1: Acquire some basic concepts of research and its methodologies.
CO2: Describe different types of research design methods.
CO3: Explain the various sampling, measurement, and scaling techniques.
CO4: Analyse the ethical practices in conducting research and dissemination of results in different forms using data collection and data preparation methods.
CO5: Apply various techniques to interpret research reports.

Text Book:

1. CR Kothari and Gaurav Garg, Research Methodology, New Age International Publishers, 2020.

References:

1. Panneerselvam R, Research Methodology, Prentice Hall of India, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U K, An introduction to Research Methodology, RBSA Publishers, 2002.
3. Ranjit Kumar, Research Methodology, 4th Edition, SAGE Publications Ltd. 2014.

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER - VII

RELAY AND HIGH VOLTAGE LABORATORY (0:0:1) 1

(Ability Enhancement Course)

(Effective from the academic year 2024 -2025)

Course Code	**21EEL72**	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Lecture Hours	16	Exam Hours	2

Laboratory Prerequisites:

1. Knowledge about high voltage engineering
2. Knowledge about power system protection
3. Knowledge about power system analysis

Laboratory Objectives:

1. To conduct experiments to verify the characteristics of over current, over voltage, under Voltage/over voltage relays both electromagnetic and Microprocessor type.
2. To conduct experiments on generator, motor and feeder protection.
3. To measure high voltage ac, dc and impulse voltage, conduct experiments to study the spark over characteristics for both uniform and non-uniform configurations using High AC and DC voltages.
4. To experimentally measure the breakdown strength of transformer oil.
5. To experimentally measure the capacitance of different electrode configuration models using Electrolytic Tank

Experiments:

1. Study the Operational Characteristics of Electromechanical Relay
2. Study the Characteristics of Numeric Under Voltage/Over Voltage Relay
3. Breakdown Test on Transformer Oil
4. Mapping of Equipotential Lines of Parallel plates using electrolytic tank
5. Measurement of HVDC using Standard Spheres
6. Spark Over Characteristics of Air Insulation Subjected to HVDC
7. Generation of Standard impulse voltage and to determine efficiency & energy of impulse generator
8. Motor Protection against Faults

Open Ended Experiments

1. Study of Operational Characteristics of Numeric Over Current Relay

2 . Measurement of HVAC using Standard Spheres

4. Fuse and MCB characteristics

Course Outcomes:

This course will enable students to

1. Apply protection schemes for electrical equipment.
2. Apply field mapping technique and capacitance calculation methods for simple geometric configurations.
3. Analyse the dielectric breakdown mechanisms.

Prepare reports effectively working as an individual or as a team member.

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER – VII

UTILIZATION OF ELECTRICAL POWER (3:0:0) 3

(Professional Elective-III)

(Effective from the academic year 2024-25)

Course Code	**21EE731**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. illustrate various heating and welding methods available for industrial applications
2. discuss the concepts of Electrolysis processes
3. apply the knowledge illumination engineering in lighting design
4. interpret speed time curves associated with electric traction
5. compare and select suitable Electrical Drive for electric traction

Preamble: Energy resource scarcity becomes one of the biggest issues in the world and leading to rise in cost. Effective utilization of Electrical energy is one of the key issues to minimize the rising cost of energy. This course will educate and create awareness among the power system engineers on the aspect of effective utilization of electrical energy in various electrical utilities. The students will be able to make proper selection of equipment according to requirement to ensure economical and efficient use of electricity.

Module – 1

Heating and welding: Electric Heating, Resistance ovens, Radiant Heating, Induction Heating, High frequency Eddy Current Heating, Dielectric Heating, The Arc Furnace, Heating of Buildings, Air – Conditioning, Electric Welding, Modern Welding Techniques.

Electrolytic Electro – Metallurgical Process: Ionization, Faraday's Laws of Electrolysis, Definitions, Extraction of Metals, Refining of Metals, Electro Deposition. (8 hours)

Module – 2

Illumination: Introduction, Radiant Energy, Definitions, Basic terms in lighting systems, Laws of Illumination, calculation of illumination levels at various locations, Polar Curves, Photometry, Measurement of Mean Spherical Candle Power by Integrating Sphere, Illumination Photometer, Energy Radiation and luminous Efficiency. (8 hours)

Module – 3

Electric Lamps: Light Emitting Diode Lamps, Parameters important for LED Lighting, "Green" Energy Solutions, Luminous Efficacy versus Luminous efficiency, LED Luminaire Efficacy, The LED Industry : current and future prospects, worldwide growth, High- Brightness LEDs, LED Applications , Challenges and limitations for the LED Industry, Requirements of Good Lighting, calculation of illumination, Street lighting, Factory lighting, Flood lighting, Glare and its remedy. (8 hours)

Module – 4

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.

Motors for Electric traction: Introduction, Series and Shunt Motors for Traction Services, Two Similar Motors (Series Type) are used to drive a Motor Car, Tractive Effort and Horse Power, AC Series Motor, Three Phase Induction Motor.

Control of motors: Control of DC Motors, Tapped Field Control or Control by Field Weakening, Multiple Unit Control, Control of Single Phase Motors, Control of Three Phase Motors.

(8 hours)

Module – 5

Braking: Introduction, Regenerative Braking with Three Phase Induction Motors, Braking with Single Phase Series Motors, Mechanical braking, Magnetic Track Brake, Electro – Mechanical Drum Brakes.

Electric Traction Systems and Power Supply:

System of Electric Traction, AC Electrification, Transmission Lines to Sub - Stations, Sub – Stations, Feeding and Distribution System of AC Traction Feeding and Distribution System for DC Tramways, Electrolysis by Currents through Earth, Negative Booster, System of Current Collection, Trolley Wires. Trams, Trolley Buses and Diesel – Electric Traction (8 hours)

Course Outcomes:

The students will be able to:

CO1: Discuss different methods of electric heating , welding, extraction and refining of metals.

CO2: Discuss the laws of illumination, apply appropriate techniques for designing lighting systems.

CO3: Discuss principles behind LED lighting, the current and past market advancements.

CO4: Analyze systems of electric traction, speed time curves, electric braking methods and control of traction motors.

Textbooks:

1. Taylor E Openshaw, "Utilization of Electric Energy", Orient Longman,1986.
2. Soni, Gupta, Bhatnagar, "A course in electric power", Dhanapat Rai & sons, 2001.
3. M. Nisa Khan "Understanding LED Illumination" September 30, 2020 by CRC Press

References:

1. J B Gupta, "Utilization of electric power and electric traction", S K Kataria & Sons, 2002
2. S.L.Uppal, "Electrical Power", Khanna pulishers,1988.
3. Partab H., "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Sons, New Delhi. Second edition
4. R.K.Rajput," Utilisation of electric power", third edition, Laxmi Publications Private Ltd.

Alternate Assessment Tools (AATs) suggested:

1. Design of illumination for a auditorium with dimensions specified
2. Design of heating method for a given application

Web links / e – resources:

1. **https://www.se.com/in/en/work/solutions/for-business/electric-utilities/**

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING Choice Based Credit System (CBCS) applicable for 2021 Scheme **SEMESTER – VII**			
ENERGY AUDITING AND DEMAND SIDE MANAGEMENT (3:0:0) 3 (Professional Elective-III) (Effective from the academic year 2024-25)			
Course Code	**21EE732**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40 Hours	Exam Hours	3

Course objectives:

This course will enable students to:

1. Understand the current energy scenario and importance of energy conservation.
2. discuss economics and auditing related to energy.
3. Understand the methods of improving energy efficiency in different electrical systems.
4. explain the scope of demand side management, its concept and implementation issues and strategies

Preamble: An energy audit is completed at a residential or commercial building to determine its energy efficiency. Simply put, energy efficiency means using less energy to do the same job. The audit will provide a complete electricity consumption and energy efficiency assessment. A systematic energy audit can be broken into four phases: planning, investigating, implementing and sustaining. Proactive facilities strive to continually improve energy efficiency by repeating these phases at regular intervals.

Module – 1

Introduction: Energy Scenarios, Energy Conservation, Energy Consumption, Energy Security, Energy Strategy, Clean Development Mechanism, Codes, standards and Legislation. (8 hours)

Module – 2

Energy Economic Analysis: The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems. (8 hours)

Module – 3

Energy Auditing: Definition of Energy Audit, Place of Audit, Energy – Audit Methodology , Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results. (8 hours)

Moule-4

Electrical System Optimization: Power Factor – correction & location of capacitors, the power triangle, motor horsepower, power flow concept, energy efficient motors, lighting basics, electrical tariff, Concept of ABT. (8 hours)

Moule-5

Demand Side Management: Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning, load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs. (8 hours)

Course outcome

The student will be able to:

CO1: Analyze about energy scenario nationwide and worldwide, also outline Energy Conservation Act and its features.

CO2: Discuss load management techniques and energy efficiency.

CO3: Understand the need of energy audit and energy audit methodology.

CO4: Understand various pillars of electricity market design.

CO5: Conduct energy audit of electrical systems and buildings.

CO6: Show an understanding of demand side management and energy conservation.

Textbooks:

1. Energy Management Handbook W.C. Turner John Wiley and Sons.
2. Energy Efficient Electric Motors and Applications H.E. Jordan Plenum Pub. Corp.
3. Energy Management W. R. Murphy, G. Mckay Butterworths.

References:

1. Energy Science Principles, Technologies and Impact J. Andrews, N. Jelley Oxford University Press.
2. Market operations in power systems: Forecasting, Scheduling, and Risk Management Shahedepour M., Yamin H., Zuyi Li. John Wiely & Sons, New York.
3. Energy Conservation Diwan, P. Pentagon Press.

Alternate Assessment Tools (AATs) suggested:

- Analysis of one-year electricity bills of the building and giving suggestions for energy Saving.
- Energy audit of the commercial building.

Web links / e – resources:

1. https://www.energy.gov.au/
2. https://www.energy.gov/scep/blueprint-2a-energy-efficiency-energy-audits- building-upgrades.

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER – VII

VLSI Circuits and Design (3:0:0) 3

(Professional Elective-III)

(Effective from the academic year 2024-25)

Course Code	**21EE733**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Appreciate the scope of microelectronic circuits in daily life.
2. Understand the MOS transistor operation in different modes.
3. Analyse the scaling effect of MOS device
4. Design and develop subsystems of various digital systems.

Preamble:

The microscopic dimensions of current silicon-integrated circuitry make possible the design of digital circuits which may be very complex and yet extremely economical in space, power requirements and cost, and potentially very fast. The space, power and cost aspects have made silicon the dominant fabrication technology for electronics in very wide ranging areas of application. The combination of complexity and speed is finding ready applications for VLSI systems in digital processing, and particularly in those application areas requiring sophisticated high speed digital processing. Although silicon MOS-based circuitry will meet most requirements in such systems and the technology is still being enhanced by on-going improvements in fabrication, there are ultimate limitations associated with the velocity of electrons (and holes) in silicon which will make MOS circuitry unsuitable for some ultra-fast systems that are now being contemplated.

Module – 1

Introduction to MOS Technology

Introduction to IC technology, MOS and related VLSI technology, basic MOS transistors, enhancement and depletion mode transistor action, n-MOS fabrication, CMOS fabrication: p-well, n-well, twin-tub process, production of e-beam masks

Basic Electrical Properties of CMOS: Ids versus Vds characteristics, MOS transistor trans-conductance gm and output conductance gds, pass transistor, n-MOS inverter, alternative forms of pull-up, CMOS inverter, MOS transistor circuit model, Latch-up in CMOS circuits

(8 hours)

Module – 2

MOS and BiCMOS Circuit Design Process

MOS Layers, Stick Diagrams: nMOS and CMOS design style, Design rules and layout, λ-based design rules, general observation on design rules, , Layout diagrams, symbolic diagrams

(8 hours)

Module – 3

Subsystem Design and Layout

Architectural issues, switch logic-Two input n-MOS, cMOS NAND and NOR Gate Logic, examples of

structured design- Parity Generator, Multiplexers, General Logic Function Block.
(8 hours)

Module – 4

Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles of Description. (Section 1.1 to 1.6.2, 1.6.4 (only Verilog), 2 of Text 2)
Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description. (Section 2.1 to 2.2 (only Verilog) of Text 2)
(8 hours)

Module – 5

Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1, 4:1, 8:1). (Section 3.1 to 3.4 (only Verilog) of Text 2)
Verilog Structural description: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder. (Section 4.1 to 4.2 of Text 2)
(8 hours)

Course Outcomes:
The students will be able to:

CO1	Comprehend the fabrication process and basic operation of MOS transistors in various modes and configurations in various modes and configurations.
CO2	Design and Develop the MOS digital circuits and subsystems
CO3	Analyze electrical properties of CMOS and design the subsystems of Digital systems
CO4	Model basic digital circuits using Verilog descriptions

Textbooks:

1. Basic VLSI Design, Douglas Pucknell and Eshragian, PHI, 3rd Edition, 2009
2. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press

References:

1. Modern VLSI Design, Wayne Wolf, Pearson Education Inc. 3rd Ediiton, 2003.
2. Introduction to CMOS VLSI Design – A Circuits and Systems Perspective, Neil Weste, Pearson Education, 3rd Edition
3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010
4. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

Alternate Assessment Tools (AATs) suggested:

- Design a 4:1 Multiplexer using NAND Gates and draw Stick Diagram
- Design a multifunction logic block for the given functionalities and draw stick diagram

Web links / e – resources:

1. **https://vlsiresources.com**
2. **https://nptel.ac.in/courses/117106092**

B.E ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER - VII

RENEWABLE ENERGY SYSTEMS (3:0:0) 3

(Professional Elective-III)

(Effective from the academic year 2024-25)

Course Code	**21EE734**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

1. Awareness about Renewable Energy Sources and technologies.
2. Adequate inputs on a variety of issues in harnessing renewable Energy.
3. Recognize current and possible future role of renewable energy sources.

Preamble: In the face of mounting environmental challenges and the imperative to transition towards sustainable development, renewable energy systems have emerged as a cornerstone of the global energy landscape. These systems harness the inexhaustible power of natural resources such as sunlight, wind, water, and geothermal heat, offering a viable alternative to fossil fuels. By reducing greenhouse gas emissions, minimizing environmental degradation, and promoting energy security, renewable energy systems contribute significantly to the fight against climate change and the pursuit of a greener, more sustainable future.

Module – 1

Introduction: Importance of electric power generation in Indian economy, factors influencing power generation, Green energy concepts, 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.

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, Working of Stirling or Brayton Heat Engine, 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.

(8 Hours)

Module – 2

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).

Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

(8 Hours)

Module – 3

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. (8 Hours)

Module – 4

Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier, Applications of Biomass Gasifier.

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant.

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy. (8 Hours)

Module – 5

Sea Wave Energy: Introduction, Motion in the sea Waves, Power Associated with Sea Waves, 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. (8 Hours)

Course outcomes:

The students will be able to

CO1: Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.

CO2: Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.

CO3: Explain the operation of various renewable energy systems.

CO4: Explain different emerging energy conversion technologies and storage.

Textbooks:

1. Shobh Nath Singh, "Nonconventional Energy Resources", Pearson, 1st Edition, 2015.
2. Nonconventional Energy Resources, B.H. Khan, McGraw Hill, 3rd Edition

References:

1. Godfrey Boyle, "Renewable Energy: Power for a sustainable Future", Oxford, 3rd Edition, 2012.
2. Tasneem Abbasi, S.A. Abbasi, "Renewable Energy Sources: Their Impact on global Warming and Pollution", PHI 1st Edition, 2011.
3. Nonconventional Energy Sources, G D Rai, Khanna Publisher, 2nd Edition

Alternate Assessment Tools (AATs) suggested:

- Solar System Design based on load requirement.

Web links / e – resources:

https://onlinecourses.nptel.ac.in/noc24_ph29/preview

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER – VII

Battery Management System (3:0:0) 3

(Professional Elective-III)

(Effective from the academic year 2024-25)

Course Code	**21EE735**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Learn the various Battery Management System parts.
2. Understand basic information about batteries.
3. Learn to measure different battery parameters.
4. Estimate state of charge of the battery.
5. Estimate state of health of the battery.

Preamble: A battery management system has a significant impact on practicality, stability, and function detection. The voltage, temperature, and current measurements are more accurate in terms of detection. Combining contemporary largescale integrated circuit technology improves the stability of the system's anti-interference ability. Lithium-ion batteries are still in the test and small-scale application stages in terms of practicality. The industry's lack of awareness is the reason why, despite certain advancements in battery management system measurement precision, durability, and other aspects, systematic induction of lithium-ion battery performance is still lacking. Even though the circuit functions of the battery management system are comparatively complete, systematic measurement and research are still lacking in the areas of group battery charging, thermal management, effective battery utilisation, and status estimation.

Module – 1

Battery Management System parts: The Power Module (PM), The battery, The DC/DC converter, load, communication channel, Examples of Battery Management Systems, Comparison of BMS in a low-end and high-end shaver, Comparison of BMS in two types of cellular phones.

Basic information on batteries: Battery systems, Definitions Battery design, Battery characteristics, General operational mechanism of batteries, Basic thermodynamics, Kinetic and diffusion over potentials, Double-layer capacitance, Battery voltage. (8 hours)

Module – 2

Lithium-Ion Battery Fundamentals: Battery Operation, Battery Construction, Battery Chemistry, Safety Longevity, Performance, Integration.

Measurement of battery parameters: Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management System Performance. (8 hours)

Module – 3

Battery Management System Functionality: Charging, Strategies, CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes.

Charge Balancing: Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults. (8 hours)

Module – 4

State-of-Charge Estimation Algorithms: Challenges, Definitions, Coulomb Counting, SOC Corrections, OCV Measurements, Temperature Compensation, Kalman Filtering, Other Observer Methods.

State-of-Health Estimation Algorithms: State of Health, Mechanisms of Failure, Predictive SOH Models Impedance Detection, Passive Methods, Active Methods, Capacity Estimation, Self-Discharge Detection Parameter Estimation, Dual-Loop System, Remaining Useful Life Estimation. (8 hours)

Module – 5

Fault Detection: Overview, Failure Detection, Overcharge/Overvoltage, Over-Temperature, Overcurrent Battery Imbalance/Excessive Self-Discharge, Internal Short Circuit Detection, Detection of Lithium Plating, Venting Detection, Excessive Capacity Loss, Reaction Strategies. (8 hours)

Course Outcomes:

The students will be able to:

CO1:	Review various Battery Management System parts.
CO2:	Clarify the basic information about batteries and demonstrate Lithium-Ion Battery Fundamentals.
CO3:	Measure different battery parameters and analyse battery performance to identify Battery Management System Functionality.
CO4:	Detail the need of Charge Balancing and state of charge estimation using various algorithms.
CO5:	Estimate the state of health of the battery and discuss battery fault detection.

Textbooks:

1. H. J. Bergveld, “Battery management systems: Design by modelling” University Press Facilities, Eindhoven,2001.
2. Phillip Weicker, “A Systems Approach to Lithium-Ion Battery Management”, artech house, 2014

References:

1. Gregory L. Plett, “Battery Management Systems: Battery Modeling”, Artech house, 2015
2. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, “Electrochemical Power Sources: Primary & Secondary Batteries”, IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.

Alternate Assessment Tools (AATs) suggested:

- Poster presentation on different types of Batteries.
- Simscape Battery Onramp.

Web links / e – resources:

1. **https://matlabacademy.mathworks.com/details/simscape-battery-onramp/orsb.**
2. **https://files.isec.pt/DOCUMENTOS/SERVICOS/BIBLIO/Sumarios_Monografias/Systems-approach-lithium-ion-battery_Weicker.pdf.**
3. **https://www.scribd.com/doc/83208581/Battery-Management-Systems-Design-by-Modelling-Book.**

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Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER - VII

INDUSTRIAL DRIVES AND APPLICATIONS (3:0:0) 3

(Professional Elective-IV)

(Effective from the academic year 2024-25)

Course Code	**21EE741**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course objectives:

This course will enable students to:

1. To define electric drive, its parts, advantages and explain choice of electric drive.
2. To explain dynamics and modes of operation of electric drives.
3. To explain selection of motor power ratings and control of DC motor using rectifiers.
4. To analyze the performance of induction motor drives under different conditions.
5. To explain the control of induction motor, synchronous motor and stepper motor drives.
6. To discuss typical applications electrical drives in the industry.

Module – 1

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

Dynamics of Electrical Drives: Fundamental Torque Equations, Speed Torque Conventions and Multi-quadrant Operation, Equivalent Values of Drive Parameters (Load with rotational motion and Translational motion).

Control Electrical Drives: Modes of Operation, Speed Control and Drive Classifications, Closed loop Control of Drives (Current-limit, Torque and speed control)

(8 hours)

Module – 2

Selection of Motor Power Ratings: Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating.

Direct Current Motor Drives: Controlled Rectifier Fed dc Drives, Single Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Three Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Multiquadrant Operation of dc Separately Excited Motor Fed Form Fully Controlled Rectifier, Chopper Control of Series Motor

(8 hours)

Module – 3

Three phase Induction Motor Drives: Analysis and Performance of Three Phase Induction Motors, Operation with Unbalanced Source Voltage and Single Phasing, starting (Star-Delta, Auto-T/F and reactor Starter), Braking (Regenerative and Plugging). Stator Voltage Control, Variable Voltage Frequency Control from Voltage Sources (VFC of IM). Voltage Source Inverter (VSI) Control, Closed Loop Speed Control and Converter Rating for VSI and Cycloconverter Induction

Motor Drives, Variable Frequency Control from a Current Source, Current Source inverter (CSI) Control (regenerative and closed-loop). (8 hours)	

Module – 4
Synchronous Motor Drives: Operation from fixed frequency supply-starting, synchronous motor, Variable frequency control of Multiple Synchronous Motors, Self-controlled synchronous motor drive employing load commutated thruster inverter, Permanent Magnet ac (PMAC) Motor Drives, Sinusoidal PMAC Motor Drives, Brushless dc Motor Drives. (8 hours)
Module – 5
Stepper Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping Rate Characteristics, Drive Circuits for Stepper Motor. **Industrial Drives:** Textile Mills, Steel Rolling Mills, Paper Mills, Cranes and Hoists, Cement Mills Machine Tools. (8 hours)

Course outcomes:

The students will be able to

CO1: Apply the fundamental concept of electric machines and power converter system to comprehend the working of industrial drives and dynamics.

CO2: Select appropriate motor for the specified applications.

CO3: Analyze the performance of dc motor drives during various operating conditions.

CO4: Analyze the performance of induction motor during unbalanced conditions, control of AC motor drives under various operating conditions.

Textbooks:

1. 1. Fundamentals of Electrical Drives Gopal K. Dubey Narosa Publishing House 2nd Edition, 2001
2. 2. Electrical Drives: Concepts and Applications (Refer to chapter 07 for Industrial Drives under module 5.) Vedum Subrahmanyam McGraw Hill 2nd Edition, 2011

References:

1. 1. Electric Drives N.K De, P.K. Sen PHI Learning 1st Edition, 2009.
2. A First Course On Electric Drives, S.K Pillai-Wiley Eastern Ltd 1990.
3. Power Electronics, Devices, Circuits and Industrial Applications, V.R. Moorthi, "Oxford University Press, 2005.
4. Electric Motor Drives, Modelling ,Analysis and Control, R.Krishnan,PHI,2008.

Alternate Assessment Tools (AATs) suggested:

- Analysis and Performance of Three Phase Induction Motors.
- Drive Circuits for Stepper Motor.

Web links / e – resources:

https://www.youtube.com/watch?v=Ub-csHc4VhA

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

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SEMESTER – VII

COMPUTER TECHNIQUES IN POWER SYSTEMS (3:0:0) 3

(Professional Elective-IV)

(Effective from the academic year 2024-25)

Course Code	**21EE742**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

· To explain formulation of network models and bus admittance matrix for solving load flow problems.

· To discuss optimal operation of generators on a bus bar and optimum generation scheduling.

· To explain symmetrical fault analysis and algorithm for short circuit studies.

· To explain formulation of bus impedance matrix for the use in short circuit studies on power systems.

· To explain numerical solution of swing equation for multi-machine stability

Preamble: Computer Techniques in Power Systems, where we explore the intersection of electrical engineering and computational tools. This course delves into essential methods for analyzing, optimizing, and managing power systems using advanced computer techniques. We navigate through simulations, data analysis, and modeling applications crucial for modern power system operations

Module – 1

Network Topology: Introduction and basic definitions of Elementary graph theory Tree, cut-set, loop analysis. Formation of Incidence Matrices. Primitive network- Impedance form and admittance form, Formation of Y Bus by Singular Transformation. Ybus by Inspection Method. Illustrative examples. (8 hours)

Module – 2

Load Flow Studies: Introduction, Classification of buses. Power flow equation, Operating Constraints, Data for Load flow, Gauss Seidal iterative method. Illustrative examples. .

(8 hours)

Module – 3

Load Flow Studies(continued) Newton-Raphson method derivation in Polar form, Fast decoupled load flow method, Flow charts of LFS methods. Comparison of Load Flow Methods. Illustrative examples. (8 hours)

Module – 4

Economic Operation of Power System: Introduction and Performance curves Economic generation scheduling neglecting losses and generator limits Economic generation scheduling including generator limits and neglecting losses Economic dispatch including transmission losses Derivation of transmission loss formula. Illustrative examples. (8 hours)

Module – 5	
Symmetrical Fault Analysis: Z Bus Formulation by Step-by-step building algorithm without mutual coupling between the elements by addition of link and addition of branch. Illustrative examples. Z bus Algorithm for Short Circuit Studies excluding numerical. **Power System Stability:** Numerical Solution of Swing Equation by Point-by-Point method and Runge Kutta Method. Illustrative examples. (8 hours)	
Course Outcomes: The students will be able to:	
CO1:	Formulate network matrices and models for solving load flow problems.
CO2:	Perform steady state power flow analysis of power systems using numerical iterative techniques.
CO3:	Apply optimization techniques to solve issues of economic load dispatch.
CO4:	Analyze short circuit faults in power system networks using bus impedance matrix.
CO5:	Apply Point by Point method and Runge Kutta Method to solve Swing Equation.
Textbooks: 1. Modern Power System Analysis, D. P. Kothari ,McGraw Hill, 4th Edition, 2011 2. Computer Methods in Power Systems Analysis, Glenn W Stagg, Ahmed H Ei – Abiad, Scientific International Pvt. Ltd., 1stEdition, 2019	
Reference Books: 1. Computer Techniques in Power System Analysis, M.A. Pai, McGraw Hill, 2ndEdition, 2006 2. Power System Analysis, HadiSaadat, McGraw Hill, 2ndEdition, 2002	
Alternate Assessment Tools (AATs) suggested: • Load flow solution using Newton Raphson method in MATLAB • Study of Faults using suitable Simulation package	
Web links and Video Lectures (e-Resources): https://nptel.ac.in/courses/108102047 https://nptel.ac.in/courses/108105067 https://nptel.ac.in/courses/108104051	

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING Choice Based Credit System (CBCS) applicable for 2021 Scheme SEMESTER – VII			
TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT (3:0:0) 3 (Professional Elective-IV) (Effective from the academic year 2024-25)			
Course Code	**21EE743**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Prepare maintenance schedule of different equipment and machines
2. Prepare trouble shooting chart for various electrical equipment, machines and domestic appliances
3. Demonstrate the procedure of different types of earthing for different types of electrical installations
4. Be Familiar about electrical safety regulations and rules during maintenance.

Preamble: Power Systems and Industrial Plants consist of number of electrical drives, transformers, circuit breakers and other equipment which require installation, commissioning and regular maintenance to prevent permanent break down. It is required to carry out/supervises installation, commissioning and maintenance of various electrical equipment in power stations, substations and industry. This course will enable the students to understand the concepts, principles and acquire basic skills of installation, commissioning and maintenance of electrical equipment in power stations, substations and industry.

Module – 1

INSTALLATION OF ELECTRICAL EQUIPMENT: Inspection, storage, foundation and handling of transformer, motor and generator at site. Tools, Accessories and instruments required for installation. Maintenance of electrical equipment -Transformer, motor, alternators and substation equipment. Indian Electricity rules. Electric Safety. Workmen's safety devices. (8 hours)

Module – 2

TESTING OF TRANSFORMERS: General Requirements for Type, Routine and Special Tests, Measurement of winding resistance; Measurement of voltage ratio and check of voltage vector relationship; Measurement of impedance voltage/short-circuit impedance and load loss; Measurement of no-load loss and current; Measurement of insulation resistance; Dielectric tests; Temperature-rise, insulation and HV test, dielectric absorption, switching impulse test. testing of power transformer, distribution transformer, CVT and special transformer with reference to Indian Standard (IS). Drying out procedure for transformer. PI index. Commissioning steps for transformer, Troubleshooting & Maintenance of transformer. (8 hours)

Module – 3

INSTALLATION AND COMMISSIONING OF ROTATING ELECTRICAL MACHINES: Degree of protection, cooling system, degree of cooling with IP- IC code (brief discussion), enclosures, rating of industrial rotating electric machine, installation, commissioning and protection of induction motor and rotating electric machine, drying out of electric rotating machine, insulation resistance measurement, site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator, protection and automation of synchronous generator, synchronous motor. (8 hours)

Module – 4

SWITCH GEAR & PROTECTIVE DEVICES:

Standards, Classification, specification, rating and duties of CB, installation, commissioning tests, maintenance schedule, type & routine tests. Operation of s/s (steps) for line Circuit breaker maintenance. Location of lightening arrester with reasons. (8 hours)

Module – 5

DOMESTIC INSTALLATIONS:

Objectives, IE Rules for Domestic Installation, Safety Management during Operation and Maintenance, Clearance and Creepages, Electric Shock, need of Earthing, different methods of Earthing, factors affecting the Earth Resistance, methods of measuring the Earth Resistance, Equipment Earthing and System Grounding, Earthing Procedure - Building installation, Domestic appliances, Industrial premises, Earthing of substation, generating station and overhead line. (8 hours)

Course Outcomes:

The students will be able to:

CO1:	Differentiate the performance specifications of transformer and rotating electrical machines.
CO2:	Demonstrate the routine tests for synchronous machine, induction motor, transformer & switchgears.
CO3:	Describe the process to plan, control and implement commissioning of electrical equipments
CO4:	Describe the different methods of earthing and the procedure of installation.

Textbooks:

1. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi
2. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, 2008.

References:

1. Philip Kiameh, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGrawHill, 2003.2.
2. R.P Singh "Electrical Workshop, Safety, Commissioning , Maintenance & testing of electrical equipment",I.K International Publishing House Pvt Ltd.
3. Relevant Indian Standards (IS Code) and IEEE Standards for-Installation, maintenance and commissioning of electrical equipment/machines
4. Dr.Ramesh L. Chakrasali "Testing and Commissioning of Electrical Equipment", Prism Engineering Education Series.

Alternate Assessment Tools (AATs) suggested:

1. Report on a visit to nearby industry/substation to observe installation/commissioning and troubleshooting of various electrical equipment and machines.
2. 2. Attend an expert lecture of the professional engineers involved in installation, commissioning and testing of heavy power equipment/machines.

Web links / e – resources:

1. http://www.bis.org.in/index.asp

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Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER – VII

DIGITAL SIGNAL PROCESSING (3:0:0) 3

(Professional Elective-IV)

(Effective from the academic year 2024-25)

Course Code	**21EE744**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the fundamental properties and definitions of Discrete Fourier Transforms (DFT), including linearity, shift, and symmetry.
2. Learn efficient techniques for computing DFT, such as circular convolution, periodic convolution, and methods like overlap-add and overlap-save.
3. Master the implementation and computational efficiencies of Fast Fourier Transform (FFT) algorithms, including decimation in time and decimation in frequency methods.
4. Gain proficiency in designing Infinite Impulse Response (IIR) digital filters using impulse invariant transformation, bilinear transformations, and frequency transformations.
5. Explore the design principles and techniques for Finite Impulse Response (FIR) digital filters, including windowing methods (e.g., Hamming, Hanning) and frequency sampling techniques.

Preamble: Digital signal processing (DSP) utilizes digital techniques and computing devices for signal processing, distinguishing it from analog methods. Despite its greater complexity and the loss of resolution inherent in analog-to-digital conversion, DSP offers unconditional stability. Through error detection and correction techniques, digital signals can be stored, transmitted, and reproduced accurately across generations. This chapter explores DSP theory and imparts practical knowledge necessary for understanding operational DSP systems.

Module – 1

Discrete Fourier Transforms: Definitions, properties-linearity, shift, symmetry Properties- circular convolution – periodic convolution, use of tabular arrays, circular arrays, Stock ham's method, linear convolution – two finite duration sequence, one finite & one infinite duration, overlap add and save methods. (8 hours)

Module – 2

Fast Fourier Transforms Algorithms : Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, Inverse radix – 2 algorithms. (8 hours)

Module – 3

Design of IIR Digital Filters: Introduction, impulse invariant transformation, bilinear transformations, All pole analog filters - Butterworth & Chebyshev filters, design of digital Butterworth filter by impulse invariant transformation and bilinear transformation, Frequency transformations. (8 hours)

Module – 4

Design of IIR Digital Filters (Continued): Design of digital Chebyshev –type 1filter by impulse

invariant transformation and bilinear transformation, Frequency transformations.
Realization of IIR digital systems: direct form, cascade form and parallel form. (8 hours)

Module – 5

Design of FIR Digital Filters: Introduction, windowing, rectangular, modified rectangular. Hamming, Hanning, design of FIR digital filters by use of windows, Design of FIR digital filters-frequency sampling techniques.
Realization of FIR systems: direct form, cascade form, linear phase form. (8 hours)

Course Outcomes:
The students will be able to:

CO1:	Determine the DFT of signals and the convolution of signals.
CO2:	Apply FFT algorithms to find the Fourier Transforms of signals by DIT and DIF methods
CO3:	Design IIR filters like Butterworth and Chebyshev
CO4:	Design FIR filters like Hamming, Hanning etc. with an understanding of frequency sampling techniques
CO5:	Realize IIR and FIR filters in direct form I and II

Textbooks:
1. Digital Signal Processing, A.NagoorKani McGraw Hill 2nd Edition, 2012
2. Digital Signal Processing, Ashok Amberdar, Cengage Publications 1stEdition, 2007

References:
1. Digital Signal Processing – Principles, Algorithms, and Applications, Jhon G. Proakis, Dimitris G. Manolakis, Pearson 4th Edition, 2007.
2. Introduction to Digital Signal Processing Jhonny R. Jhonson Pearson 1st Edition, 2016

Alternate Assessment Tools (AATs) suggested:
- Obtaining the FFT and further analysis of a given signal
- Filter design and its application on an audio signal

Web links / e – resources:
1. **https://github.com/openlists/DSPResources**
2. **https://www.analog.com/en/resources/technical-books/scientist_engineers_guide.html**

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme
SEMESTER -VII

PROGRAMMABLE LOGIC CONTROLLERS(3:0:0)3
(Professional Elective-IV)
(Effective from the academic year 2022-23)

Course Code	**21EE745**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40 Hours	Exam Hours	3

Course objectives:

1. Gain a comprehensive understanding of how automation and control systems work in industrial and manufacturing environments.
2. Acquire the skills to program, debug, and troubleshoot PLC systems.
3. Improve employability and readiness for roles in industrial automation, manufacturing, and other sectors that rely on PLCs.

Preamble: This course is designed to provide a comprehensive understanding of PLCs, which are fundamental components in industrial automation and control systems.

Module –1

Introduction to PLCs: Overview of industrial automation and control systems, Evolution and history of PLCs, Basic components of a PLC system: CPU, input/output modules, programming device, Advantages of, PLCs over traditional relay-based control systems, Applications of PLCs in various industries, Safety considerations when working with PLCs. (8 hours)

Module –2

PLC Hardware and Architecture: Detailed study of PLC hardware components and their functions, Types of input/output modules: digital inputs, digital outputs, analog inputs, analog outputs, Understanding PLC memory: program memory, data memory, retentive memory, PLC rack and module configurations. (8 hours)

Module –3

PLC Programming Fundamentals: Introduction to PLC programming languages: ladder logic, function block diagrams, structured text, Basic instructions and programming techniques in ladder logic programming, Writing and understanding ladder logic programs for simple control tasks, Using timers, counters, and comparators in PLC programs, Introduction to advanced programming concepts: sequencers, shift registers, math functions. (8 hours)

Module-4

Advanced PLC Programming: Advanced programming techniques for complex control tasks, Implementing PID control loops in PLCs, Introduction to data handling and manipulation instructions, Working with data tables, arrays, and data logging in PLCs, Troubleshooting and debugging PLC programs, Case studies and real-world examples of advanced PLC applications. (8 hours)

Module-5

PLC Networking and Integration: Overview of PLC networking: Ethernet/IP, Modbus, Profibus, DeviceNet, Interfacing PLCs with HMI (Human-Machine Interface) systems, Integration of PLCs with SCADA (Supervisory Control and Data Acquisition) systems, monitoring and control of PLC systems, Introduction to Industry 4.0 and the role of PLCs in smart manufacturing. (8 hours)

Course outcomes:

The students will be able to:

CO1: Discuss history of PLC and describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.

CO2: Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
CO3: Analyze PLC timer and counter ladder logic programs and describe the operation of different program control instructions
CO4: Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
CO5: Discuss networking and integration of PLCs

Textbooks:

1.Programmable Logic Controllers, Frank D Petruzella, McGraw Hill, 4th Edition, 2011

Reference Books:

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

Alternate Assessment Tools (AATs) suggested:

- Writing Ladder Logic diagrams for some industry applications

Web links / e – resources:

1. https://www.g-w.com/programmable-logic-controllers-2023

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING Choice Based Credit System (CBCS) applicable for 2021 Scheme **SEMESTER – VII**			
Artificial Intelligence in Power Systems (3:0:0) 3 (Open Elective- II) (Effective from the academic year 2024-25)			
Course Code	**21EE751**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

- Gain a comprehensive understanding of the national grid, regional load dispatch centers, and various components of power systems including generation, transmission, and distribution.
- Study various AI techniques including Artificial Neural Networks (ANN), Fuzzy Logic, Expert Systems, and Genetic Algorithms and applications of these AI techniques in different aspects of power systems.
- Investigate the role of AI in solar power systems, including solar irradiance, PV characteristics, and forecasting methods.
- Understand the characteristics of modern power grids and the application of AI techniques in grid management, fault detection, and stability assessment.
- Examine the integration of machine learning with SCADA systems, including intrusion detection, feature selection, and model development.
- Learn about advanced machine learning techniques for load forecasting, including evolutionary algorithms, wavelet transforms, and optimization algorithms.

Preamble: The course on Artificial Intelligence in Power Systems aims to provide a comprehensive understanding of how AI technologies can be leveraged to optimize the operation, management, and security of power systems. Students will gain insights into the integration of AI techniques such as neural networks, fuzzy logic, and genetic algorithms in addressing challenges related to load forecasting, renewable energy management, grid stability, and more. This course equips students with the skills necessary to innovate and contribute to the future advancements in the field of power systems leveraging Artificial Intelligence.

Module – 1

Introduction to Power System: National grid classification, Regional load dispatch centres, Generation, Transmission, Distribution of power, Line diagram, Substation Equipment, Challenges in Power System - load forecasting, Maintenance schedule of substation equipment, Power system security, Renewable Energy Integration, Smart Grid. (8 hours)

Module – 2

Introduction to Artificial Intelligence: Artificial Intelligence, Need for AI in Power systems, Artificial Intelligence Techniques- Artificial Neural Networks (ANN), Advantages, Disadvantages, Fuzzy Logic, Fuzzy Logic Controller, Expert Systems, Advantages, Disadvantages, Genetic Algorithms, Applications.
Machine Learning: Types of Machine Learning, Data Preprocessing, Performance Evaluation, Block diagram of machine learning process, Current Application of AI In Power Systems. Ethical and Security Considerations in AI for Power Systems. (8 hours)

Module – 3

AI in Solar Power System: Introduction, Solar Irradiance, IV and PV characteristics of solar panel, Solar power forecasting using linear regression, MPPT Techniques using Fuzzy Logic controller, Artificial Neural Network, Genetic Algorithm and Machine Learning, Merits and Demerits, Numerical on Solar power forecasting only. (8 hours)

Module – 4
AI in Modern Power Grid: Introduction, Modern Power Grid characteristics, Artificial intelligence techniques and their applications in Grid management, Faults detection, Power Grid stability assessment, Limitations in Applying Artificial Intelligence to Power Systems. Framework of smart dispatch of power systems, Applications of machine learning in security assessment and smart dispatch. (8 hours)
Module – 5
Machine learning for Power System with SCADA: SCADA Introduction, Machine Learning based Intrusion Detection System Framework, Synthetic data generation and Feature selection, Methodology – Model design and Development. **Machine learning based Load forecasting:** Electrical load study, Load profiles based forecasting, Evolutionary algorithm based STLF model, Wavelet transform-Decomposition, Oppositional Artificial Fish Swarm Optimization algorithm (OAFSA) based feature selection, Water wave optimization (WWO) with Elman neural networks (ENN) model- predictive process. (8 hours)
Course Outcomes: The students will be able to:
1. Understand the importance and application of various power system elements such as generation, transmission, and distribution. 2. Identify and differentiate between various AI techniques including ANN, Fuzzy Logic, Expert Systems, and Genetic Algorithms. 3. Compare and contrast different AI methods for improving the efficiency and reliability of solar power systems. 4. Understand various AI techniques to enhance grid management, detect faults, and assess power grid stability. 5. Explain Machine Learning Models applied to SCADA and Load Forecasting.
References: 1. Gupta J. B, Power System Analysis and Design, 5th ed. New Delhi: S. Chand Publishing, 2021. 2. AurelienGeron, Hands-on Machine Learning with Scikit-Learn &TensorFlow , O'Reilly, Shroff Publishers and Distributors pvt.Ltd 2019 3. M. Zaman, D. Upadhyay and C. -H. Lung, "Validation of a Machine Learning-Based IDS Design Framework Using ORNL Datasets for Power System With SCADA," in IEEE Access, vol. 11, pp. 118414-118426, 2023, doi: 10.1109/ACCESS.2023.3326751. 4. M. Mehedi et al., "Intelligent Machine Learning With Evolutionary Algorithm Based Short Term Load Forecasting in Power Systems," in IEEE Access, vol. 9, pp. 100113-100124, 2021, doi: 10.1109/ACCESS.2021.3096918. 5. Gong, Cihun-Siyong & Su, Chih-Hui & Tseng, Kuei-Hung. (2020). Implementation of Machine Learning for Fault Classification on Vehicle Power Transmission System. IEEE Sensors Journal. PP. 1-1. 10.1109/JSEN.2020.3010291. 6. Huaizhi Wang, Yangyang Liu, Bin Zhou, Canbing Li, Guangzhong Cao, Nikolai Voropai, Evgeny Barakhtenko,Taxonomy research of artificial intelligence for deterministic solar power forecasting,Energy Conversion and Management,Volume 214,2020,112909,ISSN 0196-8904,https://doi.org/10.1016/j.enconman.2020.112909. 7. Linfei Yin, Qi Gao, Lulin Zhao, Bin Zhang, Tao Wang, Shengyuan Li, Hui Liu, A review of machine learning for new generation smart dispatch in power systems, Engineering Applications of Artificial Intelligence, Volume 88, 2020, 103372, ISSN 0952-1976, https://doi.org/10.1016/j.engappai.2019.103372. 8. Nakas, Georgios & Dirik, Alara & Papadopoulos, Panagiotis & Matavalam, Amarsagar & Paul, Oliver & Tzelepis, Dimitrios. (2023). Online Identification of Cascading Events in Power Systems With Renewable Generation Using Measurement Data and Machine Learning.

IEEE Access. PP. 1-1. 10.1109/ACCESS.2023.3294472.
9. Al- Mahmud, Shamsul & Jayathurathnage, Prasad & Tretyakov, Sergei. (2022). Machine Learning Assisted Characteristics Prediction for Wireless Power Transfer Systems. IEEE Access. 10. 1-1. 10.1109/ACCESS.2022.3167162.
10. Stock, Simon & Babazadeh, Davood & Becker, Christian. (2021). Applications of Artificial Intelligence in Distribution Power System Operation. IEEE Access. PP. 1-1. 10.1109/ACCESS.2021.3125102.
11. Rhatrif, Abderrahmane & Bouihi, Bouchra & Mestari, Mohammed. (2024). Challenges and Limitations of Artificial Intelligence Implementation in Modern Power Grid. Procedia Computer Science. 236. 83-92. 10.1016/j.procs.2024.05.008.

Alternate Assessment Tools (AATs) suggested:

- Programming Solar power forecasting using linear regression, Poster Presentation

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/

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B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2021 Scheme

SEMESTER – VII

ELECTRICAL SAFETY AND TROUBLESHOOTING(3:0:0) 3

(Open Elective- II)

(Effective from the academic year 2024-25)

Course Code	**21EE752**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand the fundamentals of electrical components and systems
2. Understand the basics of measuring electrical parameters using various types of instruments.
3. Understand the electrical schematic diagrams and troubleshooting the electrical accessories, switchgear and motors.
4. Gain proficiency about the electrical safety systems and procedures.
5. Familiar with Indian Electricity Act 2003 and understanding earthing methods used for industrial and domestic electric systems.

Preamble: Electrical safety is a system of organizational measures to prevent harmful and dangerous effects on workers from electric current, electric arc, electromagnetic field and static electricity. Safety hazards encompass any type of substance, condition or object that can injure workers. It is mandatory for a product to conform to safety standards promulgated by safety and standard agencies. To conform to such standards, the product must pass safety tests such as the Insulation Resistance Test, Ground Bond & Ground Continuity Test and Leakage Current Test. Troubleshooting is the process of finding the problem within a faulty system and Fixing the problem. Troubleshooting allows us to fix equipment that is no longer working. In general, equipment breaks down because one part is malfunctioning. All of the other parts in the system work as expected. Troubleshooting allows us to replace the bad component instead of the entire system.

Module – 1

Electrical Fundamentals: Basic Tools, Personal Protective Equipment (PPE), Developing Safe Work Practices, Resistor Connections: Series, Parallel, Wye, Delta and Combination. Capacitor and Inductor Connections: Series and Parallel. Short-Circuit, Branches, Nodes, and Loops, Generation of DC, Single & Three-Phase AC and their Circuit Operating Principle, Power System. (8 hours)

Module – 2

Measuring and Testing: Measurement of resistance, current, voltage, power, frequency and RPM. Precautions while measuring resistance, current and voltages, Multimeter, Clamp On Meter, Oscilloscope, Power Quality and Phase Sequence Meter, Insulation Resistance Meter. Measurement of insulation resistance, Motor and transformer resistances. (8 hours)

Module – 3

Electrical Troubleshooting: Electrical Schematic Diagrams, Voltage Levels used in LV Electrical Circuits. Power, Control and Signaling Circuits: Contactors, Relays, Interlocks, etc. Fuse, Circuit Breaker, Overload, Voltage and Frequency Relays. Electrical Timer and Latch Relays. Electrical Switchboards Accessories: Terminal Block, Din Rail, Cable Trunking. Buttons, Switches, Selectors, Siren, Signaling LED. AC and DC Motor Starting and Speed Control Methods. (8 hours)

Module – 4

Electrical Safety: Safety from electricity and fire: Personal Protective equipments (PPE's) used in connection with safe use of electricity like Hand Gloves, Rubber Shoes, Waist belt, , earthing rod, Goggles etc., Safe working clearances for different voltage levels, fire extinguishers used for different applications, knowledge of Static electricity, Lightning protection, Electrical Safety Audit, elementary knowledge of first aid. (8 hours)

Module – 5

Electricity Act,2003: Act, Safety Regulations and relevant Code and Standards.

Earthing: Types of system earthing, fault level calculations, type of earthing–rod/plate, earth conductor sizes, earth resistance measurement and test equipment used, earthing of substation apparatus, transmission and distribution lines/towers, earthing at consumer premises, earthing of industrial and domestic equipment. (8 hours)

Course Outcomes:

The students will be able to:

CO1:	Analyse the basic electrical tools, components and select appropriate instruments for the measurement of various electrical parameters and analyse the methods to test electrical circuits.
CO2:	Analyse the electrical schematic diagrams and troubleshoot electrical equipment/systems.
CO3:	Analyse the equipment and methods used for electrical safety.
CO4:	Analyse the safety regulations and earthing systems used for electrical safety.

Textbooks:

1. Industrial Electrical Troubleshooting, Lynn Lundq, ETA Publication, 1st Edition, 2014
2. Testing, Commissioning, Operation and Maintenance of Electrical Equipment, Sunil S Rao, Khanna Publishers, 2024

References:

1. Electrical Safety Handbook, Dennis K Neitzel, McGraw Hill Publishers, 5th edition, 2019.
2. Electrical Safety Handbook, John Cadick, McGraw Hill Publishers, 4th edition, 2014.

Alternate Assessment Tools (AATs) suggested:

- Measuring various electrical parameters of electrical equipment.
- Analysing IE Rules and various electrical earthing methods.

Web links / e – resources:

1. https://nttinc.com/blog/troubleshooting-common-electrical-problems/
2. https://cercind.gov.in/Act-with-amendment.pdf
3. https://powermin.gov.in/en/content/electricity-act-2003

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING Choice Based Credit System (CBCS) applicable for 2021 Scheme **SEMESTER – VII**			
SMART LIGHTING SYSTEMS DESIGN (3:0:0) 3 (Open Elective- II) (Effective from the academic year 2024-25)			
Course Code	**21EE753**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Explaining the fundamental concepts of natural and artificial lighting schemes
2. Explaining the laws of illumination and lighting schemes
3. Explaining about design concepts of interior lighting systems
4. Discuss about design concepts of outdoor and flood lighting systems
5. Discuss about smart lighting systems

Preamble: Illumination engineering is a specialized field focusing on the design and implementation of lighting systems. This course offers a deep dive into the design of lighting systems, covering topics like luminous efficiency and light distribution. Understanding the intricacies of light and how it interacts with spaces is crucial for creating efficient and aesthetically pleasing lighting designs. This course will enhance knowledge of illumination engineering and discover the latest trends and techniques in the field.

Module – 1

Introduction of Light: Types of illumination, Day lighting, Artificial light sources- artificial lighting and total lighting, Quality of good lighting, Factors affecting the Physical processes-Incandescent and Halogen lamps, Fluorescent lamps, LPSV and HPSV lamps, mercury vapour lamps, metal halide lamps, LED lamps-modern trends. Supplementary lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting schemes, General and localised, Different types of Luminaires.

(8 hours)

Module – 2

Measurement of Light: Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source. (8 hours)

Module – 3

Design of Interior Lighting: Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Selection of lamp and luminance, Selection of utilisation factor, reflection factor and maintenance factor, Determination of Lamp Lumen output taking into account voltage and temperature variations, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaire, Calculation of space to mounting height ratio, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building. (8 hours)

Module – 4

Design of Outdoor Lighting: Street Lighting - Types of street lighting and their level of illumination

required, Terms related to street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of illumination level available on road. Tunnel
Lighting, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio.
Flood Lighting: Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, recommended method for aiming of lamp, Calculation of their wattage and number and their arrangement, Calculation of space to
mounting height ratio. (8 hours)

Module – 5

Smart Lighting: Lighting controllers – dimmers, motion and occupancy sensors, photo sensors and timers, Lighting Automation, Lighting system design using softwares (eg: DIALux and Relux).
(8 hours)

Course Outcomes:
The students will be able to:

CO1:	Select appropriate lighting sources for different systems.
CO2:	Apply lighting intensities required for different locations.
CO3:	Design interior, outdoor and flood lighting systems
CO4:	Design smart lighting systems

Textbooks:
1. Lighting, D.C. Pritchard, Routledge, 2016
2. Jack L. Lindsey, Applied Illumination Engineering, PHI, 1991

References:
1. Lamps and Lighting , M.A. Cayless, Routledge, 1996
2. Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications, Craig DiLouie, CRC Press, 2005
3. 3. Lighting Engineering Applied calculations R. H. Simons and A. R. Bean, Routledge;
4. 1st edition, 2020

Alternate Assessment Tools (AATs) suggested:
- Design of lighting system for a auditorium
- Design of outdoor lighting system.

Web links / e – resources:
1. **https://www.signify.com/global/lighting-academy/browser/course/lightingtheory-essentials**
2. **https://youtu.be/GbHGRMv7rDE**

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING Choice Based Credit System (CBCS) applicable for 2021 Scheme **SEMESTER – VII**			
Battery Management System (3:0:0) 3 (Open Elective- II) (Effective from the academic year 2024-25)			
Course Code	**21EE754**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Learn the various Battery Management System parts.
2. Understand basic information about batteries.
3. Learn to measure different battery parameters.
4. Estimate state of charge of the battery.
5. Estimate state of health of the battery.

Preamble: A battery management system has a significant impact on practicality, stability, and function detection. The voltage, temperature, and current measurements are more accurate in terms of detection. Combining contemporary large scale integrated circuit technology improves the stability of the system's anti-interference ability. Lithium ion batteries are still in the test and small-scale application stages in terms of practicality. The industry's lack of awareness is the reason why, despite certain advancements in battery management system measurement precision, durability, and other aspects, systematic induction of lithium ion battery performance is still lacking. Even though the circuit functions of the battery management system are comparatively complete, systematic measurement and research are still lacking in the areas of group battery charging, thermal management, effective battery utilisation, and status estimation.

Module – 1

Battery Management System parts: The Power Module (PM), The battery, The DC/DC converter, load, communication channel, Examples of Battery Management Systems, Comparison of BMS in a low-end and high-end shaver, Comparison of BMS in two types of cellular phones.

Basic information on batteries: Battery systems, Definitions Battery design, Battery characteristics, General operational mechanism of batteries, Basic thermodynamics, Kinetic and diffusion over potentials, Double-layer capacitance, Battery voltage. (8 hours)

Module – 2

Lithium-Ion Battery Fundamentals: Battery Operation, Battery Construction, Battery Chemistry, Safety Longevity, Performance, Integration.

Measurement of battery parameters: Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management System Performance. (8 hours)

Module – 3

Battery Management System Functionality: Charging, Strategies, CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes.

Charge Balancing: Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults. (8 hours)

Module – 4

Battery charging algorithms: Charging algorithms for NiCd and NiMH batteries, charging modes, end-of-charge triggers and charger features, Differences between charging algorithms for NiCd and NiMH batteries, Simulation example: an alternative charging algorithm for NiCd batteries, Charging algorithm for Li-ion batteries, The influence of charge voltage on the charging process, The influence of charge current on the charging process, Simulation example: fast charging of a Li-ion battery. (8 hours)

Module – 5

Software Implementation: Safery-Critical Software, Design Goals, Analysis of Safety-Critical Software, Validation and Coverage, Model Implementation, Balancing, Temperature Impact on State of Charge Estimation. (8 hours)

Course Outcomes:

The students will be able to:

CO1:	Review various Battery Management System parts.
CO2:	Clarify the basic information about batteries and demonstrate Lithium-Ion Battery Fundamentals.
CO3:	Measure different battery parameters and analyse battery performance to identify Battery Management System Functionality.
CO4:	Understand the need of various algorithms on battery charging.
CO5:	Understand the software implementation on battery.

Textbooks:

1. H. J. Bergveld, "Battery management systems: Design by modelling" University Press Facilities, Eindhoven,2001.
2. Phillip Weicker, "A Systems Approach to Lithium-Ion Battery Management", artech house, 2014

References:

1. Gregory L. Plett, "Battery Management Systems: Battery Modeling", Artech house, 2015
2. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, "Electrochemical Power Sources: Primary & Secondary Batteries", IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.

Alternate Assessment Tools (AATs) suggested:

- Poster presentation on different types of Batteries.
- Simscape Battery Onramp.

Web links / e – resources:

1. **https://matlabacademy.mathworks.com/details/simscape-battery-onramp/orsb.**
2. **https://files.isec.pt/DOCUMENTOS/SERVICOS/BIBLIO/Sumarios_Monografias/Systems-approach-lithium-ion-battery_Weicker.pdf.**
3. **https://www.scribd.com/doc/83208581/Battery-Management-Systems-Design-by-Modelling-Book.**