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 Semester Scheme and Syllabus 2022 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.**

ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮತ್ತು ವ್ಯವಸ್ಥಾಪನಾ ಮಹಾವಿದ್ಯಾಲಯ

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/ 104 **Date:** 21.09.2024

CONTINUOUS INTERNAL EVALUATION (CIE) AND SEMESTER END EXAMINATION (SEE) PATTERN

(Applicable to UG students admitted from the 2022 batch, effective from the Academic year 2024-25 onwards)

The UG students admitted from the 2022 batch onwards are hereby informed to note the following regarding Continuous Internal Evaluation and Semester End Examination pattern:

- The Weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Examination (SEE) is 50%.
- The Minimum passing mark for the CIE is 40% of the Maximum marks (i.e. 20 marks out of 50) and for the SEE minimum passing mark is 35% of the Maximum marks (i.e. 18 out of 50 marks).
- A student will be declared to have passed the course if they secure a minimum of 40% (i.e. 40 marks out of 100) in the combined total of the CIE and SEE.

The following tables summarize the CIE and SEE Patterns for the courses of various credits:

INTEGRATED **P**ROFESSIONAL **C**OMPETENCE **C**OURSE (IPCC) COURSES
4 OR 3 CREDITS

Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Theory Component	CIE - Internal Assessment (IA) Tests	CIE – Test 1 (1.5 hr)	40	20	-	The sum of the two internal assessment tests will be **80 Marks** and the same shall be scaled down to **20 Marks**.
		CIE – Test 2 (1.5 hr)	40			
	CIE – CCA (Comprehensive Continuous Assessment)	CCA	10	10	-	Any one assessment method can be used from the list appended below.
	Total CIE Theory			**30**	**12**	
Practical Component	CIE - Practical		30	10	-	Each laboratory experiment is to be

					assessed for **30 Marks** using appropriate rubrics.
	CIE Practical Test	20	10	-	One test after all experiments to be conducted for **20 Marks**
	Total CIE Practical		**20**	**08**	
Total CIE Theory + Practical			**50**	**20**	
SEE		100	50	18	SEE exam is a theory exam, conducted for **100 Marks**, scored marks are scaled down to **50 Marks.**
CIE + SEE			**100**	**40**	

Note: The assessment of the laboratory component for the IPCC courses shall be restricted to CIE only.

PROFESSIONAL **C**ORE **C**OURSES (PCC) / **E**NGINEERING **S**CIENCE **C**OURSES (ESC)

03 OR 02 CREDITS

Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Theory Component	CIE – IA Tests	CIE – Test 1 (1.5 hr)	40	30	-	The sum of the two internal assessment tests will be **80 Marks** and the same will be scaled down to **30 Marks**.
		CIE – Test 2 (1.5 hr)	40			
	CIE - CCAs	CCA	20	20	-	Any Two assessment methods can be used from the list. If it is project-based, one CCA shall be given.
	Total CIE Theory			**50**	**20**	
SEE			100	50	18	SEE is a theory exam, conducted for **100 Marks**, scored marks are scaled down to **50 Marks.**
CIE + SEE				**100**	**40**	

NON-IPCC COURSES **01 CREDIT – MULTIPLE CHOICE QUESTION TYPE**						
Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Continuous Internal Evaluation Component	CIE – IA Tests (MCQs)	CIE – Test 1 (1 hr)	40	40	-	The question paper pattern for this course shall be an **MCQ** of **1 or 2 Marks (s).** The questions with 2 Marks can be framed based on a higher Bloom's level. The sum of the two internal assessment tests will be **80 Marks**, and the same will be scaled down to **40 Marks**.
		CIE – Test 2 (1 hr)	40			
	CIE - CCAs	CCA	10	10	-	Any One Assessment method can be used from the list provided below.
	Total CIE			**50**	**20**	
SEE (MCQ Type)				50	18	The question paper pattern for this course shall be an **MCQ** of **1 or 2 Marks (s).** The questions with 2 Marks can be framed based on higher Bloom's level. MCQ-type question papers of 50 questions with each question of a **01 Mark**, the examination duration is 01 hour.
CIE + SEE				**100**	**40**	

PROFESSIONAL CORE COURSE LABORATORY (PCCL) / ABILITY ENHANCEMENT COURSE LABORATORY (AEC) 01 CREDIT					
Evaluation Type	**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Continuous Internal Evaluation	CIE - Practical	30	30		Each laboratory experiment is to be evaluated for **30 Marks** using appropriate rubrics.
	CIE - Practical Test	50	20		One test after all experiments is to be conducted for **50 Marks** and to be scaled down to **20 Marks**.
	Total CIE	-	**50**	**20**	
Semester End Examination		100	50	18	SEE to be conducted for **100 Marks**.
CIE+SEE		**100**		**40**	

NON-IPCC / ABILITY ENHANCEMENT COURSE (AEC) **01 CREDIT – DESCRIPTIVE TYPE**						
Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Theory Component	CIE – IA Tests	CIE – Test 1 (1.5 hr)	40	30	-	The sum of the two internal assessment tests will be **80 Marks** and the same will be scaled down to **30 Marks**.
		CIE – Test 2 (1.5 hr)	40			
	CIE - CCAs	CCA	20	20	-	Any Two assessment methods can be used from the list. If it is project-based, one CCA shall be given.
	Total CIE Theory			**50**	**20**	

SEE	100	50	18	SEE is a theory exam, conducted for **100 Marks for 02 Hours duration**, scored marks are scaled down to **50 Marks.**
CIE + SEE		**100**	**40**	

COMPUTER AIDED ENGINEERING DRAWING (BCEDK103/BCEDK203) **3 CREDIT**								
Evaluation Type		**Topics/ Modules**	**Computer Printout**	**Preparatory Sketch**	**Max Marks**	**Total Marks**	**Marks to be Scaled Down to**	**Min Marks to Pass**
CIE	**Sketch Book and CAD Modelling**	Projection of Points	10	05	15	200	20	-
		Projection of Lines	10	10	20			
		Projection of Planes	20	15	35			
		Projection of Solids	40	20	60			
		Isometric Projections	20	15	35			
		Development of lateral surfaces	20	15	35			
	Test 1	Module 1 & 2	24	06	30	70	20	-
		Module 3	32	08	40			
	Test 2	Module 3	32	08	40	70		
		Module 4	24	06	30			
	CCA 1	Module 5	08	02	10	10	10	-
	CCA 2	Module 5	08	02	10			
CIE Total							**50**	**20**
SEE		Module 1 & 2	24	06	30	100	**50**	**18**
		Module 3	32	08	40			
		Module 4	24	06	30			
CIE + SEE							**100**	**40**

COMPUTER AIDED MODELLING FOR MANUFACTURING (BME305) **1 CREDIT**								
Evaluation Type		**Topics/ Modules**	**Computer Printout**	**Preparatory Calculations / Sketch**	**Max Marks**	**Total Marks**	**Marks to be Scaled Down to**	**Min Marks to Pass**
CIE	**Sketch Book and CAD Modelling**	Module 1	60	30	90	200	20	
		Module 2	40	20	60			
		Module 3	40	10	50			
	Test 1	Module 1	20	10	30	60	20	-
		Module 2	20	10	30			
	Test 2	Module 1	20	10	30	60		
		Module 3	20	10	30			
	CCA	Module 1	30	10	40	40	10	-
CIE Total							**50**	**20**
SEE		Module 1	30	10	40	100	**50**	**18**
		Module 2	20	10	30			
		Module 3	20	10	30			
CIE + SEE							**100**	**40**

Learning Activities for CCAs:

A faculty member may choose the following CCAs 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 2022, 2023, and 2024 batch.
3. Examination Section

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institution Affiliated to VTU, Belagavi)

B. E. in Electrical & Electronics Engineering

Scheme of Teaching and Examinations – 2022 Scheme

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS) (Effective from the academic year 2022-23 onwards)

VII Semester

Sl. No.	Course Category	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Credits Distribution				Examination				Contact Hours/week
					L	T	P	Total	CIE Marks	SEE Marks	Total Marks	SEE Duration (H)	
1	IPCC	BEE701	Power System Analysis-2	TD: EE PSB: EE	3	0	1	4	50	50	100	3	4
2	PCC	BEE702	Switchgear and Protection		3	0	0	3	50	50	100	3	3
3	PEC	BEE703X	Professional Elective Course III		3	0	0	3	50	50	100	3	3
4	OEC	BEE704X	Open Elective Course II		3	0	0	3	50	50	100	3	3
5	PW	BEEP705	Major Project Phase II		0	0	7	7	100	100	200	3	14
6	PCCL	BEEL706	High Voltage Laboratory		0	0	1	1	50	50	100	3	2
TOTAL								**21**	**350**	**350**	**700**	**-**	

IPCC: Integrated Professional Core Course, **PCC**: Professional Core Courses, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC**: Non Credit Mandatory Course, **ESC**: Engineering Science Course **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Integrated Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L: T: P) can be considered as (3: 0: 2) or (2: 2: 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

Professional Elective Course III		Open Elective Course II	
Course Code	**Course Name**	**Course Code**	**Course Name**
BEE703A	Industrial Drives and Applications	BEE704A	Programmable Logic Controller
BEE703B	Utilization of Electric Power	BEE704B	Electric Vehicle Technology
BEE703C	Battery Management Systems	BEE704C	Sensors and Transducers
BEE703D	Electrical power Quality	BEE704D	Smart Lighting System Design

National Service Scheme /Physical Education/Yoga/NCC/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Open Elective Courses (OEC): Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the program.
- The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the program.
- The minimum students' strength for offering open electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.

Major Project Phase II: The objective of the Project work is (i) To encourage independent learning and the innovative attitude of the students. (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills. (iii) To impart flexibility and adaptability. (iv) To inspire teamwork. (v) To expand intellectual capacity, credibility, judgment and intuition. (vi) To adhere to punctuality, setting and meeting deadlines. (vii) To instill responsibilities to oneself and others. (viii)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.

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2022 scheme

SEMESTER – VII

Power System Analysis-2 (3:0:1) 4

(Effective from the academic year 2024-25)

Course Code	BEE701	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:1	SEE Marks	50
Total Number of Contact Hours	40+12 Lab	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 develop admittance and impedance matrices of interconnected power systems.
- To explain the use of suitable standard software package.
- To solve power flow problem for simple power systems.
- To discuss optimal operation of generators on a bus bar and optimum generation scheduling.
- To explain numerical solution of swing equation for multi-machine stability.

Preamble: This course provides an integrated understanding of power system analysis, combining theoretical concepts with practical applications. Students will model and analyze interconnected power systems, solve load flow problems, study optimal scheduling of generators, and perform stability analysis using standard software tools and laboratory experiments.

Module – 1

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

Module – 2

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

Module – 3

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

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.

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. Zbus. Algorithm for Short Circuit Studies excluding numerical.

Power System Stability: Numerical Solution of Swing Equation by Point by Point method and Runge Kutta Method excluding numerical.

Practical components for IPCC

Sl. No	Experiments
1.	To obtain Swing Curve and to Determine Critical Clearing Time, Regulation, Inertia Constant/Line Parameters /Fault Location/Clearing Time/Pre-Fault Electrical Output for a Single Machine connected to Infinite Bus.
2.	Y-Bus Formation for Power Systems with and without Mutual Coupling, by Singular Transformation
3.	Y-Bus Formation for Power Systems without Mutual Coupling, by Inspection method

4.	Load Flow Analysis using Gauss Siedal Method for the system with both PQ buses and PV Buses. By simulation
5.	Formation of Jacobian matrix in Polar Coordinates, for a System having less than 4 Buses.
6.	Determination of Bus Currents, Bus Power and Line Flows, for a Specified System Voltage.
	Open Ended Experiments:
7.	Formation of Z-Bus (without mutual coupling) using Z-Bus Building Algorithm.
8.	Load Flow Analysis using NR Method for the system with both PQ buses and PV Buses.
9.	Load Flow Analysis using Fast Decoupled Method for the system with both PQ buses and PV Buses.
10	Optimal Generation Scheduling for Thermal power plants.

Course Outcomes:

The students will be able to:

CO1: Develop network matrices and models for solving load flow problems.
CO2: Perform steady state power flow analysis of power system using numerical iterative techniques.
CO3: Apply optimization techniques to solve economic load dispatch problems in power systems.
CO4: Model symmetrical fault conditions in power systems using the bus impedance matrix approach.
CO5: Apply Point by Point method, and Runge Kutta Method to solve Swing Equation.

Textbooks:

1. Modern Power System Analysis, D P Kothari, I J Nagrath, 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.

References:

1. Power Generation Operation and Control, AllenJ Wood etal, Wiley, 2nd Edition, 2016.
2. Computer Techniques in Power System Analysis, M.A. Pai,McGraw Hill, 2ndEdition, 2012.
3. Power System Analysis, Hadi Saadat, McGraw Hill, 2nd Edition, 2002.

Comprehensive Continuous Assessment (CCA) suggested:

- Load Flow Studies – Case Analysis of Our College Campus, IEEE 30- bus system

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 2022 scheme

SEMESTER – VII

Switchgear and Protection (3:0:0) 3

(Effective from the academic year 2024-25)

Course Code	BEE702	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 discuss performance of protective relays, components of protection scheme and relay terminology.
- To explain Over current protection using electromagnetic and static relays and Over current protective schemes and microprocessor -based Protective Relays.
- To discuss pilot protection; wire pilot relaying and carrier pilot relaying differential protection, protection of generators, motors, Transformer and Bus Zone Protection.
- To explain the principle of circuit interruption and different types of circuit breakers.
- To describe the construction and operating principle of different types of fuses and to give the definitions of different terminologies related to a fuse.
- Experimentally verify the characteristics of over current, over voltage, under voltage using electromagnetic, static, distance and impedance relays.
- To discuss protection Against Over voltages and Gas Insulated Substation (GIS).
- To discuss the construction, operating principles and performance characteristics of protective devices.
- To conduct experiments and verify the characteristics of electromechanical and microprocessor based relays.
- To verify the operation of motor protection for different faults.

Preamble: The subject Switchgear and Protection introduces students to the essential components and strategies used to detect, isolate, and protect power systems from faults and abnormalities. It emphasizes the design and application of circuit breakers, relays, fuses, and protection schemes for various electrical components like generators, transformers, transmission lines, and distribution networks. The course also develops an understanding of power system stability, fault analysis, and coordinated protection practices to ensure system reliability and safety.

Module – 1

Introduction to Power System Protection: Need for protective schemes, Nature and Cause of Faults, Types of Fault, Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.

Fuses: Introductions, Definitions, Fuse Characteristics, Types of Fuses, Applications of HRC Fuses, Selection of Fuses.

Circuit Breakers: Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping.

Module – 2

Circuit Breakers: Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers. (M1)

Relay Construction and Operating Principles: Introduction, Electromechanical Relays – Hinged Armature type and Balanced Beam relays and Induction Relays, Static Relays – Merits and Demerits of Static Relays, Comparators (Difference b/w Amplitude and Phase Comparator), Numerical Relays.

Module – 3

Overcurrent Protection: Introduction, Time – current Characteristics, Current Setting, Time Setting. Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault

Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay.

Module – 4

Pilot Relaying Schemes: Introduction, Wire Pilot Protection – Circulate Current.
Differential Protection: Introduction, Differential Relays, Simple Differential Protection (Normal Condition, External and Internal Fault), Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.
Rotating Machines Protection: Introduction, Protection of Generators – Stator Protection, Percentage differential Protection. Transformer and Bus zone Protection: Introduction, Transformer Protection – Percentage Differential Protection and Buchholz Relay, Bus zone Protection, Frame Leakage Protection.

Module – 5

Numerical Protection: Numerical over current and distance protection (generalized interface).
Wide area measurement application: Introduction, PMU, WAMS architecture, Adaptive relaying - transformer protection, transmission line protection, reclosing, WAMS based protection concepts - supervision of backup zones, intelligent load shedding, load shedding and restoration.

Course Outcomes:

The students will be able to:

CO1: Describe the constructional details of fuses, Circuit Breakers and Relays

CO2: Apply the fundamental Knowledge in explaining the working principle of any power system protection elements

CO3: Relate the power system protection Knowledge to protection of power system elements

CO4: Demonstrate an understanding of numerical protection and WAMS.

Textbooks:

3. Power System Protection and Switchgear Badri Ram, D.N. Vishwakarma McGraw Hill 2nd Edition.
4. Power System Protection and Switchgear Bhuvanesh Oza et al McGraw Hill 1st Edition, 2010.

Reference Books:

1. Protection and Switchgear Bhavesh et al Oxford 1st Edition, 2011.
2. Power System Switchgear and Protection N. Veerappan S.R. Krishnamurthy S. Chand 1st Edition, 2009.
3. Fundamentals of Power System Protection Y.G.Paithankar S.R. Bhide PHI 1st Edition, 2009.

Alternate Assessment Tools (AATs) suggested:

Relay Operation Simulation (Using MATLAB/PSCAD/ETAP/Proteus/MiPower/Multisim etc.).

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in
- http:// acl.digimat.in/nptel/courses/video/108105017/108105017.html

B.E ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VII

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

(Effective from the academic year 2024-25)

Course Code	BEE703A	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 Multiquadrant 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, Multi quadrant 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 workingof 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.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

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.) VedumSubrahmanyam McGraw Hill 2nd Edition, 2011

References:

1. 1. Electric Drives N.K De,P.K. Sen PHI Learning 1st Edition, 2009.

B.E ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - VII

UTILIZATION OF ELECTRICAL POWER (Professional Elective) (3:0:0) 3
(Effective from the academic year 2024-25)

Course Code	BEE703B	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
6.

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, world wide 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: Explain various heating and welding methods available for industrial applications

CO2: Apply the engineering fundamental concepts in the analysis of Electrolysis processes

CO3: Design the lighting systems using the fundamental knowledge

CO4: Analyse speed time curves associated with electric traction

CO5: Select suitable Electrical motors based on performance charactertics for traction applications

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:

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 2022 Scheme

SEMESTER – VII

Electrical Power Quality (3:0:0) 3

(Effective from the academic year 2024-25)

Course Code	BEE703D	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. Review definitions and standards of common power quality phenomena.
2. Understand power quality monitoring and classification techniques.
3. Investigate different power quality phenomena causes and effects.
4. Understand different techniques for power quality problems mitigation.
5. Understand the various power quality phenomenon, their origin and monitoring and mitigation methods.
6. Understand the effects of various power quality phenomenon in various equipment.

Preamble: This course introduces the principles and practices of maintaining reliable, efficient, and distortion-free electricity supply. It covers measurement, analysis, and mitigation of power quality issues such as harmonics, voltage sags, transients, and interruptions, along with their impact on electrical systems and standards for compliance.

Module – 1

Introduction: Power quality-voltage quality, power quality evaluation procedures term and definitions: general classes of power quality problems, transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms.

Module – 2

Voltage sags and interruptions: Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting sags.

Transient over voltages: Sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients.

Module – 3

Transient over voltages: Fundamentals of harmonics: Harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intra harmonics.

Module – 4

Applied harmonics: Harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics.

Power Quality Benchmark: Introduction, benchmark process, power quality contract.

Module – 5

Power quality benchmark: power quality state estimation, including power quality in distribution planning.

Distributed generation and quality: DG technologies, interface to utility system, power quality issues, interconnection standards.

Course Outcomes:

The students will be able to:

CO1: **Explain** power quality concepts, terminology, and applicable standards.

CO2: **Describe** causes and impacts of voltage sags, interruptions, and transients, and outline protective measures.

CO3: **Explain** sources and effects of harmonic distortion in electrical systems.

CO4: **Apply** harmonic mitigation techniques with a thorough knowledge of effectiveness using suitable

case studies or numerical examples.
CO5: **Describe** power quality considerations in distribution planning, including issues related to distributed generation and interconnection.

Textbooks:

1. Electrical Power Quality, Dugan, Roger C, McGraw-Hill, 2003.

References:

1.Electric Power Quality, G.T.Heydt, Stars in a circle Publications, 1991.
2. Understanding power quality problems voltage sags and interruptions, Math H. J., Bollen. , IEEE Press, 2000.
3. Power quality in power systems and electrical machines, Ewald F Fuchs, Mohammad, A.S., Masoum, Academic Press, Elsevier, 2009.

Comprehensive Continuous Assessment (CCA) suggested:

Activity Based Learning- Simulation of VSC and finding THD in MATLAB

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/108/102/108102179/

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER - VI

PROGRAMMABLE LOGIC CONTROLLERS (3:0:0) 3

(Effective from the academic year 2024-25)

Course Code: 21EE751 / 22EE74A	BEE704A	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40 Hours	Total Marks	100
		Exam Hours	3

Course objectives:

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

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.

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.

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.

Module-4

PLC Programming: 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.

Module-5

PLC Networking and Integration: Overview of PLC networking. 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.

Course outcomes:

the student 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

Textbook

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

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS) applicable for 2022 Scheme

SEMESTER – VII

Electric Vehicle Technology (3:0:0) 3

(Effective from the academic year 2024-25)

Course Code	BEE704B	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 understand the basics, architecture, present & Future technologies of EV and market
2. To understand the concept of electric vehicle modelling.
3. To understand the concept of hybrid vehicles.
4. To understand various energy storage technologies.
5. To study about the motors & drives for electric vehicles.
6. To understand the charging technology, methods and vehicle grid interface in electric vehicles

Preamble:

The subject of "Electric Vehicle Technology" introduces the core concepts and technologies underlying electric vehicles (EVs). This course covers the basic components of EVs, including electric vehicle drivetrains, motors, batteries and chargers and explores how these elements work together to drive vehicle performance. Students will learn about the principles of energy storage, electric propulsion, and regenerative braking, as well as the infrastructure required for charging and maintaining EVs. By understanding these fundamentals, students will gain insight into the innovative technologies driving the shift towards cleaner, more efficient transportation solutions.

Module – 1

Introduction to Electric Vehicles: History of Electric Vehicles (EV), Social and Environmental Importance of Electric Vehicles, EV Market- Present and future trends.

Electric Vehicle Modelling: Vehicle resistance- Rolling resistance, Aerodynamic drag and Grading resistance.

EV Configuration – General EV configuration, Possible EV configurations. **(8 hours)**

Module – 2

Electric Drivetrain:

Concept of Hybrid Electric Drivetrains, Architectures of Hybrid Electric Drivetrains, Series Hybrid Electric Drivetrains (Electrical Coupling)- Operation Patterns, control strategies Parallel Hybrid Electric Drivetrains (Mechanical Coupling)- Control Strategies Fundamentals of regenerative braking and dynamic braking in electric vehicles. **(8 hours)**

Module – 3

Electric Vehicle Motors and Control:

DC Motors - Basic principle of Operation, Brushless DC Motor, speed control - Armature voltage, Field control and Chopper control

Induction Motors - Basic principle of Operation, Permanent magnet Synchronous motor (PMSM), Speed control – Stator voltage control, Constant V/f Control

Switched Reluctance Motors (SRM) Drives: Basic principle of Operation, Vibration and Acoustic Noise in SRM. **(8 hours)**

Module – 4

Energy storage for EV and HEV: Energy storage requirements, Battery parameters, Types of Batteries, Principle of operation of Lead acid Battery and Lithium Battery, Modelling of Battery.

Supercapacitors: basic principle, construction and operation.

Fuel Cell- basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Electrode Potential and Current–Voltage Curve, Fuel Cell System Characteristics.

(8 hours)

Module – 5

Charging Technologies: Standards, Conductive Charging (AC & DC), Inductive Charging – (Static and Dynamic), Battery Swap Technology, Termination methods.

DC Fast Chargers: 480V Fast charger, Medium voltage (MV) Fast Charger, Electric Vehicle charging station, Grid Impacts of Fast Chargers, V2H and H2V Power Converter, Solar Generation Integration with Electric Vehicles. **(8 hours)**

Course Outcomes:

The students will be able to:

CO1: Illustrate the historical developments, economical and environmental impact of electric vehicles.

CO2: Apply the electric vehicle modelling techniques, different architectures and control strategies to solve the problems of hybrid electric vehicles

CO3: Analyse the operation, key parameters, performance metrics and charging technologies of energy storage systems used in EVs and HEVs

CO4: Analyse the working principles of different electric motors used in electric vehicles and their speed control techniques.

Textbooks:

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, M. Ehsani, Y. Gao, S. Gay and Ali Emadi, CRC Press, 2005
2. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, CRC Press, 2021

References:

1. A Systems Approach to Lithium-Ion Battery Management, Phillip Weicker, Artech House, 1st Edition ,2014.
2. Electric Vehicle Technology Explained, James Larminie, John Lowry, John Wiley & Sons Ltd, 2012
1. Hybrid, Electric and Fuel Cell Vehicles, Jack Erjavec and Jeff Arias, Cengage Learning, 2012

Web links / e – resources:

1. https://archive.nptel.ac.in/courses/108/106/108106170/

B.E ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – VII

Sensors and Transducers (3:0:0) 3
(Open Elective)
(Effective from the academic year 2024-25)

Course Code	BEE704C	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 understand need of transducers, their classification, advantages and disadvantages
2. To understand the working of different types of transducers and sensors...
3. To understand recent trends in sensor technology and their selection
4. To understand the basics of signal conditioning and signal conditioning equipment.
5. To understand configuration of Data Acquisition System and data conversion
6. To understand measurement of various non-electrical quantities

Module – 1

Introduction to Sensors and Transducers - Introduction, Significance and Scope, importance of the course in economic growth, Impact of the course on Societal Problems - Sustainable Solutions, Career Perspective, Latest research trends and innovations.
Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers. **(8hours)**

Module – 2

Sensors and Transducers (continued): Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers, Induction Potentiometers. (8Hours)

Module – 3

Signal Condition: Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Electrical and electronic Amplifiers. Data Acquisition Systems and Conversion: Introduction, Objectives and Data Acquisition Systems, Data Conversion
(8hours)

Module – 4

Measurement of Non – Electrical Quantities: Pressure Measurement, Temperature Measurement, Flow Measurement – Introduction, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Metes, Wire Anemometers. (8 hours)

Module – 5

Measurement of Non – Electrical Quantities (continued): Measurement of Displacement, Measurement of Velocity/ Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power, Measurement of Liquid Level.
(8 hours)

Course Outcomes: The students will be able to:

CO1: Analyse and select transducers for different applications
CO2: Analyse the signal conditioning, data acquisition and data transmission systems
CO3: Apply the transducers for the measurement of various non-electrical quantities

Textbooks:

1. R.K Rajput S. Chand, “Electrical and Electronic Measurements and instrumentation”, 3rd Edition, 2013

References:

1. J.B. Gupta, “A Course in Electronics and Electrical Measurements and Instruments, Katson Books, 13th Edition, 2008
2. A. K. SawhenyDhanpat Rai, A Course in Electrical and Electronic Measurements and Instrumentation, 2015

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	**BEE704D**	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:	Understand the fundamentals of illumination, types of light sources and assess lighting quality.
CO2:	Measure lighting using photometric quantities such as luminous flux, intensity, and illumination using fundamental laws.
CO3:	Design interior lighting, outdoor, flood and 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

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

(Ability Enhancement Course)

(Effective from the academic year 2024-25)

Course Code	BEEL706	CIE Marks	50
Teaching Hours/Week (L:T:P)	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

Laboratory Course Outcomes:

This course will enable students to

1. Conduct tests, understand and describe the characteristics of various relays and dielectric breakdown mechanisms.
2. Conduct tests, understand and describe protection schemes for electrical equipment, high voltage measurement.
3. Can understand, describe the field mapping technique and capacitance calculation methods for simple geometric configurations.
4. Can effectively work as team member or individual, communicate and prepare reports effectively.

Experiments:

1. Study of Operational Characteristics of Electromechanical Relay
2. Study of 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

9. Study of Operational Characteristics of Numeric Over Current Relay
10. Measurement of HVAC using Standard Spheres
11. Fuse and MCB characteristics