# INTEGRAL UNIVERSITY, LUCKNOW
## DEPARTMENT OF ELECTRICAL ENGINEERING

**COURSE: BASIC ELECTRICAL ENGINEERING**
**COURSE CODE: EE103**

**COURSE OBJECTIVES:**

- Knowledge and concept of D.C Circuit Analysis and Network Theorems Circuit.
- Use of Steady State Analysis of Single Phase AC Circuits AC fundamentals.
- Knowledge and concept of Three Phase AC Circuits Three phase system and measuring devices.
- Basic concepts of Power System and Transformer
- Study of Electromechanical energy conversion devices: AC/ DC Machines.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Know about the concept of D.C Circuit Analysis and Network Theorems Circuit. |
| **CO2** | Steady State Analysis of Single Phase AC Circuits AC fundamentals. |
| **CO3** | Know about concept of Three Phase AC Circuits Three phase system and measuring devices |
| **CO4** | Layout of Power System and transformer |
| **CO5** | Know about Electromechanical energy conversion devices: AC/ DC Machines |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Know about the concept of D.C Circuit Analysis and Network Theorems Circuit. | 3 | 3 | 2 | 1 | 1 | 3 | | | | | | 3 |
| **CO2** | Steady State Analysis of Single Phase AC Circuits AC fundamentals. | 3 | 3 | 3 | 2 | 1 | 1 | | | | | | 2 |
| **CO3** | Know about concept of Three Phase AC Circuits Three phase system and measuring devices | 3 | 2 | 1 | 1 | 2 | 2 | 3 | | | | | 3 |
| **CO4** | Layout of Power System and transformer | 3 | 2 | 2 | 2 | 3 | 3 | | | | | | 2 |
| **CO5** | Know about Electromechanical energy conversion devices :AC/DC Machines | 3 | 1 | 1 | 1 | 1 | 2 | 1 | | | | | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: LINEAR NETWORK AND SYSTEMS**

**COURSE CODE: EE201**

| **Course Outcomes** | |
|---|---|
| **CO1** | For a given network, would be able to apply the knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits, Identify, formulate, and solve engineering problems in the area electrical circuits & systems. |
| **CO2** | For a given system with dc and ac circuits, describe the different network theorems, would be able to apply, solve and verify the solutions using modern tools for lifelong learning like MATLAB. |
| **CO3** | For given a system with two port networks described in standard form, would be able to characterize, modeling, analyze, and verify the network in terms of all network parameters. |
| **CO4** | For given a system with RL, RC, and RLC circuits, would be able to understand, perform, formulate, and solve the differential equations for RL, RC, and RLC circuits and analyze the characteristics of the system. |
| **CO5** | For given a system description, would be able to explore and apply to alternate system description, and implement using basic blocks for network transfer function in s-domain and Two port networks. |

| COs and POs MAPPING | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations in complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
| **CO1** | 3 | 3 | 2 | 3 | 2 | 1 | | 1 | 1 | 1 | | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | | 1 | | 1 |
| **CO3** | 3 | 3 | 2 | 3 | 2 | 1 | | | | | | |
| **CO4** | 3 | 2 | 2 | 3 | 1 | | | 1 | | 1 | | 1 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 1 | | 1 | | 1 | | |

3: Strong contribution, 2: average contribution, 1: Low contribution

**COURSE: ELECTROMECHANICAL ENERGY CONVERSION I**
**COURSE CODE: EE203**

**COURSE OBJECTIVES:**

- Knowledge of principle of electromechanical energy conversion in rotating machines and the laws governing it.
- Determine the emf and torque equation of dc machines. To get knowledge of constructional features and flux flow in dc machines under loading condition.To identify and select different dc machines for different applications.
- Differentiate different dc motor and dc generator on the basis of characteristics.
- To evaluate the performance of dc machines
- To identify different types of transformers and evaluate their performance

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Knowledge of electromechanical energy conversion in rotating machines |
| **CO2** | Analyze the dc machines under loading condition |
| **CO3** | Evaluate the performance of dc machines |
| **CO4** | Evaluate the performance of single phase transformers |
| **CO5** | Knowledge of three phase transformers and transformers used for special applications |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Knowledge of electromechanical energy conversion in rotating machines | 3 | 2 | 3 | 1 | 2 | 2 | 1 | | 2 | | 1 | 1 |
| **CO2** | Analyze the dc machines under loading condition | 3 | 2 | 2 | 2 | 2 | 1 | 2 | | 1 | | | 1 |
| **CO3** | Evaluate the performance of dc machines | 3 | 3 | 2 | 2 | 1 | 2 | 1 | | 1 | | | 1 |
| **CO4** | Evaluate the performance of single phase transformers | 3 | 2 | 3 | 2 | 2 | 2 | 1 | | | | 1 | 1 |
| **CO5** | Knowledge of three phase transformers and transformers used for special applications | 3 | 1 | 1 | 1 | | | | | | | | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: SOLID STATE DEVICES AND CIRCUITS**
**COURSE CODE: EE 205**

| **Course Outcomes** | |
|---|---|
| **CO1** | Analyze and designing concept of special purpose diodes for different types of operation for industrial application purpose. Understand the advancement in conductivity of semiconductors material. Analysis the different regions in which BJT operates and their applications as a switches, amplifiers etc.. |
| **CO2** | Understand the advancement in transistors like JFET, MOSFET, PMOS, NMOS, CMOS etc. and their various types' applications in Industries. Analyze the frequency response of these devices as different amplifier applications. To Understand how the gain of amplifier effected with frequency changes and their applications. |
| **CO3** | To develop and analyze the performance of small signal amplifiers and large signal amplifiers (Power amplifiers) . To understand and implement the various power amplifier in applications as transmitter and receiver in communication purpose. |
| **CO4** | Developing the concept of feedback amplifiers, their different topologies and Implement it for various applications. To analyze their stability and their responses for different applications. |
| **CO5** | To analyze the design considerations of the active and passive filters. How to develop the various orders of filters and their industrial applications. To understand the constructional difference and working of various types of oscillators. How the oscillators can be developed and their use in industries. |

| **COs- POs Mapping** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
| **CO1** | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 3 | 2 | | | | | |
| **CO3** | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 1 | | | 1 | 1 |
| **CO4** | 3 | 1 | 1 | 1 | 2 | 2 | 2 | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 3 | 3 | 3 | 3 | 2 | 3 | 2 | | 1 | | 1 | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: FUNDAMENTALS OF ELECTROMAGNETIC FIELD THEORY**

**COURSE CODE: EE207**

**COURSE OBJECTIVES:**

- To understand the students about Coordinates systems. To develop ability for analysis of three-dimensional space and obtain the solution of electromagnetic problems by Vector theorems and Operators.
- To analyze the electrostatics problems by applying fundamental law's.
- To realize and examine the magneto statics problems and response the behavior of magnetic fields in different magnetic materials
- To recognize the concepts of Gauss Law and Maxwell equation by investigation in real time domain . To learn the Concepts of Displacement Current and Wave Propagation.
- To execute the analysis of Guided Waves and transmission lines by various parameters and propagation constant .

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Given a physical quantity, students shall be able to **represent** this in vector and scalar form, **identify** type of system**, apply** vector algebra, and **formulate** the expression in different coordinates and **solve** using vector theorems. |
| **CO2** | Given a electrostatic problems of passive elements with sources, student shall be able to **analyze** and **evaluate** the problems using Gauss laws and Divergence theorem. |
| **CO3** | For a given magneto-static situation , student shall be able to generate its analytical response by Biot Savart's law and **examine**, **analyze** and **evaluate** the characteristics by Maxwell's Equation and Boundary Conditions |
| **CO4** | For a given Time varying function, students shall be able to identify its characteristics and for Wave Propagation , **select** suitable **design** of application of Maxwell's equation, **develop** various combination for Power by Pyonting Vector and explain the functions of its main components. |
| **CO5** | Given a Guided Waves and Transmission line, student shall be able to **define** its parameters**, solve/ analyze,** and **modify** its form |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Given a physical quantity, students shall be able to **represent** this in vector and scalar form, **identify** type of system**, apply** vector algebra, and **formulate** the expression in different coordinates and **solve** using vector theorems. | 3 | 3 | 2 | 1 | 2 | | 1 | | | | | |
| **CO2** | Given a electrostatic problems of passive elements with sources, **student** shall be able to **analyze** and **evaluate** the problems using Gauss laws and Divergence theorem. | 3 | 3 | 1 | 1 | 2 | | | | | | | |
| **CO3** | For a given magneto-static situation , student shall be able to generate its analytical response by Biot Savart's law and **examine**, **analyze** and **evaluate** the characteristics by Maxwell's Equation and Boundary Conditions | 3 | 3 | 1 | 1 | 2 | | | | | | | |
| **CO4** | For a given Time varying function, students shall be able to identify its characteristics and for Wave Propagation, **select** suitable **design** of application of Maxwell's equation, **develop** various combinations for Power by Pyonting Vector and explain the functions of its main components. | 3 | 3 | 2 | 1 | 2 | | | | | | | |
| **CO5** | Given a Guided Waves and Transmission line, student shall be able to **define** its parameters**, solve, analyze,** and **modify** its form | 3 | 3 | 2 | 2 | 2 | | 1 | 1 | | | | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: ELECTROMECHANICAL ENERGY CONVERSION II**
**COURSE CODE: EE211**
**COURSE OBJECTIVES:**

- Knowledge of principle of operation of three phase ac motors
- Identify different ac motors on the basis of characteristics
- Analyze different ac machines
- To evaluate the performance of ac machines
- Knowledge of parallel operation of ac generators

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Knowledge of different types of three phase induction machines |
| **CO2** | Analyze the induction machines performance under loading condition |
| **CO3** | Evaluate the performance of single phase ac machines |
| **CO4** | Knowledge of three phase synchronous machines |
| **CO5** | Evaluate the performance of synchronous machines |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Knowledge of different types of three phase induction machines | 3 | 2 | | 1 | | | | | | | | |
| **CO2** | Analyze the induction machines performance under loading condition | 3 | 2 | | | | | 1 | | | | | |
| **CO3** | Evaluate the performance of single phase ac machines | 3 | 1 | | | | | | | | | | 2 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | Knowledge of three phase synchronous machines | 3 | 2 | | | | | | | | | | 1 |
| **CO5** | Evaluate the performance of synchronous machines | 3 | 2 | | | | | 1 | | | | | |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: NUMERICAL ANALYSIS AND APPLICAION**

**COURSE CODE: EE213**

| COURSE OUTCOMES | |
|---|---|
| **CO1** | Would be able to demonstrate, understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems. |
| **CO2** | Would be able to derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. |
| **CO3** | Would be able to analyze and evaluate the accuracy of common numerical methods. |
| **CO4** | Would be able to apply numerical methods to obtain approximate solutions to mathematical problems. |
| **CO5** | Would be able to write efficient, well-documented MATLAB code and present numerical results in an informative way. |

**COs AND POs MAPPING**

| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | Design/development of solutions | investigations into complex problems | **PO5** Modern tool us | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8Ethics** | **PO9** Individual and Team work | **PO10** Communication | Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 1 | | 2 | 1 | | 1 | 2 |
| **CO2** | 3 | 3 | 2 | 3 | 2 | 1 | | 1 | 1 | | 1 | 2 |
| **CO3** | 2 | 3 | 3 | 2 | 1 | | | | | | | 1 |
| **CO4** | 2 | 3 | 3 | 2 | 1 | | | | | | | |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | | 1 | 2 |

**COURSE: SIGNAL SYSTEM ANALYSIS**
**COURSE CODE: EE217**

**COURSE OBJECTIVES:**

- Demonstrate an understanding of the fundamental properties of linear systems
- Uses of transform analysis and convolution, to analyze and predict the behavior of linear time invariant systems.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Understand mathematical description and representation of continuous and discrete time signals and systems. |
| **CO2** | Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system. |
| **CO3** | Understand and resolve the signal in frequency domain using Fourier series and Fourier transforms. |
| **CO4** | Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain. |
| **CO5** | Analyze the discrete time signals and system using DTFT, DFT and Z |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Understand mathematical description and representation of continuous and discrete time signals and systems. | 3 | 3 | | 2 | | 1 | | | 1 | 1 | | 1 |
| **CO2** | Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system. | 3 | 3 | 2 | 2 | | | | | 1 | 1 | | 1 |
| **CO3** | Understand and resolve the signal in frequency domain using Fourier series and Fourier transforms. | 3 | 3 | 2 | 2 | | 1 | | | 1 | 1 | | 1 |
| **CO4** | Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain. | 3 | 3 | 2 | 2 | | 1 | | | 1 | 1 | | 1 |
| **CO5** | Analyze the discrete time signals and system using DTFT, DFT and Z | 3 | 3 | 2 | 2 | | 1 | 1 | | 1 | 1 | | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: ELECTRICAL ENGINEERING MATERIALS**
**COURSE CODE: EE221**

**COURSE OBJECTIVES:**

- To apply the knowledge of material science engineering.
- To understand the impact of realistic constraints such as economic, environmental, safety, reliability, manufacturability and sustainability.
- To know the properties of conducting, insulating, dielectric and magnetic materials from electrical engineering point of view.
- To realize the potential of semiconducting devices with their application.
- To learn latest techniques, skills, and modern engineering tools necessary for electrical engineering fabrication processes.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1, CO2 & CO4** | To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances , devices , instruments and in the applications associated with generation, transmission and distribution of electric power. |
| **CO3** | To provide students with a moderate level understanding of the physics behind the semiconductors. |
| **CO5** | An understanding of the electrical engineering material science essential for them to work in different fabrication based industries and also motivate them to do innovative characterization based research while going for higher studies and also to work in R & D with scientific enthusiasm |

**COURSE: CONTROL SYSTEMS**
**COURSE CODE: EE301**

**COURSE OBJECTIVES:**

- To learn of Transfer function and mathematical modeling of mechanical system.
- To get the knowledge of first order and second order system.
- To gain information of the system.
- To evaluate the stability of the system using Nyquist stability criterion
- To design the compensator and also study of state space analysis.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | To learn of Transfer function and mathematical modeling of mechanical system. |
| **CO2** | To get the knowledge of first order and second order system. |
| **CO3** | To gain information of the system. |
| **CO4** | To evaluate the stability of the system using Nyquist stability criterion . |
| **CO5** | To design the compensator and also study of state space analysis. |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | To learn of Transfer function and mathematical modeling of mechanical system. | 3 | 2 | | 1 | | | | | | | | |
| **CO2** | To get the knowledge of first order and second order system. | 3 | 2 | | 1 | | | | | | | | |
| **CO3** | To gain information of the system. | 3 | 2 | | | | | | | | | | 1 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | To evaluate the stability of the system using Nyquist stability criterion . | 1 | 3 | | 2 | | | | | | | | 1 |
| **CO5** | To design the compensator and also study of state space analysis. | 2 | 2 | 3 | | | | | | | | | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: POWER ELECTRONICS**
**COURSE CODE: EE 303**

| COURSE OUTCOMES | |
|---|---|
| **CO1** | Understand and analyze the concept, design, technique, advancement and application of Bipolar junction transistor, Power Metal oxide semiconductor field effect transistor, Insulated gate bipolar junction transistor, operation of Silicon controlled rectifier (SCR), Firing circuits of Thyristor, Turn on methods of a Thyristor and Thyristor turn-off process. |
| **CO2** | Understand and analyze the concept, design, technique, advancement and application of Protection of Thyristor, Series and parallel operation of SCR, Gate turn off (GTO) thyristor.<br>Understand and analyze the concept and knowledge advancement in Gate characteristic of an SCR, Dynamic characteristics of SCR, Two transistor analogy, Rating of an SCR |
| **CO3** | Understand and analyze the concept, design, technique, advancement and application of single phase half wave and full wave controlled rectifiers with different types of load, Effect of source impedance on the performance of full wave converter, Dual converter, three phase converters and cyclo-converters |
| **CO4** | Understand and analyze the concept, design, technique, advancement and application of Single phase bridge inverters (half and full wave), Pulse width modulation (PWM) inverters, Series inverter, Parallel inverter, Mc-Murray half bridge inverter, Three phase inverter. |
| **CO5** | Understand and analyze the concept, design, technique, advancement and application of choppers, chopper circuits, Multi quadrant choppers, Commutation of choppers, Switched mode power supplies. |

| CO- PO MAPPING | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
| **CO1** | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 |
| **CO2** | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 |
| 3:Strong Contribution, 2:Moderate Contribution, 1:Weak Contribution | | | | | | | | | | | | |

**COURSE: DIGITAL CIRCUITS AND SYSTEMS**

**COURSE CODE: EE305**

**COURSE OBJECTIVES:**

- To understand number representation and conversion between different representation in digital electronic circuits.
- Became familiar with the digital signal, positive and negative logic, Boolean algebra, logic gates, logical variables, the truth table, number systems, codes, and their conversion from one to others.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand competence in Combinational Logic Problem formulation.
- To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines.
- To understand competence in analysis of synchronous and asynchronous sequential circuits.
- To understand characteristics of memory and their classification.
- To understand concept of Programmable Devices, PLA, PAL, PLD and FPGA and implement digital system.
- To impart how to design Digital Circuits.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Convert different type of codes and number systems which are used in digital communication and computer systems. Develop a digital logic and apply it to solve real life problems. |
| **CO2** | Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency. |
| **CO3** | Analyze, design and implement combinational and sequential logic circuits. |
| **CO4** | Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods. |
| **CO5** | Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints. |
| **CO6** | Classify different semiconductor memories. Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO 12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | | 1 | 2 | 1 | | 1 | | 1 |
| **CO2** | 2 | 3 | | 2 | 2 | 1 | 3 | | 1 | 1 | 1 | 1 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | | | | | | 1 | 1 |
| **CO4** | 2 | 3 | 3 | 2 | | 2 | 2 | | 1 | 2 | 3 | |
| **CO5** | 1 | 2 | 2 | 2 | 2 | 2 | | 3 | 1 | | 1 | |
| **CO6** | | 2 | | 2 | | 2 | | 2 | | | 1 | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: POWER SYSTEM-I**
**COURSE CODE: EE-307**

**COURSE OBJECTIVES:**

- To get knowledge of Power System Components and Transmission Lines
- To get knowledge of inductance and capacitance of Over-Head Transmission Lines
- To attain knowledge of Corona and Overhead line Insulators
- To study about Mechanical Design of transmission line and Insulated cables
- To have the knowledge of Electrical Design of Transmission Line and Neutral grounding

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Understand thePower System Components and Transmission Lines |
| **CO2** | Analyse the inductance and capacitance of Over-Head Transmission Lines |
| **CO3** | Understand the phenomenon of Corona and Overhead line Insulators |
| **CO4** | Having knowledge of Mechanical Design of transmission line and Insulated cables |
| **CO5** | Design Electrical Transmission Line and Neutral grounding |

**CO-PO MAPPING:**

| CO | | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Understand thePower System Components and Transmission Lines | 3 | 2 | 1 | 1 | | | | | | | | 1 |
| **CO2** | Analyse the inductance and capacitance of Over-Head Transmission Lines | 3 | 3 | | 1 | | | | | | | | 1 |
| **CO3** | Understand the phenomenon of Corona and Overhead line Insulators | 3 | 3 | 1 | 2 | | | | | | | | 1 |
| **CO4** | Having knowledge of Mechanical Design of transmission line and Insulated cables | 3 | 2 | 3 | | | | 3 | | 3 | 2 | 2 | 1 |
| **CO5** | Design Electrical Transmission Line and Neutral grounding | 3 | 1 | 3 | 2 | 2 | 2 | | | 3 | 2 | 2 | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: POWER SYSTEM-II**
**COURSE CODE: EE-311**

**COURSE OBJECTIVES:**

- Representing elements of a power system including generators, transmission lines, and transformers.
- Understand the functioning of a synchronous machine and represent it with simple models.
- Perform Fault analysis for a balanced three-phase power system.
- Analyze multi-node power systems using an admittance matrix or impedance matrix representation of the power system.
- Factor the admittance matrix to obtain a solution of the network voltages.
- Understand the formulation of the power flow problem, and have the ability to cast any given system in this framework.
- Solve power flow problems by the application of Newton method & Gauss seidel
- Perform Steady-state analysis for a balanced three-phase power system.
- Reflection and Transmission of travelling waves under different line loadings
- Protection of equipments and line against travelling waves

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Representation of Elements in Electric Power System in Per-Unit system and Analysis of Symmetrical faults. |
| **CO2** | Analysis of Unsymmetrical faults. |
| **CO3** | Understanding the formulation of the power flow problem and to cast any given system in this framework. |
| **CO4** | Understanding the concept of steady state and transient stability. |
| **CO5** | Need of Protection of equipments and line against travelling waves. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | | | 2 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | | | | | | | |
| **CO3** | 3 | 3 | 1 | 2 | 2 | | | | | | | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | | | | | 2 | 2 | |
| **CO5** | 3 | 3 | 3 | | | 2 | 1 | | | | 2 | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: Microprocessor and Peripheral Devices**
**COURSE CODE: EE-313/ EEE-313**
**COURSE CREDIT: 4**

**PREREQUISITES:**

| Subject | Description | Level of study |
|---|---|---|
| Digital Circuits & Systems EE305 | Digital Circuits | UG |

**COURSE OBJECTIVES:**

- Knowledge of I/O devices and memories
- To get knowledge of architecture of 8085 and 8086
- To attain knowledge of different instruction set of 8085 and 8086
- To study about different types of Programmable Peripheral Interface
- To have the knowledge of analog to digital and digital to analog converter chips

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Understand the basics of microprocessor |
| **CO2** | Understand the architecture of 8085 and 8086 |
| **CO3** | Knowledge of instruction set of 8085 and 8086 |
| **CO4** | Knowledge of programmable peripheral interface |
| **CO5** | Knowledge of analog to digital and digital to analog converter |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Understand the basics of microprocessor | **3** | | | **1** | **1** | **1** | **1** | | | | | **3** |
| **CO2** | Understand the architecture of 8085 and 8086 | **3** | **2** | **2** | **2** | **2** | **1** | | | | | | **3** |
| **CO3** | Knowledge of instruction set of 8085 and 8086 | **3** | **2** | **2** | **2** | **2** | **1** | | | | | | **3** |
| **CO4** | Knowledge of programmable peripheral interface | **3** | **2** | **2** | **2** | **2** | **1** | **1** | | | | | **3** |
| **CO5** | Knowledge of analog to digital and digital to analog converter | **3** | **1** | **1** | **1** | **1** | **1** | **1** | | | | | **3** |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**SYLLABUS WITH CO:**

| UNIT | CONTENT | CO |
|---|---|---|
| I | **Introduction of Microcomputer System**:<br>General definition of minicomputer, microprocessor, CPU( central processing unit), I/O(Inputoutput) devices, clock, memory, bus architecture, tri-state logic, address bus, data bus and control bus. Semiconductor Memories: Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, ROM (Read-only memory),RAM *(*Random-access memory). | **1** |
| II | **Architecture of 8-bit Microprocessor:**Introduction to 8085 and 8086 microprocessor, Pin description and their internal architecture.<br>Operation and Control of Microprocessor : Timing and control unit, memory read/write machine cycles, Input-output read/write machine cycles, interrupt acknowledge machine cycle. | **2** |
| III | **Instruction Set:**<br>Addressing modes- Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, unspecified flags and instructions, assembly language programming, assembler directives, subroutines. | **3** |
| IV | **Interfacing:**Interfacing of memory chips, Interfacing of Input-output devices, Input-output addressing,Input-output memory mapped schemes, 8255 Programmable Peripheral Interface, 8257 Direct memory access Controller, 8259 Interrupt priority Control, 8253/8254 Programmable timer/counter with modes of operation.Interrupts: Interrupt structure of 8085 microprocessor. | **4** |
| V | **Programmable Peripheral Interface:**<br>Intel 8255 pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, analog to digital converter and digital-to-analog converter chips and their interfacing.Programmable Interval Timer: Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter read methods. | **5** |

**References:**

1.B.Ram, "Fundamentals of Microprocessor and Microcomputer", Dhanpat Rai Publication, 4th Edition.2008

2. M.Rafiquzzaman, "Microprocessors and Applications", John Wiley & Sons ,2008

3. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, reprinted 2008

4. Gaonkar R.S.,"Microprocessor Architecture,Programming and Applications", 6th Ed., Penram International, 2013.

**COURSE: PROCESS INSTRUMENTATION**
**COURSE CODE: EE323**

**COURSE OBJECTIVES:**

- Knowledge of different process ant its characteristics.
- Understanding of different control loops used in process.
- Study and analysis of feedback control system and its applications.
- Applications and design of multi-loop control system.
- Concepts and design of multivariable control systems.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Know about different process ant its characteristics. |
| **CO2** | Understand different control loops used in process |
| **CO3** | Use feedback control system. |
| **CO4** | Design of multi-loop control system. |
| **CO5** | Design of multivariable control systems. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 1 | 1 | 1 | 3 | 1 | | | | 1 | 3 |
| **CO2** | 3 | 2 | 2 | 1 | 3 | 2 | 1 | | | | 1 | 2 |
| **CO3** | 3 | 2 | 2 | 1 | 3 | 3 | 3 | | | | 1 | 3 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | 3 | 3 | | | | 1 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | | | | 1 | 3 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: CONVENTIONAL & CAD OF ELECTRICAL MACHINES**

**COURSE CODE: EE325**

**COURSE OBJECTIVES:**

- To develop knowledge on principles of design of static and rotating machines.
- To understand the fundamental concepts of design process, designing of main dimensions & cooling systems of transformers and rotating machine.
- To provide advanced knowledge and understanding about the construction and design of the electrical machines.
- To provide the the basis and the methodologies to correct a design of the electrical machines (transformers, rotating AC machines and DC machines).
- To understand the design optimization of the electrical machine for industrial, automotive and aerospace applications.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Student understands the basic concept of design, limitations faced in the designing process, and classification & importance of Insulating materials. |
| **CO2** | Student is able to understand the design concepts of transformers and know about how to design the core, yoke & windings. |
| **CO3** | Upon completing the course, student is able to understand the factors affecting the size of rotating machines and design of core & armature in DC machines along with selection of frame size. |
| **CO4** | Student is able to understand the rotor design of Induction motor and field system design of Synchronous machines & DC machines along with problem solving techniques related to design. |
| **CO5** | Student understands the importance of Computer aided design and different approaches based on their applications along with the concept of optimization. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | | | | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | |
| **CO3** | 3 | 3 | 1 | 2 | 2 | | | | | | 2 | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | | | | | 2 | 2 | |
| **CO5** | 2 | 2 | 2 | | | 2 | 2 | | | | | |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**INTEGRAL UNIVERSITY, LUCKNOW**
**DEPARTMENT OF ELECTRICAL ENGINEERING**

**COURSE: MODERN POWER SYSTEM**
**COURSE CODE: EE-331/ EEE-331**
**COURSE CREDIT: 4**

**PREREQUISITES:**

| Subject | Description | Level of study |
|---|---|---|
| Power System I EE307 | Basic of Power System | UG |

**COURSE OBJECTIVES:**

- Knowledge of modelling of different component of power system
- To get knowledge of load frequency control technique
- To attain knowledge of modelling of three phase transmission line
- To study about different types of power electronic control for Load flow
- To have the knowledge of power distributors.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Understand the modelling of power system components |
| **CO2** | Understand the load frequency control |
| **CO3** | Knowledge of three phase transformer and transmission line |
| **CO4** | Knowledge of load flow |
| **CO5** | Knowledge of power distributors |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Understand the modelling of power system components | **3** | **3** | **3** | **1** | **1** | **1** | **1** | | | | | **3** |
| **CO2** | Understand the load frequency control | **3** | **3** | **3** | **2** | **2** | **1** | | | | | | **3** |
| **CO3** | Knowledge of three phase transformer and transmission line | **3** | **3** | **3** | **2** | **2** | **1** | | | | | | **3** |
| **CO4** | Knowledge of load flow | **3** | **2** | **2** | **2** | **2** | **1** | **1** | | | | | **3** |
| **CO5** | Knowledge of power distributors | **3** | **1** | **1** | **1** | **1** | **1** | **1** | | | | | **3** |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: RENEWABLE ENERGY TECHNOLOGY**
**COURSE CODE: EE343**

**COURSE OBJECTIVES:**

- To understand the students about Energy systems. To develop ability for analysis of sustainability.
- To analyze the sun as source of energy, by applying fundamental law's.
- To realize and examine the hydro power potential, hydropower generation and distribution, in different system.
- To recognize the Basics & Power Analysis, Wind resource assessment, by investigation in real time domain.
- To execute the analysis of potential of nuclear energy, with hybrid energy systems.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Given an energy systems and quantifying energy students shall be able to represent this in comparison to various conventional Fossil fuels, identify type of system, apply vector algebra, and formulate the Remedies & alternatives for fossil fuels. |
| **CO2** | Given a Modeling of Solar Energy with sources, student shall be able to analyze theory of solar cells, solar radiation, solar characteristics and limitations. |
| **CO3** | For a Wind Energy systems, student shall be able to generate its analytical response and resource assessment, analyze and evaluate the characteristics by Power Conversion Technologies. |
| **CO4** | For a given Hydro power, students shall be able to identify its characteristics and for Generation and Distribution,, select suitable design of application of Mini and Micro-hydel Power with various combination for System |
| **CO5** | Given a Nuclear Energy system, student shall be able to define its fuel enrichment, different types of nuclear reactors, nuclear waste disposal, solve/ analyze, and modify Integrated Energy systems, |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Given an energy systems and quantifying energy students shall be able to represent this in comparison to various conventional Fossil fuels, identify type of system, apply vector algebra, and formulate the Remedies & alternatives for fossil fuels. | 3 | 3 | 2 | | | | | | | | | |
| **CO2** | Given a Modeling of Solar Energy with sources, student shall be able to analyze theory of solar cells, solar radiation, solar characteristics and limitations. | 3 | 3 | 2 | 2 | 2 | | | | | | | |
| **CO3** | For a Wind Energy systems, student shall be able to generate its analytical response and resource assessment, analyze and evaluate the characteristics by Power Conversion Technologies. | 3 | 3 | 1 | | | | | | | | | 2 |
| **CO4** | For a given Hydro power, students shall be able to identify its characteristics and for Generation and Distribution,, select suitable design of application of Mini and Micro-hydel Power with various combination for System | 3 | 2 | 3 | 2 | 3 | | | | | 2 | 2 | |
| **CO5** | Given a Nuclear Energy system, student shall be able to define its fuel enrichment, different types of nuclear reactors, nuclear waste disposal, solve/ analyze, and modify Integrated Energy systems, | 3 | 3 | 3 | | | 2 | 1 | | | | | |
| 3: Strong contribution, 2: Average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: POWER ELECTRONICS BASED CONVERTERS DESIGN**
**COURSE CODE: EE345**

**COURSE OBJECTIVES:**

- Knowledge and concept of non-isolated DC-DC converters.
- Analysis & Design of Isolated Converters.
- Knowledge and concept of AC Regulators.
- Analysis & Design of Self Driven Inverters.
- Designing of Soft switching Converters.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Know about the concept of non-isolated DC-DC converters. |
| **CO2** | Analyze & Design Isolated Converters. |
| **CO3** | Know about concept of AC Regulators. |
| **CO4** | Analyze & Design Self Driven Inverters. |
| **CO5** | Design Soft switching Converters. |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Know about the concept of non-isolated DC-DC converters. | 3 | 1 | 1 | 1 | 1 | 3 | 1 | | | | | 3 |
| **CO2** | Analyze & Design Isolated Converters. | 3 | 2 | 3 | 1 | 3 | 3 | 1 | | | | | 3 |
| **CO3** | Know about concept of AC Regulators. | 3 | 1 | 1 | 1 | 1 | 3 | 1 | | | | | 3 |
| **CO4** | Analyze & Design Self Driven Inverters. | 3 | 2 | 3 | 1 | 3 | 3 | 1 | | | | | 3 |
| **CO5** | Design Soft switching Converters. | 3 | 2 | 3 | 3 | 3 | 3 | 2 | | | | | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: POWER SYSTEM PROTECTION**
**COURSE CODE: EE 401**

**COURSE OBJECTIVES:**

- To learn the basics of relays .
- To get the knowledge of relay application.
- To gain the knowledge of protection of Transmission line.
- To study the different types of circuit breaker.
- To gain the knowledge of protection of Alternator.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Learn the basics of relays. |
| **CO2** | Acquire knowledge of relay application |
| **CO3** | Acquire knowledge of protection of Transmission line. |
| **CO4** | Knowledge the different types of circuit breaker. |
| **CO5** | Gain the knowledge of protection of Alternator.. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | 1 | | | | | | | | 1 |
| **CO2** | 3 | 2 | | 1 | | | | | | | | |
| **CO3** | 3 | 2 | | | | | | | | | | 1 |
| **CO4** | 3 | 2 | | 2 | | | | | | | | 1 |
| **CO5** | 3 | 1 | 2 | | | | | | | | | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: ELECTRIC DRIVES**

**COURSE CODE: EE403**

**COURSE OBJECTIVES:**

- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
- Analyze the operation of motor drives system to satisfy four-quadrant operation to meet mechanical load requirements.
- Understand the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives.
- Describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives.
- Learn speed control of induction motor drives in an energy efficient manner using power electronics.
- Learn the basic operation of stepper motors and switched-reluctance motor drives.
- Realize an appreciation of power quality issues in powering electric drives.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | **Conceptualize** fundamental elements of drive systems, **design** important elements of a drive system, **understand** the multi-quadrant operation and **analyze** it for different types of operation. |
| **CO2** | **Understand** and **evaluate** dynamics of motor-load combination, **Develop** the thermal model of a motor, **Analyze** steady state and transient state stability, **select** and **determine** the motor power rating for various duty cycles. |
| **CO3** | **Analyze** and **perform** the dynamics during starting and braking of DC and AC motor, **evaluate** energy loss and **implement** various methods to reduce it, **examine**, **develop** and **solve** various energy relations during starting and braking. |
| **CO4** | **Acquire** detailed knowledge of DC Shunt and Series motor operation using generalized machine theory, **Apply** the concepts of AC-DC and DC-DC Converters to evaluate and **enhance** the performance of steady and transient state operation, **Implement** speed control and current control loops of a DC Motor drive. **Understand** how DC Drives may pollute the power supply and **analyze** how to mitigate such pollution. |
| **CO5** | **Understand** the working of various phase controlled converters used in AC Drives**. Learn** the working principle and **design** details of frequency controlled converters used in induction motor drives. **Analyze** and **perform** the modeling and controlling CSI based drives. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | | 1 | | | | | |
| **CO2** | 3 | 3 | 2 | 1 | 2 | | | | | | | |
| **CO3** | 3 | 3 | 2 | 2 | 2 | 2 | | | | | | |
| **CO4** | 3 | 3 | 3 | 1 | 2 | 1 | | 1 | | | 1 | |
| **CO5** | 3 | 3 | 3 | 2 | 2 | | 1 | | 1 | | 1 | |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: APPLICATION OF POWER ELECTRONICS TO POWER SYSTEM**
**COURSE CODE: EE 423**

| Course Outcomes | |
|---|---|
| **CO1** | To Analyze the steady state and dynamic problems in AC transmission system. To understand about the FACTs controllers and their types and their applications in AC system. |
| **CO2** | To understand what are the parameters to control and improve power in transmission system and these parameters are controlled and improve by followings shunt controllers like series controllers, shunt controller, combine series shunt controller, and phase angle regulators. To understand their working, design and its implementations in AC system, applications and its advantages in AC system. |
| **CO3** | Analysis the modeling of different series, shunt controllers and analysis its control strategies to improve AC system stability. |
| **CO4** | To analyze what are the power quality problems in distribution system? To understand the harmonics and how it does affects the power flow and power quality. To understand what are the harmonic propagation and resonance. |
| **CO5** | To understand, analyze and implementation to mitigate the harmonics. To analysis the different types of filters to mitigate the harmonics. To analysis how the voltage sags and swells, voltage flicker arises in the AC system due to harmonics and its calculation. |

| CO- PO MAPPING | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
| **CO1** | 3 | 2 | 1 | 1 | 2 | 2 | 1 | | | | | |
| **CO2** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | | | | 1 | |
| **CO4** | 3 | 1 | 1 | 2 | 2 | 2 | 2 | | | | | |
| **CO5** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | 2 | 3 |
| 3:Strong Contribution, 2:Moderate Contribution, 1:Weak Contribution | | | | | | | | | | | | |

**COURSE: POWER SYSTEM DYNAMICS**
**COURSE CODE: EE427**

**COURSE OBJECTIVES:**

- To understand the students about dynamics of Power systems. To develop ability for analysis of system stability and obtain the solution of transient problems.
- To analyze the modeling of synchronous machine by applying fundamental law's.
- To realize and examine the excitation systems and response the behavior of prime mover controllers in different system.
- To recognize the concepts of dynamics of synchronous generator Connected to Infinite Bus by investigation in real time domain.
- To execute the analysis of transient and voltage stability by various parameters and comparison with angle stability.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Given a Power System Dynamics Problems, students shall be able to represent this in various conventional models, identify type of system, apply vector algebra, and formulate the expression in different System Model and solve using mathematical terms. |
| **CO2** | Given a Modeling of Synchronous Machine with sources, student shall be able to analyze System Simulation and evaluate the Steady State Performance using Equivalent Circuit of Synchronous Machine. |
| **CO3** | For a Excitation systems & Prime Mover Controllers, student shall be able to generate its analytical response by Standard Block Diagram and examine, analyze and evaluate the characteristics by State Equations and Load Modeling. |
| **CO4** | For a given System Model, students shall be able to identify its characteristics and for Stator Equation, select suitable design of application of Network Equation, develop various combination for System Simulation Small Signal Analysis with Block Diagram Representation for Single Machine System,. |
| **CO5** | Given a Modeling and Analysis of Transient and Voltage Stability, student shall be able to define its Stability Evaluation, solve/ analyze, and modify energy functions for direct stability<br>evaluation; |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Given a Power System Dynamics Problems, students shall be able to represent this in various conventional models, identify type of system, apply vector algebra, and formulate the expression in different System Model and solve using mathematical terms. | **3** | **3** | **2** | | | | | | | | | |
| **CO2** | Given a Modeling of Synchronous Machine with sources, student shall be able to analyze System Simulation and evaluate the Steady State Performance using Equivalent Circuit of Synchronous Machine. | **3** | **3** | **2** | **2** | **2** | | | | | | | |
| **CO3** | For a Excitation systems & Prime Mover Controllers, student shall be able to generate its analytical response by Standard Block Diagram and examine, analyze and evaluate the characteristics by State Equations and Load Modeling. | **3** | **3** | **1** | | | | | | | | | **2** |
| **CO4** | For a given System Model, students shall be able to identify its characteristics and for Stator Equation, select suitable design of application of Network Equation, develop various combination for System Simulation Small Signal Analysis with Block Diagram Representation for Single Machine System | **3** | **2** | **3** | **2** | **3** | | | | | **2** | **2** | |
| **CO5** | Given a Modeling and Analysis of Transient and Voltage Stability, student shall be able to define its Stability Evaluation, solve/ analyze, and modify energy functions for direct stability evaluation. | **3** | **3** | **3** | | | **2** | **1** | | | | | |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: UTILIZATION OF ELECTRICAL ENERGY AND TRACTION**
**COURSE CODE: EE431**

**COURSE OBJECTIVES:**

- To impart the detail knowledge of different types of Electrical Heating
- To understand about Electrical Welding, Refrigeration and Air conditioning.
- To study different definitions of Illuminations and its Laws
- To understand types of Electric Traction, system of track electrification, Tractive effort.
- Study of salient features of traction Drives. To impart knowledge of Diesel Electric Traction

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | **Conceptualize** fundamental elements of electrical heating, **designing** of different elements used in electrical heating, **understand** working and application of different type of furnaces. |
| **CO2** | **Understand** different types and working of electrical welding, **understand** different instrument used for electrical welding. **Acquire** detailed knowledge electro-deposition, laws of electrolysis and its application in different field. |
| **CO3** | **Acquire** knowledge of different Laws of Illuminations, **Develop** the designing skill for indoor and outdoor lighting system. **Understand** construction and operation of Refrigeration and air conditioner system, **Analyze** the electric circuit and **Learn** the maintenance of domestic refrigerator. |
| **CO4** | **Understand** operation, mechanism and types of track electrification used of a traction system. **Acquire** detailed knowledge of different terminology used in electric traction. |
| **CO5** | **Acquire** knowledge of different motor drives operation, **Analyze** starting, braking and of different type of motor drives used for traction **Apply** the concepts of AC-DC and DC-DC Converters for traction drives, **Implementation** of bridge transition speed control of a DC traction drive. **Understand** the concept of diesel electric traction. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 1 | 2 | 2 | 2 | | | 2 | | 1 |
| **CO2** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | | | 2 | | 1 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 1 | 1 | 3 | | 1 | | 1 | | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | | 3 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: POWER QUALITY & MITIGATION**
**COURSE CODE: EE433**

**Course Objective** :

- Students will comprehend power quality problems and their sources.
- Students will be able to apply power and power quality monitoring algorithms
- Students will be able to propose solutions for power quality problems

**Course Outcomes** :

**CO1: Classify** the power quality problems
**CO2: Analyze** voltage sag problems and suggest preventive techniques
**CO3: Identify** the harmonic sources and the effects of harmonic distortion
**CO4: Identify** the DG sources; **analyze** the power quality issues and operating conflicts when DG is interconnected to the grid.
**CO5: Understand** reasons for grounding and describe the wiring & grounding problems and solutions

**CO-PO MAPPING:**

| | **PO1** Engineering knowledge | **PO2** Problem analysis | **PO3** Design /Development of solutions | **PO4** Conduct investigations into complex problem | **PO5** Modern tool usage | **PO6** Engineer & society | **PO7** Environment &sustainablity | **PO8** Ethics | **PO9** Individual & Team work | **PO10** Communication | **PO11** Project Management & Finance | **PO12** Lifelong Learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 1 | | | | | | | | |
| **CO2** | 3 | 3 | 3 | 1 | | | | | 3 | | 3 | 3 |
| **CO3** | 3 | 3 | 3 | | | | | | 3 | | 3 | 3 |
| **CO4** | 3 | 3 | 3 | | | | | 2 | | | | |
| **CO5** | 3 | 3 | 3 | | | | | 2 | | | 3 | 2 |
| 3. Strong Contribution 2. Moderate Contribution 1.Weak Contribution | | | | | | | | | | | | |

**COURSE: HIGH VOLTAGE DC TRANSMISSION**

**COURSE CODE: EE435**

**COURSE OBJECTIVES:**

- To introduce students with the concept of HVDC Transmission system.
- To familiarize the students with the HVDC converters and their control system.
- To expose the students to the harmonics and faults occur in the system and their prevention.
- To Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.
- To Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links
- To Analyze the different harmonics generated by the converters and their variation with the change in firing angles.
- To Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.
- To Study and understand the nature of faults happening on both the AC and DC sides of the converters and formulate protection schemes for the same.
- To Review the existing HVDC systems along with MTDC systems and their controls
- To Recognize the need to follow the advancements in both the existing systems and HVDC systems and determine the most economic coexistence of both.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Choose intelligently AC and DC transmission systems for the dedicated application(s). |
| **CO2** | Identify the suitable two-level/multilevel configuration for high power converters. |
| **CO3** | Select the suitable protection method for various converter faults. |
| **CO4** | Decide the configuration for harmonic mitigation on both AC and DC sides. |
| **CO5** | Identify suitable reactive power compensation method and basics of MTDC system. |

**CO-PO MAPPING:**

| CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | | | | | | | | 2 | |
| **CO2** | 3 | 3 | 2 | 2 | 2 | | | | | | | |
| **CO3** | 3 | 3 | 1 | | | | | | | | | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | | | | | 2 | 2 | |
| **CO5** | 3 | 3 | 3 | | | 2 | 1 | | | | 2 | |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | |

**COURSE: HIGH POWER SEMICONDUCTOR DEVICES**
**COURSE CODE: EE439**

| COURSE OUTCOMES | |
|---|---|
| **CO1** | To understand the construction and working of power switches like diode, transistor, IGBT and their practical applications in industries. |
| **CO2** | Analysis of different types thyristors their practical implementation. To understand the different methods to turn it on and their blocking characteristics. |
| **CO3** | To understand the structure and operation of MOSFET, Silicon IGBT, Silicon carbide IGBT and its practical application in electrical devices for industries. |
| **CO4** | To understand the operation and structure of VMOS and DMOS and its practical application in electrical devices for industries. |
| **CO5** | To understand the operation and structure of silicon MCT, BRT,EST, Gallium Nitride devices and its practical application in electrical devices for industries. |

| CO- PO Mapping | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning | |
| **CO1** | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | | | | | |
| **CO2** | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | | | | |
| **CO3** | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | | 1 | | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 1 | | 3 | | 2 |
| **CO5** | 3 | 2 | 3 | 2 | 3 | 2 | 2 | | 1 | | 3 | | 2 |
| 3. Strong Contribution 2. Moderate Contribution 1.Weak Contribution | | | | | | | | | | | | | |

**COURSE : FLEXIBLE AC TRANSMISSION SYSTEMS(FACTS)**

**COURSE CODE: EE441**

**Course Objective** :To familiarize power engineers about the Flexible AC Transmission devices and their applications in power systems with respect to active/reactive power control.

**Course Outcomes** :

**CO1: Understand** the importance of controllable parameters and benefits of FACTS controllers.

**CO2: Know** the significance of shunt, series compensation and role of FACTS devices on system control.

**CO3: Analyze** the functional operation and control of GCSC, TSSC and TCSC.

**CO4: Describe** the principles, operation and control of UPFC and IPFC.

**CO-PO MAPPING:**

| **CO\PO** | **PO1**Engineering knowledge | **PO2** Problem analysis | **PO3** Design /Development of solutions | **PO4** Conduct investigations into complex problem | **PO5** Modern tool usage | **PO6** Engineer & society | **PO7** Environment &sustainablity | **PO8** Ethics | **PO9** Individual & Team work | **PO10** Communication | **PO11** Project Management & Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 1 | | 1 | | | 2 | 1 | | |
| **CO2** | 3 | 3 | 3 | 1 | | | 3 | | 3 | 1 | 3 | |
| **CO3** | 3 | 3 | 3 | 1 | | | | | 3 | 1 | 3 | 1 |
| **CO4** | 3 | 3 | 3 | 1 | | | | | 3 | 1 | | 1 |
| 3: Strongly contributed 2: Average contributed 1: Low contributed | | | | | | | | | | | | |

**COURSE: SPECIAL ELECTRICAL MACHINE**
**COURSE CODE: EE443**

**COURSE OBJECTIVES:**

- Knowledgeof slip power recovery scheme
- To get knowledge of constructional features of special machines such as single phase synchronous motor and ac servomotor.
- To attain knowledge of working of stepper motorand switched reluctance motor and there drive circiuits
- To study about different types of magnets and there application in different machines
- To have the knowledge of working and application of linear induction motor and universal motor.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Evaluate the performancespecial induction motors and slip power recovery schemes |
| **CO2** | Analyze the performance of single phase synchronous motor and ac servomotor |
| **CO3** | Evaluate the performance of drive circuit of stepper motors |
| **CO4** | Knowledge of permanent magnet machines |
| **CO5** | Knowledge of linear induction motor and universal motor used for special applications |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Evaluate the performancespecial induction motors and slip power recovery schemes | **3** | **2** | **2** | **1** | | | | | | | | **1** |
| **CO2** | Analyze the performance of single phase synchronous motor and ac servomotor | **3** | **2** | | | | | | | | | | **1** |
| **CO3** | Evaluate the performance of drive circuit of stepper motors | **3** | **3** | **2** | **2** | | | | | | | | **1** |
| **CO4** | Knowledge of permanent magnet machines | **3** | **2** | | | | | | | | | | **1** |
| **CO5** | Knowledge of linear induction motor and universal motor used for special applications | **3** | **1** | | | | | | | | | | **2** |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: ELECTRICAL SYSTEM & SUBSTATION DESIGN**
**COURSE CODE: EE 445**

**COURSE OBJECTIVES:**

- To develop knowledge of general aspects of electrical system design
- Having Knowledge of Medium and HV installations
- Having knowledge of installation of transformers, Switchgears and protective devices
- To get knowledge of Design of illumination systems
- To get the knowledge ofdifferent types of Substation, Substation equipment and its function.

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Understands the general aspects of electrical system design |
| **CO2** | Selection of main distribution board; Sub distribution board; MCCB, ELCB, MCB and cables forsub circuits |
| **CO3** | Understand installation of transformers, Switchgears and protective devices |
| **CO4** | knowledge of Design of illumination systems |
| **CO5** | knowledge oftypes of Substation, Substation equipment and its function. |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Understands the general aspects of electrical system design | 3 | 2 | | 1 | | | | | | | | 1 |
| **CO2** | Selection of main distribution board; Sub distribution board; MCCB, ELCB, MCB and cables forsub circuits | 3 | 2 | | | | | 1 | | | | | 1 |
| **CO3** | Understand installation of transformers, Switchgears and protective devices | 3 | 1 | | | | | | | | | | 2 |
| **CO4** | Knowledge of Design of illumination systems | 3 | 2 | | | | | | | | | | 1 |
| **CO5** | Knowledgeoftypes of Substation, Substation equipment and its function. | 3 | 2 | | | | | 1 | | | | | 1 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |

**COURSE: ELECTRIC VEHICLES**
**COURSE CODE: EE447**

**COURSE OBJECTIVES:**

- Knowledge of different types of electric vehicles
- Knowledge of different types of converters used in electric vehicles
- Knowledge of current sensors and speed sensors used in electric vehicles
- Knowledge of charge controllers and batteries used in electric vehicles
- To identify different types of electric vehicles on the basis of performance

**COURSE OUTCOMES (CO):**

***After completion of the course, a student will be able to***

| COURSE OUTCOME (CO) | DESCRIPTION |
|---|---|
| **CO1** | Knowledge of different electric vehicles and their environmental impact |
| **CO2** | Knowledge of different types of converters used in electric vehicles |
| **CO3** | Knowledge of current sensors and speed sensors used in electric vehicles |
| **CO4** | Knowledge of charge controllers and batteries used in electric vehicles |
| **CO5** | Identify different types of electric vehicles |

**CO-PO MAPPING:**

| | CO | **PO1** Engineering Knowledge | **PO2** Problem Analysis | **PO3** Design/development of solutions | **PO4** Conduct investigations into complex problems | **PO5** Modern tool usage | **PO6** Engineer and Society | **PO7** Environment and Sustainability | **PO8** Ethics | **PO9** Individual and Team work | **PO10** Communication | **PO11** Project Management and Finance | **PO12** Lifelong learning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | Knowledge of different electric vehicles and their environmental impact | 2 | | | | | | 3 | | | | | 1 |
| **CO2** | Knowledge of different types of converters used in electric vehicles | 3 | | | | | 2 | | | | | | 1 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | Knowledge of current sensors and speed sensors used in electric vehicles | | 3 | 2 | | | | | | | | | 1 |
| **CO4** | Knowledge of charge controllers and batteries used in electric vehicles | 3 | 1 | | | | | | | | | | 2 |
| **CO5** | Identify different types of electric vehicles | | | | | 1 | | 3 | | | | | 2 |
| 3: Strong contribution, 2: average contribution, 1: Low contribution | | | | | | | | | | | | | |