Fundamentals of Electrical Engineering

Course Description:
This course provides a comprehensive understanding of electrical circuits, magnetic circuits, AC circuits, and single-phase transformers. It covers fundamental concepts such as Ohm's Law, Kirchhoff's Laws, circuit theorems, AC power analysis, and transformer operations. By the end of the course, learners will have a solid foundation in analyzing and solving electrical circuit problems.

Audience Profile:

- Engineering students specializing in Electrical and Electronics Engineering.
- Technicians and professionals working with electrical systems.
- Individuals interested in learning about electrical circuit fundamentals and transformer operations.

Prerequisites:

- Basic knowledge of physics and mathematics.
- Familiarity with fundamental algebraic and trigonometric concepts.
- Understanding of basic electrical concepts is recommended but not required.

Course Objectives:
By the end of this course, learners will be able to:

- Understand and apply the fundamental laws governing electrical circuits.
- Analyze series and parallel electrical circuits using circuit theorems.
- Explain magnetic circuit concepts and their electrical analogs.
- Solve problems related to AC circuits, including power factor and resonance.
- Understand the working principles, efficiency, and performance of single-phase transformers.

Table of Contents (TOC):

Unit – I: Electric Circuits

- EMF, Potential difference, current, power, Energy (Definition & Units SI).
- Ohm's Law, types of sources (Current & Voltage).
- Ideal and Practical Sources (Independent Sources only).
- Source Conversion, Superposition theorem with DC source.
- Circuit element resistance, factors affecting resistance, series & parallel combination of resistances.
- Kirchhoff's Laws (KVL, KCL) statement & Numerical.

- Star Delta transformation.
- Circuit Element Inductance, Self and Mutual Inductance.
- Circuit Element Capacitance.

Unit – II: Magnetic Circuits

- Types of Magnetic Materials.
- Flux, flux density, flux intensity.
- MMF, reluctance, permanence, permeability.
- Analogous electric circuit.
- Calculation for composite magnetic circuit.
- Concept of leakage flux and fringing.
- B-H curve, phenomena of magnetic hysteresis.

Unit – III: AC Circuits

- Generation of single-phase voltage, average and RMS value for sinusoidal waveform.
- Periodic function, phasor representation of sinusoidal electrical quantities.
- Steady-state behavior of RLC circuit with excitation.
- Reactance, impedance, power and energy in AC circuit.
- Simple numerical on series and parallel AC circuit.
- Concept and importance of power factor.
- Resonance in series circuits.
- Principle of Generation of three-phase voltage, Phase sequence.
- Star & Delta Connected three-phase system.
- Voltage, Current & Power relations for Balanced three-phase system only (With numerical).

Unit – IV: Single Phase Transformer

- Basic construction of Transformer (core & shell type).
- Principle of operation, EMF equation.
- Transformer ratings, No-load & On-load operation with leakage reactance.
- Losses, efficiency.
- Definition & formula for voltage regulation, OC & SC test.
- Equivalent circuit of the Transformer.