

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

1. **Name of the Academic Unit:** Electrical Engineering

2. **Subject Name:** Basic Electrical Engineering **L-T-P:**3-1-0 **Credits:** 4

3. **Pre-requisites:** Nil

4. **Syllabus and reference books:**

Syllabus: Introduction: Power Generation, Transmission and Distribution; circuit elements; Nodes, Branches & Loops, KCL & KVL; Signals: Delta, Step and Ramp function, Different types of DC and AC signals; DC Circuit Analysis; DC Transients: RC Circuits, RL Circuits; AC circuits (Sinusoids and Phasors): Phasor relation with circuit elements (R,L,C), Phasor diagram impedance and admittance; Kirchhoff's laws, Mesh and Node voltage methods in AC, Network theorems; R-L-C Network, resonance; Three phase EMF generation, Delta and Y connection, Solution of Three phase circuits; AC Power: Instantaneous and average power, Measurement of power in three phase circuits; Magnetic circuits: Examples and solutions, Faraday's Law, Magnetically Coupled circuit, Hysteresis and Eddy current losses; Single phase transformer: construction, rating, equivalent circuit, Tests on single phase transformers, Efficiency, regulation, parallel operation; Electromechanical Power Conversion; Three phase Induction Motor: The revolving magnetic field, Principle of operation, construction, ratings, equivalent circuit, tests, Torque speed and power speed characteristics, Speed control.

Reference Books:

- 1) Electrical Technology; Edward Hughes; Longman Scientific and Technical
- 2) Engineering Circuit Analysis; William H. Hayt, Jr. Jack E. Kemmerly; McGRAW-Hill International Edition
- 3) Electric Machinery; A.E. Fitzgerald, Charles Kingsley Jr. Stephen D. Umans; McGRAW-Hill
- 4) NPTEL WEB Course "Basic Electrical Technology" URL: <https://nptel.ac.in/courses/108105053>
- 5) Electric Machines; D. P. Kothari, I.J.Nagrath; Tata McGRAW-Hill

5. **Lecture-wise break-up:**

Sl. No.	Topic	No. of lectures
1.	Introduction: Power Generation, Transmission and Distribution Course overview	1
2.	Circuit elements, independent current and voltage sources, symbols, examples, battery and solar cells.	1
3.	Concept of Electrical circuits. Nodes, Branches & Loops, KCL & KVL	1

4.	Signals: Delta, Step and Ramp function, Different types of DC and AC signals	1
5.	DC Circuit Analysis: Star Delta and Delta Star Transformation, Mesh Currents, and Node Voltages Method	1
6.	Superposition Theorem, Thevenin's Theorem, Norton's Theorem	1
7.	DC Circuit Analysis: Examples, Problem solving	2 (T)
8.	DC Transients: Capacitance and inductance and their series/parallel combinations.	1
9.	RC Circuits, RL Circuits transients	2
10.	Response of RL circuit to sinusoidal inputs.	1
11.	AC circuits (Sinusoids): Average and effective values of sinusoids, Phasors, j operator	1
12.	Phasor relation with circuit elements (R,L,C), impedance and admittance and their representation, Phasor diagram	2
13.	Kirchhoff's laws in AC, Impedance combinations (AC): series-parallel, star-delta	1
14.	Mesh and Node voltage methods in AC circuits	1
15.	Network theorems (AC)	1
16.	DC Transient and AC Circuits: Problem solving	2 (T)
17.	AC Power: Instantaneous and average power, reactive power, apparent power, power factor.	1
18.	R-L-C Network, resonance, Low Pass, High Pass and Band Pass filters, Bandwidth and Q factor.	1
19.	Three phase EMF generation	1
20.	Delta and Y connection – line and phase quantities	1
21.	Solution of Three phase circuits, balanced supply voltage and balanced load – phasor diagram	1
22.	Measurement of power in three phase circuits	1
23.	Three phase AC Circuit: Problem solving	2 (T)
24.	Magnetic circuits: Ampere's law and B-H curve	1
25.	Example of linear and nonlinear magnetic circuits, Methods of solution	1
26.	Faraday's Law, Magnetically Coupled circuit, Mutual Inductance	1
27.	Magnetic circuits: Hysteresis and Eddy current losses	1
28.	Magnetic Circuit: Problem Solving	2 (T)
29.	Transformers: Construction, EMF equation, ratings	1
30.	Ideal Transformer, No load and loaded phasor diagram	1

31.	Practical Transformer, Exact and approximate equivalent circuits	1
32.	Determination of Equivalent circuit parameters, , open and short circuit tests, Per unit parameter values and its importance	1
33.	Transformers: Regulation and efficiency, All day efficiency	1
34.	Parallel operation of single phase transformers, Equal and unequal no load voltage	1
35.	Transformer: Problem Solving	2 (T)
36.	Electromechanical Power Conversion. Generating and Motoring mode of operation.	1
37.	Induction Motor: The revolving magnetic field, Principle of operation, construction, ratings	2
38.	Induction Motor: Equivalent circuit	1
39.	No load and Blocked rotor test, Determination of equivalent circuit parameters	1
40.	Induction Motor: Power relations, Torque – speed characteristics	1
41.	Induction Motor Speed Control and applications	1
42.	Induction Motor: Problem solving	2(T)
Total number of hours		39(L), 12(T)