

ELECTRIC CIRCUIT I

ENEE 101

Lecture : 3
Tutorial : 1
Practical : 3

Year : I
Part : I

Course Objectives:

To understand the fundamental concept and analysis of AC and DC electrical circuits.

- 1 Introduction to Electric Circuits (6 hours)**
 - 1.1 Overview of electrical supply
 - 1.2 Electric current and potential
 - 1.3 Circuit components
 - 1.3.1 Electrical sources: Dependent and independent, voltage and current source
 - 1.3.2 Electrical load: Linear and nonlinear
 - 1.4 Ohm's law, limitation and application
 - 1.5 Resistance and resistivity
 - 1.6 Factors affecting resistance
 - 1.7 Effect of temperature on resistance
 - 1.8 Conductance and conductivity
 - 1.9 Power and energy
 - 1.10. Series and parallel combination of resistor
 - 1.11. Current and voltage divider rules

- 2 DC Network Analysis (16 hours)**
 - 2.1 Network terminology
 - 2.2 Kirchhoff's laws
 - 2.3 Nodal analysis method
 - 2.4 Mesh analysis method
 - 2.5 Star/Delta and Delta/Star transformation
 - 2.6 Superposition theorem
 - 2.7 Thevenin's theorem
 - 2.8 Norton's theorem
 - 2.9 Maximum power transfer theorem
 - 2.10 Compensation theorem and reciprocity theorem

- 3 Capacitance and Inductance (4 hours)**
 - 3.1 General concept of capacitance and geometrical point of view
 - 3.2 Factors affecting capacitance

- 3.3 Energy stored in capacitor
- 3.4 Capacitors in series, parallel combination
- 3.5 General concept of inductance and geometrical point of view
- 3.6 Inductance in series, parallel combination with mutual inductance
- 3.7 Energy stored in an inductor

4 AC System (5 hours)

- 4.1 Introduction of AC quantities
- 4.2 Faraday's law of electromagnetic induction
- 4.3 Generation of alternating voltage
- 4.4 Waveform and its characteristics
- 4.5 Average value
- 4.6 Root mean square (rms) value
- 4.7 Phase and phase difference
- 4.8 Phasor representation

5 Single Phase AC Circuit (8 hours)

- 5.1 AC circuit analysis with resistive, inductive and capacitive load
- 5.2 AC circuit analysis comprising series configurations of RL, RC, and RLC loads
- 5.3 AC parallel circuit analysis
- 5.4 Resonance in RLC series and parallel circuit, bandwidth and quality factor
- 5.5 Measurement of power in single phase AC system

6 Three Phase Circuit Analysis (6 hours)

- 6.1 Advantage of three phase AC system
- 6.2 Generation of three phase AC Voltage
- 6.3 Phase sequence and its importance
- 6.4 Interconnection of three phase coils
- 6.5 Phase and line quantities in star and delta connection
- 6.6 Analysis with balanced and unbalanced load
- 6.7 Power measurement in three phase AC circuit and Blondel theorem
- 6.8 Power factor and its correction

Tutorial (15 hours)

Tutorials will encompass numerical exercises from all chapters

Practical (45 hours)

- 1. Familiarization of electrical elements, sources and measuring devices related to electrical circuits and safety rules to be followed in labs
- 2. Verification of Ohms law and effect of temperature on resistance
- 3. Verification of Kirchhoff's law and series and parallel combination of resistor
- 4. Verification of Thevenin theorem and maximum power transfer theorem

5. Verification of superposition and reciprocity theorem
6. Measurement of Inductance of a coil and perform series-parallel combination of capacitor and inductor
7. Verifications of Faradays law of induction
8. Measurement of AC quantities using oscilloscope and study phase relation of RL and RC load
9. Measurement of power and power factor in a single-phase AC series RL circuit and study of improvement of power factor using capacitor
10. Study the phenomenon of resonance in RLC Series and parallel circuit
11. Measurement of line, phase and neutral relations in three phases balanced and unbalanced load
12. Phase sequence detection and power analysis using a power analyzer
13. To study power measurement in a three phase AC circuits by two-wattmeter method

Reference

1. Cogdell, J.R. (1996). Foundations of electrical engineering (Latest Edition). Prentice Hall.
2. Hughes, T.P. (2004). Human-built world: How to think about technology and culture. University of Chicago Press.
3. Rizzoni, G., Kearns, J. (2009). Fundamentals of electrical engineering. McGraw-Hill Education.
4. Alexander, C.K. (2013). Fundamentals of electric circuits. McGraw-Hill Education.
5. Mayergoyz, I.D., Lawson, W. (1997). Basic electric circuit theory: A one-semester text (Latest Edition). Gulf Professional Publishing.
6. Theraja, B.L., Theraja, A.K. (2014). A textbook of electrical technology. S. Chand Publishing.