

B.Sc. Physical Sciences with Physics as one of the Core Disciplines

DISCIPLINE SPECIFIC ELECTIVE COURSE – DSE 7-3: ELECTRIC CIRCUIT ANALYSIS

Course Title and Code	Credits	Credit distribution of the course			Pre-requisite of the course
		Lecture	Tutorial	Practical	
Electric Circuit Analysis DSE 7-3	4	2	0	2	

COURSE OBJECTIVES

This course covers the basic circuit concepts in a systematic manner which is suitable for analysis and design. It aims at study and analysis of electric circuits using network theorems and two-port parameters.

LEARNING OUTCOMES

By the end of this course, the student will be able to:

- Explain the laws and methods of analysing DC and AC networks
- Define nodal and loop analysis
- Solve complex electric circuits using network theorems.
- Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
- Evaluate the performance of two port networks.
- Use Millman's theorem to reduce multiple voltage sources in parallel to a single equivalent voltage source.

SYLLABUS OF DSE 7-3 **THEORY COMPONENT** **(Hours: 30)**

Unit I

(8 Hours)

Circuit Analysis: Ideal voltage source, real voltage source, current source, Kirchhoff's current law, Kirchhoff's voltage law, node analysis, mesh analysis, Star and Delta conversion DC Transient Analysis: Charging and discharging with initial charge in RC circuit, RL circuit with initial current, time constant, RL and RC Circuits with source

Unit II

(5 Hours)

AC Circuit Analysis: Sinusoidal voltage and current, Definitions of instantaneous, peak to peak, root mean square and average values, form factor and peak factor (for half-rectified and full-rectified sinusoidal wave, rectangular wave and triangular wave)

Unit III

(7 Hours)

Voltage-current relationship in resistor, inductor and capacitor, phasor, complex impedance, power in AC circuits, sinusoidal circuit analysis for RL, RC and RLC Circuits, resonance in series and parallel RLC Circuits (Frequency Response, Bandwidth, Quality Factor), selectivity, application of resonant circuits

Unit IV

(10 Hours)

Network Theorems: Principal of duality, Superposition theorem, Thevenin theorem, Norton theorem, Their applications in DC and AC circuits with more than one source, Maximum Power Transfer theorem for AC circuits, Reciprocity Theorem, Millman's Theorem, Tellegen's theorem
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission Parameters, Impedance matching

PRACTICAL COMPONENT: ELECTRIC CIRCUIT ANALYSIS

(Hours: 60)

Every student must perform at least seven experiments from the following list of experiments:

1. Verification of Kirchoff's Law.
2. Verification of Superposition Theorem by using d.c. and a.c. voltage source
3. Verification of Norton's theorem.
4. Verification of Thevenin's Theorem and Maximum Power Transfer Theorem by using d.c. and a.c. voltage sources,
5. Determination of unknown capacitance using de Sauty's Bridge
6. Determination of time constant of RC and RL circuit
7. Study of frequency response of RC circuit
8. Study of frequency response of a parallel LCR Circuit and determination of its resonant frequency, impedance at resonance, quality factor and bandwidth.
9. Explore electrical properties of matter using Arduino:
 - a. To study the characteristics of a series RC Circuit.
 - b. To study the response curve of a series LCR circuit and determine its resonant frequency, impedance at resonance, quality factor and bandwidth

REFERENCES

- 1) A Textbook of Electrical Technology, B. L. Thareja, A. K. Thareja, Volume II, S. Chand
- 2) Fundamentals of Electric Circuits, C. Alexander and M. Sadiku, McGraw Hill (2008)
- 3) Electric Circuits, S. A. Nasar, Schaum's Outline series, Tata McGraw Hill (2004)
- 4) Electrical Circuits, K. A. Smith and R.E. Alley, 2014, Cambridge University Press
- 5) Electrical Circuit Analysis, K. Mahadevan and C. Chitran, 2nd Edition, 2018, PHI Learning Pvt. Ltd.