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CSE250 – Circuits and Electronics

Introduction to CSE250

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Course content

Fundamental electrical concepts and measuring units; Direct current: voltage, current, resistance and power; Laws of electrical circuits and methods of network analysis; Circuit theorems; First order transient circuits; Alternating current: instantaneous and R.M.S. current; voltage and power, average power for various combinations of R, L and C circuits; Laws of electrical circuits and methods of network analysis; Circuit theorems; phasor representation of sinusoidal quantities; Power analysis of AC circuits; The course includes a compulsory 3 hour (per week) laboratory work.

Course objectives

- To describe basic linear electrical circuit components such as, dependent and independent voltage and current sources, resistors, capacitors and inductors. I-V characteristics of these elements.
- To familiarize students with basic electrical parameters such as voltage, current and power and passive sign convention for computing these parameters.
- To explain basic laws like Ohm's law, Kirchhoff's voltage and current law, Thevenin's and Norton's theorem, Maximum power transfer theorem, Superposition theorem as well as voltage/current divider rule and characteristic equations for capacitors/inductors.
- To introduce several circuit solving methods such as Source transformation, Nodal and Mesh analysis, method using Superposition theorem, Thevenin/Norton's equivalent circuit that take advantage of basic laws.
- To teach how to apply circuit solving techniques to solve steady-state circuits which contain resistors and dependent sources with direct current.
- To analyze first order transient circuits with resistors, capacitors and inductors in time domain.
- To introduce phasors and analyzing circuits containing resistors, capacitors and inductors in phasor domain with alternating current.

Course outcomes

Upon successful completion of this course, students will be able to,

- **Describe** the behaviour of basic linear electrical circuit components.
- **Identify** basic circuit parameters like voltage, current and power.
- **Explain** basic laws of electricity which are used in circuit problems
- **Apply** circuit solving techniques that uses electrical laws to **evaluate** the circuit parameters of a given circuit.
- **Analyze** the behaviour of a first order transient circuit.
- **Evaluate** circuit parameters in phasor domain in an AC circuit.

Lesson plan . . .

No	Topic	Lecture#
1	Illustrating the motivation behind taking this course. What are the real-life implications of this course materials?	Lecture 1
2	Discuss basic circuit parameters like voltage, current, energy and power definitions and units. Introducing passive sign convention, positive-negative voltage/current/power. Discuss different types of circuit elements (active, passive), different types of sources (DC/AC, voltage/current, dependent/independent). Introducing circuit symbols.	Lecture 2
3	Introducing basic electrical components: resistors, voltage Source, current Source. I-V characteristics of a circuit element. Basic laws of electrical circuits: Ohm's law. Using Ohm's law to find power. Discuss various circuit configurations: Series, Parallel, -Y etc. How to identify them and calculate equivalent resistance. Open and short circuit	Lecture 3
4	Defining Node/Supernode. Introducing Current Sign Convention. Basic laws of electrical circuits: Kirchhoff's current law. Statement and application of KCL. Current divider rule in parallel circuit. Illustrating convention doesn't change the KCL equation. Usefulness of supernode.	Lecture 4
5	Defining Mesh/Supermesh. Revisiting Passive Sign Convention. Basic laws of electrical circuits: Kirchhoff's voltage law. Statement and application of KVL. Voltage divider rule in series circuit. Illustrating the assumption of current direction doesn't change the KVL equation. Usefulness of supermesh.	Lecture 5
	Quiz 1	
6	Open circuit, Short circuit I-V characteristics. Idea of circuit equivalence. Equivalence with inactive current/voltage sources. Series-parallel equivalent circuit for resistance/voltage source/current source. Ideal/ non-Ideal current/voltage source. Calculating equivalent resistance of series-parallel circuit. Basic circuit theorem: Source Transformation theorem. Failure of applying in Wheatstone bridge circuit.	Lecture 6
7	Explaining Nodal Analysis technique, using it to solve for current, voltage, power in a given circuit (multiple examples)	Lecture 7
8	Reintroducing dependent sources. Demonstrating Nodal Analysis with dependent sources. Problems with floating voltage sources, using Supernodes to solve such circuits.	Lecture 8
9	Explaining Mesh Analysis technique, using it to solve for current, voltage, power in a given circuit (multiple examples).	Lecture 9

Lesson plan . . .

10	Demonstrating Mesh Analysis with dependent sources. Problems with common current sources, using Supermeshes to solve such circuits.	Lecture 10
Quiz 2		
Midterm		
11	Linear circuit elements. I-V characteristics of linear circuits. Circuit Theorems: Thevenin's theorem. Motivation behind Thevenin's theorem.	Lecture 11
12	Using Thevenin's theorem for solving circuits. Condition for maximum power transfer. Norton's theorem, relation between Thevenin's and Norton's theorem.	Lecture 12
13	Using test voltage/current sources while applying Thevenin's and Norton's theorem. Solving resistance matching problems for maximum power transferring.	Lecture 13
14	Reintroduction to circuit linearity, linearity of voltage, current in circuits, non-linearity of power. Circuit theorem: Superposition theorem. Using superposition theorem for solving DC circuits.	Lecture 14
15	Solving circuits using superposition theorem with dependent sources.	Lecture 15
Quiz 3		
16	Capacitors and Inductors, their component equations. SI unit for measuring capacitance and inductance. Transient circuits, visualizing and analyzing transient circuits.	Lecture 16
17	Response of transient circuit: first order (RC/RL) circuit, time constant. Analyzing and plotting first order transient circuit response.	Lecture 17
18	Complex number review. Alternating current, importance of AC circuit. Visualizing the dynamics of an AC circuit.	Lecture 18
19	Phasor diagram, introducing Impedance. Defining impedance for different elements Phasor analysis of an AC circuit. Instantaneous voltage, current and power.	Lecture 19
20	Peak RMS voltage/current, real and reactive power. Applying superposition theorem on AC circuits containing sources of different frequencies.	Lecture 20
Quiz 4		
Final Exam		

Course materials

- Text and reference books

Sl.	Title	Author(s)	Publication Year	Edition	Publisher	ISBN
1	Fundamentals of Electric Circuits	Charles K. Alexander, Matthew N. O. Sadiku	2019	6th	McGraw Hill Education	978-9353165505
2	Introductory Circuit Analysis	Robert L. Boylestad	2013	12th	Pearson Education India	978-9332518612

- Other materials (if any)
  - Lecture slides

Mark distribution (*tentative)

Assessment tools	Weightage (%)
Attendance	10
Assignment	5
Quiz	15
Lab	20
Midterm	25
Final	25
Total	100

Participation	Grade (/10)
90% or above	10
80% to below 90%	9
70% to below 80%	8
60% to below 70%	7
50% to below 60%	6
Below 50%	0

Thank you for your attention