Course Description and Outcome Form
Department of Computer Science and Engineering
School of Engineering and Computer Science
Brac University

A. Course General Information:

Course Code:	CSE250 CSE250L
Course Title:	Circuits and Electronics Circuits and Electronics Laboratory
Credit Hours (Theory+Lab):	3 + 0
Contact Hours (Theory+Lab):	3 + 3
Category:	Program Core
Type:	Required, Engineering, Lecture + Laboratory
Prerequisites:	None
Co-requisites:	None

B. Course Catalog Description (Content):

Fundamental electrical concepts and measuring units of electrical charge, voltage, current, resistance, and power; Laws of electricity (Ohm's law, Kirchhoff's Current and Voltage law) and various methods of electrical circuit analysis (Nodal, Mesh); Introduction to basic electrical circuit elements; I-V characteristics; Circuit analysis in Direct current, First-order Transient and Alternating current mode, for various combinations of Resistive, Inductive and Capacitive networks; Phasor representation of sinusoidal quantities; Circuit theorems for linear circuits (Source Transformation, Superposition, Thevenin, Norton and Maximum Power Transfer). This course includes compulsory 3-hour laboratory work.

C. Course Objective:

The objectives of this course are to:

1. Introduce students to ideal linear electrical circuit components such as dependent and independent voltage and current sources, resistors, capacitors and inductors and their characteristic equations.
2. Illustrate the I-V characteristics of any two-terminal devices and infer circuit equivalence.
3. Define physical quantities related to electricity such as voltage, current and power and introduce passive sign convention for computing these quantities.
4. Explain fundamental laws like Ohm’s law, Kirchhoff’s voltage and current law, as well as important linear circuit theorems such as Thevenin’s and Norton’s theorem, maximum power transfer theorem, superposition principle, and source transformation.
5. Familiarize students with several circuit-solving techniques aside from the circuit theorems, such as the voltage/current divider rule, series-parallel circuit equivalence, and nodal and mesh analysis, that take advantage of the fundamental laws and theorems of the linear circuit.

6. Analyze first-order transient circuits with resistors, capacitors and inductors in the time domain.
7. Introduce phasors and analyze alternating current (AC) circuits constructed from sinusoidal sources, resistors, capacitors and inductors in the phasor domain.

D. Course Outcomes (COs):

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

Sl.	CO Description	Weightage (%)
CO1	**Understand** and **Describe** the foundational concepts of electricity, including relevant physical quantities and the governing laws that dictate its behavior, such as Kirchhoff's current and voltage law, and Ohm's law, etc.	10
CO2	**Describe** linear circuit theorems, such as superposition principle, source transformation, Thevenin and Norton's theorem, maximum power transfer theorem, and demonstrate the ability to **Apply** them efficiently.	35
CO3	**Analyze** the behavior of analog electrical circuits constructed from networks of diverse linear elements by utilizing various tools, including nodal and mesh analysis, circuit equivalence, voltage and current divider rules, and phasors domain analysis.	35
CO4	**Demonstrate** competence in using laboratory equipment, such as oscilloscopes, function generators, and multimeters, to build, test, and verify analog circuits, and troubleshoot circuit problems.	10
CO5	Collaborate effectively in a group in the laboratory, and **Report** their findings and insights clearly and concisely, using technical language and documentation standards.	4
CO6	**Design** schematics and **Simulate** electrical circuits using software programs, such as LTspice and EveryCircuit to analyze circuit behaviors.	4

E. Mapping of CO-PO-Taxonomy Domain & Level- Delivery-Assessment Tool:

Sl.	CO Description	POs	Bloom's taxonomy domain/level	Delivery methods and activities	Assessment tools
CO1	**Understand** and **Describe** the foundational concepts of electricity, including relevant physical quantities and the governing laws that dictate its behavior, such as Kirchhoff's current and voltage law, and Ohm's law, etc.	**PO1**	Cognitive / Understand, Apply	Lectures, Notes/Handouts, Simulation Demo	Quiz, Exam, Assignment
CO2	**Describe** linear circuit theorems, such as the superposition principle, source transformation, Thevenin and Norton's theorem, maximum power transfer theorem, and demonstrate the ability to **Apply** them efficiently.	**PO1, PO2**	Cognitive / Understand, Apply, Analyze	Lectures, Notes/Handouts, Simulation Demo	Quiz, Exam, Assignment
CO3	**Analyze** the behavior of analog electrical circuits constructed from networks of diverse linear elements by utilizing various tools, including nodal and mesh analysis, circuit	**PO2**	Cognitive / Apply, Analyze	Lectures, Notes/Handouts, Simulation Demo	Quiz, Exam, Assignment

	equivalence, voltage and current divider rules, and phasors domain analysis.				
CO4	**Demonstrate** competence in using laboratory equipment, such as oscilloscopes, function generators, and multimeters, to build, test, and verify analog circuits, and troubleshoot circuit problems.	**PO3, PO9**	Cognitive / Apply, Analyze, Psychomotor / Precision, Manipulation	Lab Class	Lab Work, Hardware Lab Test
CO5	Collaborate effectively in a group in the laboratory, and **Report** their findings and insights clearly and concisely, using technical language and documentation standards.	**PO10**	Cognitive / Apply, Analyze	Lab Class	Lab Report
CO6	**Design** schematics and **Simulate** electrical circuits using software programs, such as LTspice and EveryCircuit to analyze circuit behaviors.	**PO3**	Cognitive / Apply, Analyze, Create	Lab Class	Lab Work, Software Lab Test

F. Course Materials:

i. 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
3	Foundations of Analog and Digital Electronic Circuits	Anant Agarwal, Jeffrey H. Lang	2005	1st	Morgan Kaufmann Publishers	978-1558607354
4	Electric Circuits	James W. Nilsson Susan A. Riedel	2010	9th	Pearson College Div	978-0136114994

ii. Other materials (if any):

a. Lecture notes
b. Lab handouts
c. Video lectures
d. Simulation tools
    i. LTspice
    ii. Everycircuit

G. Lesson Plan:

No	Topic	Week/Lecture#	Related CO (if any)
1	Illustrating the motivation behind taking this course. What are the real-life implications of these course materials?	Week 1/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), and different types of sources (DC/AC, voltage/current, dependent/independent). Introducing circuit symbols.	Week 1/Lecture 2	CO1
3	Introducing basic electrical components: resistors, voltage source, current source. Basic laws of electrical circuits: Ohm's law. I-V characteristics of a resistor. Discuss passive sign convention, finding power of circuit elements by P=VI. Defining nodes, loops and mesh. Discuss various circuit configurations: Series, Parallel and others. How to identify series and parallel connections and calculate equivalent resistance. Open and short circuit	Week 2/Lecture 1	CO1
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 a parallel circuit. Illustrating convention doesn't change the KCL equation. Show usefulness of supernode.	Week 2/Lecture 2	CO1
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 a series circuit. Illustrating the assumption of the current direction doesn't change the KVL equation. Show usefulness of supermesh.	Week 3/Lecture 1	CO1
6	I-V characteristics of basic circuit elements: Resistor, Voltage source, Current source, Open circuit, Short circuit, any two-terminal device/circuit, a combination of elements (e.g. voltage/current source in series/parallel with resistor). Idea of circuit equivalence. Series-parallel equivalent circuit for resistance/voltage source/current source combinations. Ideal/ non-Ideal current/voltage source. Simplifying circuits by means of equivalence. Basic circuit theorem: Source Transformation theorem. Failure of applying in Wheatstone bridge circuit.	Week 3/Lecture 2	CO2
Quiz 1 (Lec 1-6)			
7	Explaining Nodal Analysis technique, using it to solve for current, voltage, and power in a given circuit (multiple examples)	Week 4/Lecture 2	CO3

8	Reintroducing dependent sources. Demonstrating Nodal Analysis with dependent sources. Problems with floating voltage sources, using Supernodes to solve such circuits.	Week 5/Lecture 1	CO3
9	Explaining MeshAnalysis technique, using it to solve for current, voltage, and power in a given circuit (multiple examples).	Week 5/Lecture 2	CO3
10	Demonstrating Mesh Analysis with dependent sources. Problems with common current sources, using Supermeshes to solve such circuits.	Week 6/Lecture 1	CO3
11	Linear circuit elements. Linearity of voltage, current in circuits, and non-linearity of power. Circuit theorem: Superposition theorem. Using superposition theorem for solving DC circuits. Superposition Theorem for circuits with Dependent Sources.	Week 6/Lecture 2	CO2
Quiz 2 (Lec 7-11)			
Midterm (Lec 1-11)			
12	Reintroduction to circuit linearity, I-V characteristics of linear circuits. Circuit Theorems: Thevenin's theorem. The motivation behind Thevenin's theorem.	Week 8/Lecture 1	CO2
13	Using test voltage/current sources while deactivating sources to find Thevenin's. Solving resistance matching problems for transferring maximum power. Norton's theorem, the relation between Thevenin's and Norton's theorem.	Week 8/Lecture 2	
14	Using Thevenin's/Norton's theorem for solving circuits. Maximum transferable power and condition for it.	Week 9/Lecture 1	CO2
Quiz 3 (Lec 12-14)			
15	Capacitors and Inductors, their component equations. SI unit for measuring capacitance and inductance. Transient circuits, visualizing and analyzing transient circuits.	Week 10/Lecture 1	CO1
16	Response of transient circuit: first order RC circuit, time constant. Analyzing and plotting first-order transient circuit response. Finding capacitor current from capacitor voltage.	Week 10/Lecture 2	CO3
17	Response of transient circuit: first order RL circuit, time constant. Analyzing and plotting first-order transient circuit response. Finding inductor voltage from inductor current.	Week 11/Lecture 1	CO3
18	Complex number review. Alternating current, the importance of AC circuit. Visualizing the dynamics of an AC circuit, Amplitude, RMS voltage/current and finding them from a graph.	Week 11/Lecture 2	CO1
19	Introducing Impedance. Defining impedance for various elements, Phasor analysis of an AC circuit. Instantaneous voltage, current and power. Applying superposition theorem on AC circuits containing sources of different frequencies	Week 12/Lecture 1	CO3
Quiz 4 (Lec 15 - 19)			
Final Exam (Lec 1 - 19)			

H. Lab Experiments:

No.	Experiment Name	Type	Week/Experiment No.	Related CO (if any)
1	Introduction to Laboratory Instruments (Part 1)	Hardware	Week 2 / Experiment 0	CO4
2	Introduction to Series and Parallel Circuits.	Hardware	Week 2 / Experiment 1	CO4
3	Verification of KVL and KCL.	Hardware	Week 3 / Experiment 2	CO4
4	Verification of Superposition Principle.	Hardware	Week 3 / Experiment 3	CO4
5	Introduction to Laboratory Instruments (Part 2)	Hardware	Week 4 / Experiment 0	CO4
6	I-V Characteristics and Circuit Equivalence.	Hardware	Week 4 / Experiment 4	CO4
7	Study of I-V Characteristics, and Verification of Thevenin's and Maximum Power Theorem using Software (LTspice) Simulation. (Dependent sources, I-V characteristics, sweep parameters)	Software	Week 5 / Experiment 5	CO6
8	Verification of Thevenin's Theorem and Maximum Power Transfer Theorem.	Hardware	Week 6 / Experiment 6	CO4
Midterm				
9	Open practice for Lab Test	Hardware	Week 8 / Practice	
Hardware Lab Test				
10	Study of Transient Behaviour of RC Circuit.	Hardware	Week 10 / Experiment 7	CO4
11	Study of Transient Circuits Using Software Simulation.	Software	Week 11 / Experiment 8	CO6
12	Study of AC Circuits Using Software Simulation.	Software	Week 11 / Experiment 9	CO6
Software Lab Test				

I. Assessment Tools:

i. Theory:

Assessment Tools	Weightage (%)
Attendance and Class Participation	10
Quiz	15
Assignment	5
Midterm Examination	25
Final Examination	25
Total	**80%**

ii. Lab:

Assessment Tools	Weightage (%)
Lab Attendance	2
Lab Performance	4
Lab Report	4
Hardware Lab Test	6
Software Lab Test	4
Total	**20%**

J. CO Assessment Plan:

Assessment Tools	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
Quiz	✔	✔	✔			
Assignment	✔	✔	✔			
Midterm Examination	✔	✔	✔			
Lab Work				✔		
Lab Report					✔	
Software Lab Test						✔
Hardware Lab Test				✔		
Final Examination	✔	✔	✔			

K. CO Attainment Policy:

As per the course outcome attainment policy of the Department of Computer Science and Engineering.

L. Grading Policy:

As per the grading policy of the Department of Computer Science and Engineering.

M. Course Coordinators:

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