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
Course Title:	Circuits and Electronics
Credit Hours (Theory+Lab):	3 + 0
Contact Hours (Theory+Lab):	3 + 3
Category:	Program Core
Type:	Required, Engineering, Lecture + Laboratory
Prerequisites:	PHY112: Principles of Physics II

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 the passive sign convention for computing these quantities.
4. Explain fundamental laws like Ohm's law, and 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.
8. Train students to build and analyze linear electrical circuits using resistors, capacitors, inductors, and independent/dependent sources to reinforce theoretical concepts and understand circuit behavior.
9. Develop students' ability to measure, verify, and troubleshoot linear circuit performance using standard laboratory instruments such as multimeters, oscilloscopes, and function generators, applying systematic experimental procedures.
10. Enhance teamwork and technical communication skills by engaging students in collaborative laboratory work and structured documentation of experimental results.

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, Ohm's law, etc.	10
CO2	**Describe** linear circuit theorems, such as the superposition principle, source transformation, Thevenin and Norton's theorem, and maximum power transfer theorem, and demonstrate the ability to **Apply** them efficiently.	30
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 phasor domain analysis.	35
CO4	**Develop** hands-on circuit-building and troubleshooting skills by collaborating in groups to perform lab tasks, utilizing laboratory equipment, such as oscilloscopes, function generators, and multimeters, to measure, verify, and troubleshoot analog circuits.	7
CO5	Collaborate effectively in a group in the laboratory, and **Report** their findings and insights clearly and concisely, using technical language and documentation standards.	6
CO6	**Demonstrate** individual competence in using laboratory equipment, such as oscilloscopes, function generators, and multimeters, to build, test, and verify analog circuits, as well as troubleshoot circuit problems.	12

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 equivalence, voltage and current divider rules, and phasor domain analysis.	PO2	Cognitive / Apply, Analyze	Lectures, Notes/Handouts, Simulation Demo	Quiz, Exam, Assignment
CO4	**Develop** hands-on circuit-building and troubleshooting skills by collaborating in groups to perform lab tasks, utilizing laboratory equipment, such as oscilloscopes, function generators, and multimeters, to measure, verify, and troubleshoot analog circuits.	PO3, PO9	Cognitive / Apply, Analyze, Psychomotor / Precision, Manipulation	Lab Class	Lab Work
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	**Demonstrate** individual competence in using laboratory equipment, such as oscilloscopes, function generators, and multimeters, to build, test, and verify analog circuits, as well as troubleshoot circuit problems.	PO3	Cognitive / Apply, Analyze, Create	Lab Class	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 Slides
b. Practice Problems
c. Video Lectures
d. Lab hand-outs and manuals
e. Everycircuit (simulation software)
f. Tinkercad (simulation software)
g. LTSPICE (simulation software)

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 sources, and current sources. I-V characteristics of basic circuit elements: Resistor, Voltage source, Current source, Open circuit, Short circuit. Discuss passive sign convention, finding the power of circuit elements by P=VI.	Week 2/Lecture 1	CO1
4	Ohm's law, basic circuit terminologies, series and parallel configurations, series-parallel circuits using resistors, the idea of circuit equivalence, calculating equivalent resistance, and handling open and short circuits.	Week 2/Lecture 2	CO3

5	Kirchhoff's Current Law (KCL), statements and applications, current divider rule (CDR), Kirchhoff's Voltage Law (KVL), statements and applications, voltage divider rule (VDR), assumptions about current/voltage direction, legal and illegal connections violating KCL/KVL.	Week 3/Lecture 1	CO1
6	Equivalent voltage sources and current sources, series and parallel connections of sources, simplification techniques using equivalence, handling combinations of elements (resistors and voltage/current sources).	Week 3/Lecture 2	CO3
Quiz 1 (Lecture 1-6)			
7	Explaining the 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. Explaining the Mesh Analysis technique, using it to solve for current, voltage, and power in a given circuit (multiple examples).	Week 5/Lecture 1	CO3
9	Demonstrating Mesh Analysis with dependent sources. Problems with common current sources, using Supermeshes to solve such circuits.	Week 5/Lecture 2	CO3
10	Linear circuit elements. Linearity of voltage, current in circuits, and non-linearity of power. Circuit theorem: Superposition theorem. Using the superposition theorem for solving DC circuits. Superposition Theorem for circuits with Dependent Sources.	Week 6/Lecture 1	CO2
Quiz 2 (Lecture 7-10)			
Midterm (Lecture 1-10)			
11	Revision of I–V characteristics of basic circuit elements and circuit equivalence, I–V characteristics of voltage sources in series with resistors and current sources in parallel with resistors, ideal and non-ideal sources, source transformation theorem, problem-solving applications.	Week 8/Lecture 1	CO2
12	I–V characteristics of any two-terminal linear circuits, inverse design (predicting circuit elements and calculating equivalent resistances from I–V graphs), understanding that multiple circuit configurations can produce the same I–V response, concept of circuit equivalency, problem-solving, deducing that every linear circuit has an equivalent version (Thevenin's/Norton's theorem).	Week 8/Lecture 2	CO3
13	Reintroduction to circuit linearity, circuit theorems with focus on Thevenin's theorem, motivation and applications of Thevenin's theorem for simplifying and analyzing circuits.	Week 9/Lecture 1	CO2
14	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 theorems.	Week 9/Lecture 2	CO2

15	Using Thevenin's/Norton's theorem for solving circuits. Maximum transferable power and conditions for it.	Week 10/Lecture 1	CO2
Quiz 3 (Lecture 11-15)			
16	Capacitors and Inductors, their component equations. The SI unit for measuring capacitance and inductance. Transient circuits, visualizing and analyzing transient circuits.	Week 11/Lecture 1	CO1
17	Response of transient circuit: first-order RC circuit, time constant. Analyzing and plotting the first-order transient circuit response. Finding the capacitor current from the capacitor voltage.	Week 11/Lecture 2	CO3
18	Response of transient circuit: first-order RL circuit, time constant. Analyzing and plotting the first-order transient circuit response. Finding inductor voltage from inductor current.	Week 12/Lecture 1	CO3
19	Complex number review. Alternating current: the importance of AC circuits. Visualizing the dynamics of an AC circuit, Amplitude, and RMS voltage/current, and finding them from a graph.	Week 12/Lecture 2	CO1
20	Introducing Impedance. Defining impedance for various elements, Phasor analysis of an AC circuit. Instantaneous voltage, current, and power. Applying the superposition theorem on AC circuits containing sources of different frequencies	Week 13/Lecture 1	CO3
Quiz 4 (Lecture 16 - 20)			
Final Exam (Lecture 11 - 20)			

H. Lab Experiments & Probable Timeline:

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 the Superposition Principle.	Hardware	Week 3 / Experiment 3	CO4
5	Open practice for Lab Test	Hardware	Week 4 / Practice	
6	**Labtest 1**	Hardware	Week 5 / Exam	CO6
Midterm Week				
7	Study of I-V Characteristics and Circuit Equivalence.	Hardware	Week 8 / Experiment 4	CO4
8	Verification of Thevenin's Theorem and Maximum	Hardware	Week 9 / Experiment 6	CO4

	Power Transfer Theorem.			
9	Study of Transient Behaviour of RC Circuit.	Hardware	Week 10 / Experiment 7	CO4
10	Open practice for Lab Test	Hardware	Week 11 / Practice	
11	**Labtest 2**	Hardware	Week 12 / Exam	CO6
Final Week				

I. Assessment Tools:

i. Theory:

Assessment Tools	Weightage (%)
Attendance and Class Participation	5
Quiz	15
Assignment	5
Midterm Examination	25
Final Examination	25
Total	**75%**

ii. Lab:

Assessment Tools	Weightage (%)
Lab Attendance	2
Lab Performance	5
Lab Report	6
Lab Test	12
Total	**25%**

J. CO Assessment Plan:

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