

Course Code: EEE-1105	BNQF Code: 07141105	Credits: 3.0 (3 Hours)
Course Title: Electrical Circuits and Devices		Year: 1 st Semester: 1 st
Total Marks: 100		
Course Type: Core Course		
Pre-requisite: Basic mathematics, hardware related knowledge, basic knowledge in physics		

Rationale of the Course

This course will provide a basic knowledge of Electrical Circuits. Students should be able to identify, define and describe different components and relevant terms. This course will help the students to gain theoretical knowledge and will also help to do hardware implementation in the course of Basic Electronics, Digital Electronics, Embedded Systems and Robotics.

Course Objectives

- To understand the operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To apply concepts for the design of Regulators and Amplifiers.
- To verify the theoretical concepts through laboratory and simulation experiments.
- To implement mini projects based on concept of electronics circuit concepts.

Course Contents

Introduction to voltage, current, voltage source, conductors, insulators, resistances; Ohm's law, KVL, KCL, voltage and current divider rules:

Network sources and Analysis: Voltage sources; Voltage sources in parallel; Open and short circuits; Current sources in series and parallel; Source conversion; Branch-current analysis; Mesh analysis; Nodal analysis; Y- Δ and Δ -Y conversion.

Network Theorems: Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem; Millman's theorem; Substitution theorem; Reciprocity theorem.

Basic Passive Elements: Resistors, inductors and capacitors in series and parallel; transient response in capacitive networks; Charging and discharging phases; R-L transients; Storage cycle, Decay phase.

Fundamentals of AC and the Basic elements and Phasors: AC fundamentals; Generation of alternating voltage & currents; Sine wave; Frequency spectrum and phase relations; General format of sinusoidal voltage and currents; Phase & algebraic representations of sinusoids; Average & RMS (effective) values; Response of basic R,L,C elements to a sinusoidal voltage & currents; frequency response of basic elements; Impedance and phasor diagram; Average power & power factor; Complex numbers: Rectangular & polar form: Active & reactive power; Resonance, Series & parallel resonance circuit; Quality factor, Selectivity; Fourier Series.

Transformer: Construction and features of transformer; Transformer on no- load and on load; emf-equation; Phasor diagram; Equivalent circuits; Losses and efficiency.

Course Learning Outcomes (CLO): (at the end of the course, student will be able to:)

CLO1	Recall and articulate the fundamental principles of electrical circuits, including Ohm's Law, Kirchhoff's laws, and basic circuit analysis techniques, applying them to solve simple electrical problems.
CLO2	Understand and demonstrate proficiency in the characteristics and behaviors of electronic devices, such as diodes and transistors, explaining their operating principles and basic applications in electronic circuits.
CLO3	Memorize and apply the principles of electrical energy and power, demonstrating an understanding of the relationships between voltage, current, and power in electrical circuits, and their significance in practical applications.

Mapping of Course Learning Outcomes (CLO) to Program Learning Outcomes (PLO)

	PLO 1	PLO 2	PLO 3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1	✓											
CLO2		✓										
CLO3	✓											

Teaching-Learning Strategies (TLS)

TLS1	Interactive discussion using white board / multimedia.
TLS2	Active discussion in class (online/onsite) regarding efficient solving of the logical and mathematical problems of communication systems
TLS3	Assignment and Presentation of diverse problems based on the corresponding lectures.
TLS4	Evaluation of class performances to reach each student in a class for every topic.

Assessment Strategies (AS)

AS1	Quiz
AS2	Class Test
AS3	Assignment
AS4	Presentation
AS5	Midterm
AS6	Group Discussion

Mapping of Course Learning Outcomes (CLOs) with the Teaching -Learning and Assessment Strategies

Couse Plan

Week	Lesson	Discussion Topic	TLS	AS	Mapping with CLO
1	1	Voltage and Current, Resistance, Power and Energy	TLS1, TLS2	AS6	CLO1
	2	Ohm's Law, Branches, Node	TLS1, TLS2	AS1, AS6	CLO1
	3	Series dc Circuits, Kirchhoff's Voltage Law (KVL)	TLS1, TLS2	AS1, AS6	CLO1
2	4	Voltage divider Rule(VDR)	TLS1, TLS2	AS6	CLO1
	5	Parallel dc Circuits, Series Parallel dc Circuits,	TLS1, TLS2	AS6	CLO1
	6	Kirchhoff's Current Law (KCL),	TLS1, TLS2	AS6	CLO1
3	7	Current Divider Rule (CDR) <u>Assignment #1</u> (will be due by Wk4)	TLS1- TLS3	AS6	CLO1
	8	Equivalent resistance (Req)	TLS1, TLS2	AS6	CLO3
	9	Methods of Analysis (Nodal analysis)	TLS1, TLS2	AS6	CLO3
4	10	Methods of Analysis (Mesh/Loop analysis)	TLS1, TLS2	AS6	CLO3
	11	Methods of Analysis (Mesh/Loop analysis)	TLS1, TLS2, TLS4	AS6	CLO3
	12	Class Test 1 and Recap	TLS1, TLS2, TLS4	AS2	CLO1, CLO3

Week	Lesson	Discussion Topic	TLS	AS	Mapping with CLO
5	13	Alternating current fundamental	TLS1, TLS2, TLS4	AS6	CLO2
	14	Phase and phase difference	TLS1, TLS2	AS6	CLO2
	15	R.M.S value, Average value,	TLS1, TLS2	AS6	CLO2
6	16	AC through resistance	TLS1, TLS2	AS6	CLO2
	17	AC through inductance, capacitance, Average power	TLS1, TLS2	AS6	CLO2
	18	Reactive power, Apparent power, Power factor <u>Assignment #2</u> (will be due by Wk8)	TLS1- TLS3	AS3, AS6	CLO3
7	19	Reactive power, Apparent power, Power factor	TLS1, TLS2	AS6	CLO3
	20	Frequency response of basic elements;	TLS1, TLS2	AS1,AS6	CLO3
	21	Midterm Exam 1	-	AS5	-
8	22	Complex numbers: Rectangular	TLS1, TLS2	AS6	CLO3
	23	Polar form: Active & reactive power;	TLS1, TLS2	AS1, AS2, AS6	CLO3
	24	Resonance, Series & parallel resonance circuit	TLS1, TLS2	AS6	CLO3
9	25	Resonance, Series & parallel resonance circuit	TLS1, TLS2	AS6	CLO3

Week	Lesson	Discussion Topic	TLS	AS	Mapping with CLO
	26	Quality factor, Selectivity, Fourier Series.	TLS1, TLS2	AS6	CLO3
	27	Quality factor, Selectivity, Fourier Series.	TLS1, TLS2	AS6	CLO3
10	28	Construction and features of transformer	TLS1, TLS2	AS6	CLO3
	29	Transformer on no- load and on load	TLS1, TLS2	AS6	CLO3
	30	Emf-equation	TLS1, TLS2	AS6	CLO3
11	31	Phasor diagram, Equivalent circuits, Losses and efficiency.	TLS1, TLS2	AS6	CLO3
	32	Phasor diagram, Equivalent circuits, Losses, and efficiency.	TLS1, TLS2	AS6	CLO3
	33	Quiz/Class Test 2 and Recap	TLS1, TLS2	AS2	CLO3
12	34	Superposition theorem, Thevenin's theorem	TLS1, TLS2	AS6	CLO3
	35	Maximum power transfer theorem	TLS1, TLS2	AS6	CLO3
	36	Millman's theorem	TLS1, TLS2	AS6	CLO3
13	37	Substitution theorem	TLS1, TLS2	AS6	CLO3
	38	Reciprocity theorem.	TLS1, TLS2	AS6	CLO3
	39	Midterm Exam 2		AS5	-
14	40	Presentation	-	AS4	-
	41	Makeup Class	TLS1, TLS2	ALS6	CLO1, CLO2,

Week	Lesson	Discussion Topic	TLS	AS	Mapping with CLO
					CLO3
	42	Review Class	TLS1, TLS2	ALS6	CLO1, CLO2, CLO3
15		Preparatory Leave			
16-18		Final Exam			

Recommended Books:

1. **R. L. Boylestad**, Introductory Circuit Analysis, Prentice Hall, 2006.
2. **R. M. Kerchner, G. F. Corcoran**, Alternating Current Circuits, Wiley Eastern Limited, 1994.
3. **J. Nagarath and D. P. Kothari**, Electric Machines, Tata McGraw-Hill, 1999.
4. **F. Puschstein, T. C. Lloyd, A. G. Conrad**, Alternating Current Machines, Asia Publishing House, 1996.

Assessment and Evaluation

1. Before Final [40 marks]

Bloom's Criteria	Attendance (05)	Class Test/Quiz (05)	Assignment (05)	Presentation (05)	Midterm Exam (20)
Remember		2	3	2	8
Understand		3	2	3	12
Apply					
Analyze					
Evaluate					
Create					

2. Final Exam [60 marks]

Bloom's Criteria	Score for the Test
Remember	25
Understand	35
Apply	
Analyze	
Evaluate	
Create	

Course Code: EEE-1106	BNQF Code: 07141106	Credits: 1.5 (2 Hours)
Course Title: Electrical Circuits and Devices LAB		Year: 1 st Semester: 1 st
Total Marks: 100		
Course Type: Core Course (Lab)		
Pre-requisite: None		

Rationale of the Course

This course will provide the basic knowledge of Electrical Circuits. Students should be able to identify, define and describe different components and relevant terms. This course will help the students to gain theoretical knowledge and will also help to do hardware implementation during Basic Electronics, Digital Electronics, Embedded Systems and Robotics.

Course Objectives

- To understand the physical construction, working and operational characteristics of Semiconductor devices.
- To understand the operation of power supply circuits built using filters, rectifiers and voltage regulators.
- To discuss the manufacturing process of monolithic ICs & the fabrication of components on monolithic IC.

Course Contents

Introduction and Safety: Lab safety guidelines and best practices. Introduction to lab equipment (power supplies, multimeters, oscilloscopes, etc.).

Basic Circuit Analysis: Verification of Ohm's law through practical experiments. Analysis of series and parallel resistive circuits.

Kirchhoff's Laws: Verification of Kirchhoff's voltage and current laws in circuits.

Network Theorems: Verification of network theorems such as Thevenin's theorem and Norton's theorem.

Capacitors and Inductors: Charging and discharging experiments with capacitors. Investigation of inductance and inductive effects.

Time Domain Analysis: Study of transient responses in RC and RL circuits. Time constant measurement and analysis.

Alternating Current (AC) Circuits: Introduction to AC circuits and waveform measurements. AC circuit analysis with resistors, capacitors, and inductors.

AC Power Analysis: Measurement of power in AC circuits (active, reactive, apparent power). Power factor measurement and correction.

Semiconductor Devices: Characteristics of diodes and rectifier circuits. Study of basic transistor circuits (common emitter, common base, etc.).

Operational Amplifiers (Op-Amps): Applications of op-amps in amplifiers and filters. Practical op-amp circuits and their analysis.

Digital Logic Circuits (if applicable): Introduction to basic digital logic gates (AND, OR, NOT, etc.). Building and testing combinational and sequential logic circuits.

Sensors and Transducers: Working with sensors and transducers (temperature, light, etc.). Calibration and data acquisition.

Final Project: Integrating concepts learned in previous experiments to design and build a more complex electrical circuit or system.

Course Learning Outcomes (CLO): (at the end of the course, student will be able to:)

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Mapping of Course Learning Outcomes (CLO) to Program Learning Outcomes (PLO)

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1	✓											
CLO2		✓										
CLO3	✓											

Teaching-Learning Strategies (TLS)

TLS1	Interactive discussion using Online/multimedia or whiteboard.
TLS2	Active discussion in class regarding efficient solving of the logical and mathematical problems and implementation

TLS3	Group discussion and implementation regarding diverse problems and corresponding lectures
TLS4	Evaluation of class performances to reach each student in a class for every topic.

Assessment Strategies (AS)

AS1	Quiz
AS2	Viva
AS3	Lab Report
AS4	Lab Assessment
AS5	Lab Final

Mapping of Course Learning Outcomes (CLOs) with the Teaching -Learning and Assessment Strategies

Course Plan

Week	Discussion Topic	TLS	AS	Mapping with CLO
1	Lab 1: Introduction to different elements of Electrical circuits Lab	TLS1, TLS3	AS4	CLO1, CLO2
2	Lab 2: Verification of Ohm's Law	TLS1, TLS3	AS3, AS4	CLO1, CLO2
3	Lab 3: Verification of Kirchhoff's Voltage Law (KVL) & Voltage divider rule (VDR) (1)	TLS1, TLS3, TLS4	AS3, AS4	CLO1, CLO2
4	Lab 4: Verification of Kirchhoff's Voltage Law (KVL) & Voltage divider rule (VDR)(2)	TLS1, TLS3, TLS4	AS4	CLO1, CLO2
5	Lab 5: Verification of Kirchhoff's Current Law (KCL)& Current divider rule (CDR)(1)	TLS1, TLS3, TLS4	AS3, AS4	CLO1, CLO2
6	Lab 6: Verification of Kirchhoff's Current Law (KCL)& Current divider rule (CDR)(2)	TLS1, TLS3, TLS4	AS3, AS4	CLO1, CLO2
7	Lab Assessment Based on Lab1 - Lab6	-	AS4	-

8	Lab 7: Verification of Superposition Theorem	TLS1, TLS3, TLS4	AS3	CLO1, CLO2
9	Lab 8: Verification of Thevenin's Theorem	TLS1, TLS3, TLS4	AS3, AS4	CLO1, CLO2
10	Lab 9: Verification of Maximum Power Transfer Theorem	TLS1, TLS3, TLS4	AS3, AS4	CLO3
11	Lab 10: Reactive power, Apparent power, Power factor (1)	TLS1, TLS3, TLS4	AS3,AS4	CLO3
12	Lab 11: Reactive power, Apparent power, Power factor (2)	TLS1, TLS3, TLS4	AS3,AS4	CLO3
13	Lab Assessment Based on Lab 6 - Lab11	-	AS3,AS4	-
14	Make up Class/Review Class	TLS1, TLS3, TLS4	AS3,AS4	CLO1, CLO2, CLO3
15	Preparatory Leave			
16 -18	Lab Final Week Based on Lab1 - Lab 11	-	AS5	-

Recommended Books:

1. **R. M. Kerchner, G. F. Corcoran**, Alternating Current Circuits, Wiley Eastern Limited, 1994.
2. **J. Nagarath and D. P. Kothari**, Electric Machines, Tata McGraw-Hill, 1999.
3. **F. Puschstein, T. C. Lloyd, A. G. Conrad**, Alternating Current Machines, Asia Publishing House, 1996.