Course Outline of BS Electrical Engineering Degree Program

Course Title	Linear Circuit Analysis		Course Code	EE 115
Course Pre-requisite(s)	NA		Credit Hrs.	3
Course Instructor	Aamer Munir		Semester	SPRING '21

Text Book(s)	Title		*Engineering Circuit Analysis, 8th Edition.*
	Author		Hayt, Kemmerly and Durbin
	Publisher		Mc Graw Hill
Ref. Book(s)	Title		*Electric Circuits, 9th Edition.*
	Author		J.W. Nilsson and Susan. A. Riedel
	Publisher		Pearson Education

Course Catalog Description:	Basics of resistance, inductance and capacitance; Fundamental electrical quantities; Techniques to analyze the linear circuits at DC; Ideal OP-AMP and its application as inverting, non-inverting, summing, difference, differentiating and integrating amplifiers; Methods to analyze the source fee and driven RL, RC and RLC circuits at DC.

Course Learning Outcomes	At the end of this course the student should be able to
	1- Describe physics, operation and current-voltage characteristics of resistors, capacitors and inductors, and illustrate the basic electrical quantities, passive sign convention and properties of fundamental circuit elements **[PLO1]**
	2- Perform DC analysis of the simple linear circuits to find the steady state solutions by applying different circuit analysis techniques (Ohm's law, KCL, KVL, parallel and series resistor rules, current and voltage divider techniques, node voltage and mesh current methods, superposition, source transformation, Thevenin, Norton and maximum power transfer theorems **[PLO1]**
	3- Analyze for transients and forced response in simple RL and RC circuits at DC and determine the response of simple RLC circuits at DC with switches and step function input **[PLO1]**
	4- Analyze the simple ideal OP-AMP based circuits (inverting, non-inverting, summing, difference, differentiating and integrating amplifiers) **[PLO1]**

No	Assigned Program Learning Outcome (PLO)	Level	Tool
1	Engineering Knowledge: *An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems*	R	M + F
Level	*I = Introduction, R = Reinforcement, E = Evaluation.*		
Tool	*A = Assignment, Q = Quiz, M = Midterm, F=Final, L=Lab, P=Project, W=Written Report*		

Wk #	Course Contents/Topics	Chap	CLOs	Tools
01	**Introduction:** Objectives of Electrical Engineering, Why circuit theory is important for achieving EE objectives? Migration from field theory to circuit theory,limitations of circuit theory, the importance of computer simulations in circuit domain	1+2		
02	**Basic components and electric circuits:** Electric Units and scale, Charge, Current, Voltage and power, Voltage and current sources; Concept of resistance, Can resistance be negative? Can resistance be non-linear? Power rating of resistors, Breakdown of resistors, Design criteria of resistors and relevant limitations, Typical resistance values of the resistors commercially available and why in this range? Practical Sources and their V-I characteristics. The concept of load in circuits **Ohm's law:** its limitations, applications;	1+2	CLO1	A, M, F
03	**Voltage and Current Laws:** KCL, its limitations and applications, examples and problems; KVL, its limitations and applications, examples and problems; Single loop circuits with examples (circuit elements in series); Single node pair circuits with examples(circuit elements in parallel)	3	CLO2	A, M, F
04	Series and parallel sources, Series and parallel resistors, Voltage and current division and their application, The concept of ground in circuits, Why earth ground is important?	3	CLO2	A, M, F
05	**Basic Voltage and Mesh Analysis:** Nodal Analysis: Why needed? How applied to solve the circuits? Super node; The concept of duality in circuit theory; The concept of circuit topologies and their use; Mesh Analysis; Super mesh	4	CLO2	A, M, F
06	**Handy Circuit Analysis Techniques/Theorems:** Linearity and time invariance, Circuit Theorems: Why needed, although other analysis techniques are available? Superposition theorem	5	CLO2	
07	**Handy Circuit Analysis Techniques/Theorems:** Source transformation theorem, Thevenin theorem, Norton Theorem	5	CLO2	
08	**Handy Circuit Analysis Techniques/Theorems:** Maximum power transfer theorem with a brief detail of matching circuits; what if the load resistance cannot be made equal to the source/Thevenin resistance of the network? A very brief introduction of matching network. Delta-wye conversion	5	CLO2	A, M, F
09	**The Operational Amplifier (OP-AMP):** The need for OP-AMP? The active circuits, Realization of OP-AMP from active circuits, The ideal op-amp with its equivalent circuit model, its characteristic parameters, Idea vs. practical OP-AMP, Transfer characteristics, OP-AMP as an abstraction: why? OP-AMP and the role of negative feedback	6	CLO4	
10	**The Operational Amplifier (OP-AMP):** Single OP-AMP based circuits, OP-AMP: Cascaded stages, Design of useful circuits using OP-AMPs, OP-AMP circuit with capacitors and inductors.	6	CLO4	A, M, F

11	**Capacitors:** The capacitance: Why significant? The idea of memory/storage in circuit elements**.** Minimum discussion of capacitance device physics to enable students to appreciate the use of this effect**,** The parallel plate capacitor: a best architecture for achieving capacitance**,** The current and voltage across parallel plate capacitors with physical meanings**,** Capacitors in parallel and series**,**	7	CLO1	
12	**Inductors:** The inductance, minimum discussion of its device physics to enable students to appreciate the use of this effect**,** The inductor and why coil is the best architecture/structure for achieving the inductance? The combination of inductances and capacitances**,** The consequences of linearity.	7	CLO1	A, F
13	**Basic RC and RL Circuits:** Source free RL circuit**,** Properties of exponential response**,** Source free RC circuit, General form of the solution**,** Unit step function, Rectangular function**,**	8	CLO3	
14	**Basic RC and RL Circuits:** Driven RL Circuits**,** Natural and forced response of RL circuits**,** Driven RC circuits and their overall response**,** Sequentially switched circuits response prediction	8	CLO3	A, F
15	**The RLC Circuits:** Source free parallel RLC circuits: Over damped**,** Source free parallel RLC circuits: Critically and under damped**,** Physical meanings/explanation of over, critically and under damped responses of RLC circuits	9	CLO3	
16	**The RLC Circuits:** Source free series RLC circuits: Critically and over damped Source free series RLC circuits: Under damped,**,** Complete Response of RLC circuits**,** Lossless LC circuits and their importance in real world applications Switched RC circuits and why preferred over lossless LC circuits**,** A brief introduction of switched Capacitor circuits and why they are preferred over switched RC circuits.	9	CLO3	A, F

Appendix

Mapping Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

Course Learning Outcome (CLO) mapping with Program Learning Outcomes (PLO)														
	CLOs		PLOs											
			1	2	3	4	5	6	7	8	9	10	11	12
1	CLO-01		✓											
2	CLO-02		✓											
3	CLO-03		✓											
4	CLO-04		✓											

Assessment of CLOs						
	Direct Assessment				Indirect Assessment	
	Q	A	M	F	IO	SSS
CLO1	✓	✓	✓	✓	✓	✓
CLO2	✓	✓	✓	✓	✓	✓
CLO3	✓	✓	✓	✓	✓	✓
CLO4	✓	✓	✓	✓	✓	✓

Direct Assessment - Q: Quiz, A: Assignment, M: Midterm Exam, F: Final Exam,
Indirect Assessment - IO: Instructor Observation, SSS: Students Satisfaction Survey

Grading Criteria	
Assessment Tools	Weightage (%)
Quizzes	10
Assignments	10
Mid	30
Final	50
Grading Scheme	Relative Grading with two thresholds. No A, A+ grade < 65 F < 30

Academic Integrity:

Academic integrity is of central importance to education at NUCES. Students have the responsibility to know and observe the requirements of the NUCES Code of Academic Honesty available: http://www.nu.edu.pk/Student/Conduct and the penalties resulting from violation of this code. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Cheating in any form and on any academic work results in serious penalties that include dissmissal from the university.

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