Spring 2024

ECE 231-102: Circuits & Systems I

Oksana Manzhura

ABET COURSE OUTLINE

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Department of Electrical and Computer Engineering
New Jersey Institute of Technology

Academic Year: **2023-2024**
Term:**Spring 2024**

Course Instructor: ***Oksana Manzhura***
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office hours/open classroom workshop:
Office hours and extra sessions schedule provided separately by email; Contact 24/7 by e-mail*; Extra office meetings available upon request.*

Course Number and Title: ***ECE 231: Circuits and Systems I***
(3 credits, 3 contact hours, required course)
Text book*:* Nilsson, J.W. and Riedel, S.A., Electric Circuits, **11th Edition**, Pearson Prentice Hall, Upper Saddle River, NJ.

Course Catalog Description (including prerequisites and co-requisites):
A first course in circuits and systems, covering the basic concepts of electric circuit theory. Topics include basic circuit elements, loop and node analysis, network theorems, sinusoidal steady-state analysis, power, resonance, mutual inductance, and ideal transformers.
Prerequisites: Phys 121, Math 112 or Math 133.

Specific Course Learning Outcomes (CLO): The student will be able to

1. Develop firm understanding of physical principles behind electric circuit theory.
2. Thoroughly understand operation of passive circuit elements and their specific use in electric circuits.
3. Understand concepts of current and voltage, use and operation of ideal and non-ideal sources independent and dependent, electrical power and power sign convention.
4. Use Ohm's law and Kirchhoff's laws to produce a set of circuit equations, finding voltages and currents in a circuit
5. Use node voltage method of analysis, understand a concept of supernode for reduction of equations needed for a solution.
6. Use mesh current method of analysis, understand a concept of supermesh for reduction of equations needed for a solution.
7. Use Thevenin and Norton equivalents for circuit reduction, time constant and power calculation.
8. Understand superposition principle and use it to simplify a complex circuit solution.
9. Solve for transient response of first order resonant circuit
10. Understand and use phasor representation of sinusoidal excitation.
11. Develop firm knowledge and use of all circuit analysis methods applied to time varying excitation.
12. Understand operation of an ideal transformer.
13. Be able to calculate instantaneous, average and RMS power.
14. Use National Instruments' Multisim circuit modeling and analysis application software.
15. Use Digilent Analog Discovery Portable Circuit Design Kit (aka Portable Lab) to perform simple analog circuit experiments.

Relevant Student Outcomes (ABET criterion 3):

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (CLO 1-15)
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (CLO 2, 3, 13, 14, 15)
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (CLO 14, 15)
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (CLO14, 15)
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.(CLO1-15)

Course Outline:

Week	Chapter/ Sections	Topics	Problems*
1, 2	Appendix B, *Lecture Notes.*	***PRE-TEST*** **Pre-Test Common mistakes correction. Simple Graph Plotting. Complex numbers in circuit theory.**	**Special problems on functional signal expressions. Special problems on complex numbers.** *(distributed by email or class file depository)*
2, 3	Ch. 1.1-1.6	**Basic Concepts of Electricity**	**1.4, 1.7, 1.9, 1.12, 1.15, 1.19**
3	Ch. 2.1-2.3	**Voltage and Current Sources, Ohm's Law, Circuit Models**	**2.2, 2.6, 2.8, 2.10**
3	Ch 2.4-2.5	**Kirchhoff's Laws, Dependent Sources in circuits**	**2.18, 2.21*, 2.23, 2.32,**
4	Ch 3.1-3.4	**Resistance in Parallel and Series connections**	**3.3, 3.4, 3.5, 3.6, 3.7, 3.9***
5		***QUIZ I***	
5	Ch 3.5-3.7	**Current and Voltage Dividers, Concept of Load Resistance, Measurements of Current and Voltage.**	**3.12, 3.16, 3.18*, 3.32, 3.34, 3.37**
		Wheatstone Bridge, PI to TEE transforms *Home Lab Assignment #1* *(Materials distributed during prior week)*	**3.52, 3.58, 3.59, 3.66*H*, 3.73*H***
6	Ch 4.1-4.13	**Circuit Calculations, Node Voltage Method,**	**4.1, 4.3, 4.6, 4.9, 4.12, 4.13, 4.16, 4.17, 4.18, 4.21, 4.22, 4.26, 4.27, 4.28,**
7		**Mesh Current Method, Source Transformations,**	**4.36, 4.38, 4.39, 4.41, 4.42, 4.46, 4.47, 4.52, 4.56, 4.57, 4.59, 4.60, 4.62, 4.63,**
8		***QUIZ II***	
9		**Norton/Thevenin Equivalents Maximum Power delivery, Superposition** *Home Lab Assignment #2 (optional)*	**4.64, 4.66, 4.68, 4.74, 4.75, 4.77, 4.78, 4.79, 4.81 4.87, 4.88, 4.93, 4.96, 4.102*H* , 4.103*H***
10	Ch 6.1-6.3	**Inductors and Capacitors in Circuits**	**6.2, 6.3, 6.5, 6.7, 6.10, 6.15, 6.16, 6.17, 6.19*, 6.21, 6.22, 6.23, 6.24*H*, 6.27, 6.28, 6.31*H*, 6.35**
	Ch 6.4-6.5, *LN, Appendix C.1*	**Mutual Inductance**	**6.36, 6.39, 6.40, 6.41, 6.47, 6.53**
11	Ch 5.1-5.7	**Operational Amplifier as a Dependent Source Element** *Home Lab Assignment #3 (possible)*	**5.1, 5.3, 5.5, 5.18, 5.21, 5.23, 5.33, 5.35**
12	Ch 9.1-9.9 Ch	**Sinusoidal Sources, Phasors. Passive Elements in Frequency Domain Kirchhoff's Laws in Frequency Domain Thevenin /Norton Equivalents Node and Mesh Methods of Circuit Analysis**	**9.1, 9.2, 9.3, 9.7, 9.8H, 9.9, 9.11, 9.13, 9.15, 9.16*, 9.18H, 9.22, 9.23, 9.24, 9.28, 9.29, 9.30, 9.34, 9.36, 9.40 9.43, 9.44, 9.45.**
13	Ch 10.1-10.3	**Instantaneous, Average, RMS Power**	**10.1, 10.4, 10.5, 10.6*, 10.10, 10.11, 10.12, 10.17**
14		***QUIZ III***	
15	Ch 7	**First Order transient response**	
15		***FINAL***	

Grading Policy:

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Three class examinations:	20%, 20%, 20%.
Final examination:	35%
Homework, quizzes, class participation:	4%
Take-Home Laboratory assignments:	***4% Assignment#1 + 3% Assignment #2 and #3 for completion (reports and simulations required)***
*and/or Optional Multisim Project **H***	*5% extra*

*Problems (marked with asterisk) should be solved using MultiSim (available in Computer Labs and for purchase as Student License). Getting started link: http://www.ni.com/white-paper/10710/en

Problems marked ***H*** are mandatory for Honors sections.

Honors class fulfills 15% more work in form of homework, test problems and projects.

Tests and final exams are closed notes and books, formula sheets allowed for tests 2(one page), 3 (2 pages) and final (3 pages).

Attendance: required at class lectures and problem solving sessions. Cellular phones and Beepers: Shut off or in quiet mode.

NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students