Course Instructor: Oksana Manzhura
email: oksana.manzhura@njit.edu; office: 205 ECEC, tel.: 973 596-3504

Course Number and Title: ECE 231: Circuits and Systems I
(3 credits, 3 contact hours, required course)

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 Thévenin 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 (CLOs 1-15)
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (CLOs 11, 14)
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (CLOs 4, 15).
### Course Outline:

| Week | Chapter/Sections | Topics | Problems*
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<td><strong>1</strong></td>
<td>Appendix B, Lecture Notes.</td>
<td><strong>PRE-TEST</strong> Pre-Test Common mistakes correction. Complex numbers in circuit theory. Basic Concepts of Electricity Voltage and Current Sources, Ohm’s Law, Circuit Models</td>
<td>Special problems on complex numbers. (distributed by email or class file depository) 1.9, 1.10, 1.11, 1.12, 1.14, 1.15, 1.19*, 1.27 2.1, 2.2, 2.3, 2.6, 2.8, 2.10</td>
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<td><strong>2</strong></td>
<td>Ch. 1.4-1.6, Ch. 2.1-2.3</td>
<td>Kirchhoff’s Laws, Dependent Sources in circuits Resistance in Parallel and Series connections Current and Voltage Dividers, Concept of Load Resistance, Measurements of Current and Voltage. Wheatstone Bridge, PI to TEE transforms Home Lab Assignment #1</td>
<td>2.18, 2.19, 2.21*, 2.22, 2.23, 2.32, 2.33, 2.34 3.3, 3.4, 3.5, 3.6, 3.7, 3.9* 3.12, 3.13, 3.14, 3.16, 3.18*, 3.19, 3.32, 3.33, 3.34, 3.37, 3.38 3.52, 3.53, 3.58, 3.59, 3.66II, 3.73II</td>
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<td><strong>5</strong></td>
<td>Ch 4.1-4.13</td>
<td>Circuit Calculations, Node Voltage Method, Mesh Current Method, Source Transformations, Norton/Thévenin Equivalents, Maximum Power delivery, Superposition</td>
<td>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, 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, 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, 4.102II, 4.103III</td>
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<td><strong>11</strong></td>
<td>Ch 5.1-5.7</td>
<td>Operational Amplifier as a Dependent Source Element</td>
<td>5.1, 5.3, 5.5, 5.18, 5.21, 5.23, 5.33, 5.35</td>
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<td><strong>13</strong></td>
<td>Ch 7.1-7.7</td>
<td>First Order Systems, RL &amp; RC. Natural and Step Response.</td>
<td>7.1, 7.2, 7.4, 7.8*, 7.12, 7.14, 7.23, 7.25, 7.26, 7.28, 7.33, 7.36, 7.54, 7.64, 7.68, 7.69, 7.71</td>
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One hour open classroom workshop is offered twice a week to complement lecture hours. Schedule changes per semester.

**Grading Policy:**

- **Class Pre-test:** 5%
- **Three class examinations:** 19%, 19%, 19%.
- **Final examination:** 28%
- **Homework, quizzes, class participation:** 5%
- **Take-Home Laboratory assignments:** 5% +5% for completion (reports and simulations required)
- **Or Optional Multisim Project II:** 5% extra

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*Problems (marked with asterisk) should be solved using MultiSim (available in Computer Labs). Getting started link: [http://www.ni.com/white-paper/10710/en](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 (one page), 3 (2 pages) and final (3 pages). Attendance: required at class lectures and problem solving sessions. Cellular phones and Beeper: 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.