Course Syllabus

ELCT 221 – Circuits

Course Coordinator

Undergraduate Program Committee

Catalog Description

Analysis of linear ac circuits using complex variables. Nodal and mesh analysis, Thevenin and Norton transformations, linearity, superposition, use of math solvers, circuit simulators, and computer-interfaced instrumentation.

Course delivery structure:

Lectures

Credit Hours 3

**Contact Hours** - three 50-minute lecture periods per week

Prerequisite(s) by course

C or better grade in MATH 142 and ELCT 102 or D or better grade in ELCT 220

Prerequisite by topics

Ohm’s Law, Kirchhoff’s law, power, DC circuit nodal, mesh analysis, DC circuit theorems

Required Textbooks and other materials

1. **CIRCUITS,** Third Edition by Fawwaz T. Ulaby, Michel M. Maharbiz, and Cynthia M. Furs. ISBN: 978-1-934891-19-3

or cost-free version of the book downloadable from   
<https://www.publishing.umich.edu/publications/ee/>

Note that this book will also be used in ELCT 221, ELCT 222

2**.** USB instrument**:**

**Analog Discovery 2 Kit** (preferred) - can be purchased at the University bookstore or online, e.g. <https://digilent.com/shop/academic/academic-price-list/>.

(you will need to create your academic account on digilent.com to see the academic prices)

or **ADALM2000** **kit** can be purchased online e.g. [www.mouser.com](http://www.mouser.com)

3. **Analog parts kit** ADALP2000 by Analog Devices Inc. (or equivalent parts kit) -

can be purchased e.g. from <https://www.digikey.com/products/en?keywords=adalp2000>

All readings/materials comply with copyright/fair use policies.

Course Learning Outcomes:

Students who successfully complete the course will at least be able to:

1. solve problems on ac linear circuits using concepts of phasor domain and impedance
2. perform Thevenin transformation and calculate power delivered to the load in linear ac circuits
3. find transfer functions and generate Bode plots for R-L-C circuits in a frequency range
4. use MATLAB (or equivalent) tool for ac circuit analysis using matrix equations, to generate frequency responses and to make graphs of transfer function.
5. use SPICE (or equivalent) simulations to build the schematics and generate frequency responses and graphs of transfer function.
6. build simple RC and RLC circuits and measure their time and frequency response using USB instrument.

Learning Outcomes for this course are equivalent for all delivery methods.

Course Contribution to ABET Student Outcomes:

ELCT 221 Learning outcomes contributes to the achievement of the following ABET student outcomes:

|  |  |
| --- | --- |
| **Course learning outcome** | **ABET student outcome** |
| 1 - 5 | 1 |
| 6 | 6 |

ABET student outcome 1 - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

ABET student outcome 6 - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions

Course Topics:

* Review: Direct current (DC) circuit analysis
* Periodical and non-periodical waveforms. Sinusoidal (AC) waveforms
* Resistors, capacitors and inductors in circuits with time-varying voltages or currents
* AC circuit analysis using complex numbers; phasors and impedances
* Nodal and Mesh Analysis of AC circuits
* Thevenin and Norton transformations in AC circuits
* Power in AC circuits
* Two-port networks: frequency response, transfer functions, Bode plots
* Transient processes in RLC circuits
* SPICE simulations of RLC circuits
* Power loss in cables; transformers
* Three-phase circuits

Assignments

Course assignments include homework, project, tests, and final examination.

Most of the assignments will be given online using LON-CAPA. Students must complete and submit the assignment online before the due time shown in that assignment. Past the due time the assignment window closes automatically.

For LON-CAPA based exams, the total points are calculated as 50% of the points for computer graded part plus 50% of the points for the report part.

Reports are electronic documents: text (m-files), word or pdf files, showing all your work for the test, including the MATLAB code. Circuit schematics, frequency graphs etc can be uploaded as separate documents, e.g. images

Reports containing MATLAB codes without explanations and comments will receive low points.

If there is an Honor Section, then Honors section students will have additional question(s) on homework and/or test assignments.

The weight of the assignments in the final course grade is as follows:

* HWs 30%
* 1 Project 5%
* Midterm exams (2) 40%
* Final Exam 25%

Grade forgiveness

One lowest HW score will be dropped from the final grade calculation.

Approximate grading scheme is as follows:

|  |  |
| --- | --- |
| Score | Grade |
| 90 - 100 | A |
| 85 - 89 | B+ |
| 80 - 84 | B |
| 75 - 79 | C+ |
| 70 - 74 | C |
| 65 - 69 | D+ |
| 60 - 64 | D |
| score < 60 | F |

Approximate Course Outline/Schedule

Topics for class meetings are listed below. However, circumstances may call for a departure from this schedule. Any changes to the topics will be made in advance.

|  |  |
| --- | --- |
| **Topic** | **Week** |
| Introduction  Review: Potential, Voltage, Current and Ohm’s Law (Ch.2-1),  KCL, KVL (Ch.2-2), DC circuit analysis (Ch. (3-2…3-4) | Weeks 1, 2 |
| Sinusoidal (AC) signals (Ch. 7-1);  Capacitors and inductors in AC circuits;  Phasors and complex numbers (Ch.7-2); | Week 3,4 |
| AC Circuit analysis using complex variables (Ch.7-3,7-4)  AC Circuit analysis using MATLAB | Week 5,6 |
| AC Nodal analysis  AC Mesh Analysis (Ch. 7-9) | Week 6, 7 |
| AC Thevenin and Norton techniques (Ch.7-9) | Week 8-10 |
| Power in AC circuits (Ch.8) | Week 10,11 |
| Two-port networks: transfer functions (Ch. 9-1, 9-2,9-4)) | Week 11,12 |
| Bode plots (Ch. 9-3) | Week 12 |
| Transient processes in RLC circuits | Week 13 |
| AC circuit analysis using SPICE | Week 14 |
| Power loss in cables, magnetically coupled circuits, transformers (Ch.11) | Week 15 |
| Three-phase circuits (Ch. 10) | Week 16 |
| Final Exam preview | Week 16 |

Technology requirements

Every EE class requires routine computer and online skills such as use of Blackboard Learning Management system (LMS), VPN and composition of documents.

In addition, this class has the following requirements:

Students are required to have laptops (tablets) with internet access during every class session. Windows OS is strongly recommended.

Students are expected to have sufficient skills and user credentials to download and install the software required for the course (MATLAB or equivalent, SPICE – any version, e.g. multisim.com)

Students must be able to access to LON-CAPA LMS to get the assignments and submit the results (homework, tests etc.). Cisco VPN is needed to access LON-CAPA outside the USC campus

Please contact your instructor or University IT if you need help with internet access setup, software installation or usage.