EE 321 – Electrical Circuits II

EE 321: 3 credits; 3 lecture hours per week, MWF 1:10-2:00 pm.
Prerequisite: EE 261 with a C or better, certified major in Electrical Engineering, Computer Science, or Computer Engineering.

Instructor: T. R. Fischer
E-mail: fischer@eecs.wsu.edu. Tel. 509-335-4960 Web site: www.eecs.wsu.edu/~fischer
Office: EME Room 404. Office hours: M 2:10-3:00, TuTh 1:30-2:30, W 3:45-4:45 (except for problem sessions), or by appointment.

Text: Nilsson and Riedel, Electric Circuits, 10th Edition, Prentice-Hall, 2011. Note: International versions of the text, and previous editions typically have virtually identical chapter content, except for different homework exercises. If you use a different edition, avoid submitting a solution to the wrong homework problem!

Numerical Tools
Computational tools are required to complete some of the homework problems and the semester project. There are several options. A “student version” of Matlab is available for purchase and includes the Control, Signal Processing, DSP, and Image Processing Toolboxes. Matlab is available on some EECS computers. Open source “Octave” is available for download from the GNU Octave web page. Many Matlab scripts and functions can run directly using Octave. (After installing Octave, it is necessary to install various packages (roughly equivalent to Matlab toolboxes). For EE 321 applications, it is necessary to install the Control (and all related) packages. In many cases, Matlab scripts and functions can be run, without modification, using Octave. There are, however, occasional differences, and some minor program adjustment may be required to run a Matlab function in the Octave environment. Caveat emptor.) It is also possible to use “Mathematica” instead of Matlab or Octave to complete the EE 321 Homework assignments and Project. The instructor will provide examples of the use of Matlab (and Octave), but not Mathematica.

If not familiar with Matlab, it is recommended that you get a good reference. Here are a few.
MATLAB Tutorials – There are many Matlab tutorials available on the web, e.g. http://www.mathworks.com/access/helpdesk/help/help/tech_doc/learn_matlab/

Spend some time reading (at least) introductory material, to become familiar with basic commands, syntax, vector and matrix notation, plotting, and creating your own functions (m-files).

Course Requirements

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Homework Policy: The homework and course project assignments will be assigned and collected in class. Assignments handed in after class are late. Students may hand in late assignments any time until the next class after the assignment due date for a 20% reduction in grade. Papers handed in more than one class late will receive zero credit and not be graded.

Test Dates:
Test 1 – Anticipated date: Wednesday, September 27
Test 2 – Anticipated date: Wednesday, November 1
Final Exam – Thursday, December 14, 3:10 - 5:10 pm.
The final exam is comprehensive.
Course Project: The course project will involve analysis of a circuit using several different methods and MATLAB. A typed project report will be required. The project will be assigned early in the semester. There will be an intermediate due date to ensure students have started the project and are on the right track. Projects are to be individual effort: No collaboration with other students is allowed on the course project.

Academic Integrity: The WSU academic integrity policy is presented on-line at http://conduct.wsu.edu/ under the “Policies” link. It is each student’s responsibility to read and know the policies. (From WSU Online): “Academic integrity is the cornerstone of the university. You assume full responsibility for the content and integrity of the academic work you submit. You may collaborate with classmates on assignments, with the instructor’s permission. However the guiding principle of academic integrity shall be that your submitted work, examinations, reports, and projects must be your own work. Any student who violates the University’s standard of conduct relating to academic integrity will be referred to the Office of Student Conduct and may fail the assignment or the course.”

In EE321, students may discuss the homework, and work together to solve the exercises. However, all of the work that is submitted must be individual effort (that is, no copying of some else’s homework solution, computer program, plots, etc.). For example, you may discuss a Matlab exercise, how to approach the problem, what Matlab functions can be used, etc., but all programs should be your own effort. The course project, however, is to be individual effort only.

Accommodation Statement: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center. For more information contact a Disability Specialist at 509-335-3417, http://accesscenter.wsu.edu, Access.Center@wsu.edu Please notify the instructor during the first week of class of any accommodations needed for the course.

Safety The University has provided the following statement for all course syllabi: “Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the “Alert, Assess, Act” protocol for all types of emergencies and the Run, Hide, Fight response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able). Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBIs Run, Hide, Fight video and visit the WSU safety portal.”
WSU LEARNING GOALS & OUTCOMES

Critical and Creative Thinking: Graduates will use reason, evidence, and context to increase knowledge, to reason ethically, and to innovate in imaginative ways.

Quantitative Reasoning: Graduates will solve quantitative problems from a wide variety of authentic contexts and everyday life situations.

Scientific Literacy: Graduates will have a basic understanding of major scientific concepts and processes required for personal decision-making, participation in civic affairs, economic productivity and global stewardship.

Information Literacy: Graduates will effectively identify, locate, evaluate, use responsibly and share information for the problem at hand.

Communication: Graduates will write, speak and listen to achieve intended meaning and understanding among all participants.

Diversity: Graduates will understand, respect and interact constructively with others of similar and diverse cultures, values, and perspectives.

Depth, Breadth, and Integration of Learning: Graduates will develop depth, breadth, and integration of learning for the benefit of themselves, their communities, their employers, and for society at large.
ASSESSMENT

Ref: http://school.eecs.wsu.edu/undergraduate/ee/prog_ed_objectives_and_student_outcomes

School of EECS Program Educational Objectives and Student Outcomes

Program Educational Objectives

1. Our graduates have professional careers in industry or academia or are engaged in advanced studies.

2. Our graduates adapt to changes in technology as well as to the needs of society.

3. Our graduates continue to seek knowledge to thrive in an increasingly globalized society.

4. Our graduates are successful team members or team leaders.

5. Our graduates conduct themselves with integrity and incorporate proper ethical considerations in their work.

Student Outcomes (ABET a – k)

a) an ability to apply knowledge of mathematics, science, and engineering

b) an ability to design and conduct experiments, as well as to analyze and interpret data

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d) an ability to function on multidisciplinary teams

e) an ability to identify, formulate, and solve engineering problems

f) an understanding of professional and ethical responsibility

g) an ability to communicate effectively

h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i) a recognition of the need for, and an ability to engage in, life-long learning

j) a knowledge of contemporary issues

k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
Overview and Course Goals

Overview and Objectives: EE 321 provides a comprehensive development of core systems and signals concepts, and their application to linear circuit analysis and design. By the end of the course, students should be able to

a) write down differential-equation models for linear circuits, and to put these circuit differential equations into standard, state-space-, and Laplace-domain forms;
b) solve linear differential equations for circuits using several methods, including the method of undetermined coefficients, the convolution-based approach, Laplace-domain solutions, and state-space-based solutions (by computer);
c) understand core system-theory concepts and constructs such as the transfer function, frequency response, and impulse response;
d) design and analyze filter circuits;
e) understand the operation of mutual inductors, as an additional circuit component;
f) understand and be able to apply several mathematical techniques underlying systems/signal analysis, including Laplace-domain analysis and Fourier Series.

ABET Outcomes (Assessment via Tests, Project, Final Exam)

A. An ability to apply knowledge of mathematics, science and engineering.
1. Chooses and implements problem solving strategies.
2. Analyzes and interprets information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
3. Converts information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).
4. Completes calculations using data, equations, and techniques.

B. An ability to design and conduct experiments as well as analyze and interpret data.
1. Designs experiments for a purpose (e.g., to test a hypothesis, characterize components or devices, derive relationships, test performance, evaluate interactions, determine parameters, simulate use cases, etc.).
2. Designs procedures within parameters and consideration of variables.
3. Obtains data for the implementation or analysis of a given design or experiment.
4. Generates mathematical/symbolic/graphical representations of the data for analysis, interpretation, and communication purposes.
5. Evaluates the results in comparison with the literature and/or theory.
6. Identifies limitations and recommendations for further experiments.

E. An ability to identify, formulate, and solve engineering problems.
1. Constructs a problem statement that articulates what constitutes a solution.
2. Identifies measurable parameters associated with both the problem and the solution.
3. Selects an approach or, as appropriate, approaches to solve the problem.
4. Implements the selected approach, or approaches, to obtain a solution.
5. Validates a solution.

K. Have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
1. Uses modern engineering techniques, skills and tools (such as computer software, simulation packages, and diagnostic equipment) to make a choice, decision, or action.
2. Combines use of engineering tools plus system operating information to monitor performance, find optimal operating conditions, and/or develop designs.
3. Evaluates which techniques or tools are most appropriate to complete a specific engineering task.
EE 321 – Topics and Approximate Number of Lectures

“Electrical Circuits II Prereq EE 261 with grade of C or better. State space analysis, Laplace transforms, network functions, frequency response, Fourier series, two-ports, energy and passivity.”

Major Topics, Reading Assignments, and Approximate Number of Lectures, in order of coverage:
Week 1: Introduction; Review of EE 261: circuit analysis and differential equation description;
    State variables and circuit analysis (Read Text, Chap. 8, notes)
Week 2: State Variables and Circuit Analysis (2 classes, notes)
Weeks 3-4: Laplace Transform (Read Text Chapter 12)
    Step and impulse functions;
    Operational transforms;
    Inverse Laplace transform;
    Partial fraction expansion;
    Initial and final value theorems
Weeks 5-8: Circuit Analysis using Laplace Transforms (12 classes, Text Chap 13)
    Circuit analysis in the s-domain;
    Transfer function; Poles, Zeros;
    Frequency response (Read, Text Appendix E)
    Impulse response, unit step response;
    Convolution
Weeks 9-10: Frequency Selective Circuits (6 classes; Text Chap 14)
    Low-Pass, High-Pass, Band-Pass, Band-Reject Filters;
Weeks 11-12: Active Filters (6 classes, Chap 15, Notes)
Weeks 13-14: Fourier Series (6 classes, Text Chap 16, Notes)
Week 15: Mutual Inductance and Transformers (2 classes, Chap 9, Chap 13);
    Two-Port Parameters (1 class, Chapter 18)

Anticipated Test Dates:
Test 1 Wednesday, September 27
Test 2 Wednesday, November 1
Final Exam – Thursday, December 14, 3:10-5:10 pm

Recommendation: That each student develop a personal “study book” for this (and every) course. In addition to the notes taken during class lecture, this should include the following.
1. All homework submitted, and all homework solutions.
2. All subsequent study notes on the homework, including correction of any errors made on the homework assignments.
3. All notes taken on the textbook (or any other) reading related to the topics covered in the course. (This would include any derivations of equations, questions that arise during the reading, etc.)
4. All assessment or drill problems from the text that the student works out.
5. All additional end-of-chapter problems worked out (in addition to the homework problems).
6. A summary of the work completed for the semester design project.