Master Course Description for EE-215 (ABET sheet)

Title: Fundamentals of Electrical Engineering

Credits: 4

UW Course Catalog Description

Coordinator: Tai Chen, Teaching Professor of Electrical and Computer Engineering

Goals: To develop the fundamental tools of linear circuit analysis which will be useful to all engineers. To learn the "alphabet" of circuits, including wires, resistors, capacitors, inductors, independent and dependent voltage and current sources, and operational amplifiers. To prepare students for more advanced courses in circuit analysis.

Learning Objectives: At the end of this course, students will be able to:

1. *Identify* linear systems and represent those systems in schematic form.
2. *Explain* precisely what the fundamental circuit variables mean and why the fundamental laws governing them are true.
3. *Apply* Kirchhoff's current and voltage laws, Ohm's law, and the terminal relations describing inductive and capacitive energy-storage elements to circuit problems.
4. *Simplify* circuits using series and parallel equivalents and using Thevenin and Norton equivalents
5. *Perform* node and loop analyses and set these up in standard matrix format.
6. *Explain* the physical underpinnings of capacitance and inductance.
7. *Identify and model* first and second order electric systems involving capacitors and inductors.
8. *Predict* the transient behavior of first and second order circuits.

Textbook: Nilsson and Riedel, *Electric Circuits, 12th Ed.* Pearson, 2022

Reference Texts: Ulaby, Maharbiz and Furze, *Circuit Analysis and Design*, Michigan Publishing

Laboratory Handbook: Available from course website.

Prerequisites by Topic:

1. Fundamental physics (PHYS 122), including concepts of power, energy, force, electric current, electric fields, and fundamentals of RC, LC, and RL circuits;
2. Fundamental mathematics (MATH 126 or MATH 136), trigonometric and (complex) exponential functions. As this course requires differential equaitons in the last few weeks, MATH 307 or AMATH 351 should be taken concurrently.

Topics:

1. Fundamental electric circuit quantities (charge, current, voltage, energy, power) [0.5 week]
2. The "alphabet" of circuit schematics (resistors, wires, sources, etc.) [0.5 week]
3. Analysis, graph theory concepts: loops, nodes, supernodes [0.5 week]
4. Kirchhoff's current and voltage laws [0.5 week]
5. Ohm's law [0.5 week]
6. Series and parallel resistor combinations, voltage and current division [1 week]
7. Thevenin and Norton equivalents; linearity and superposition solution methods [1 week]
8. Linear algebraic techniques (node analysis; loop/mesh analysis) [2 weeks]
9. Op amp circuits [1 week]
10. Capacitors and inductors [0.5 week]
11. First and second order circuits in the time domain [2 weeks]

Course Structure: The class meets for three 50-minute lectures and one 110- minute recitation section per week. The latter is administered by teaching assistants. Homework is assigned weekly. Two exams are given nominally at the ends of the 4th and 8th weeks, and a comprehensive final exam is given at the end of the quarter.

Computer Resources: None required. (Spice is introduced in EE 233.)

Laboratory Resources: Students perform basic circuit laboratories using personal multimeters and parts kits sold by the department. No departmental laboratory facilities are used.

Grading: Suggested: Homework (20%), Labs (25%), Midterms (35%), Final Exam (20%).

ABET Student Outcome Coverage: This course addresses the following outcomes:

H = high relevance, M = medium relevance, L = low relevance to course.

(1) *An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.* **(H)** The course is primarily oriented toward electronic circuit analysis. However, some assignments require students to identify an engineering problem (the modeling of a linearized element, for example, or the construction of an analog adder), and apply the new knowledge learnt to formulate a solution, and demonstrate that it works.

(2) *An ability to design and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.* **(M)** Students conduct simple circuit experiments using multimeters, a breadboard and a parts kit, including some design of experiments that will provide linear models of nonlinear elements. The experiments require students to account for differences between measured data and predictions. The student will also use knowledge of statistics to a data set of electrical circuit elements and calculate mean, median and standard deviation. They will fit the data set to known distribution functions. Reasons for device-to-device fluctuations in

circuit elements will be discussed in the lab as they are important to account for in circuit design.

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