MAE 140 (4 units) Linear Circuits

Class/Laboratory Schedule: four hours of lecture, eight hours outside preparation.

12 hours/week total

Course Coordinator(s): Mauricio de Oliveira

Textbooks/Materials:

1. The Analysis and Design of Linear Circuits, Thomas & Rosa, 7th Edition

Catalog Description: Steady-state and dynamic behavior of linear, lumped-parameter electrical circuits. Kirchoff's laws. RLC circuits. Node and mesh analysis. Operational amplifiers. Signal acquisition, conditioning and filtering. Design applications in engineering.

Prerequisites: Admission to the engineering major and grades of C- or better in Phys 2B, Math 20D and Math 20F.

Required Course
Technical Elective Course
Other:

Performance Criteria:

Objective 1

- 1.1 Given a resistance circuit with dc inputs, students should be able to define a set of circuit variables, and to formulate the algebraic equations which describe the circuit.
- 1.2 Given a dynamic circuit with time-varying inputs, students should be able to define a set of circuit variables, and to formulate the equations which describe the circuit.

Objective 2

- 2.1 Given a resistance circuit with dc inputs, select an appropriate analysis technique and find the circuit response.
- 2.2 Given a dynamic circuit with time-varying inputs, select an appropriate analysis technique and find the circuit response.

Objective 3

3.1 Students will demonstrate an understanding of the design of active circuits using operational amplifiers and an appreciation of the signal conditioning properties required for digital acquisition.

Course Objectives:

(Numbers in parenthesis refer to the specific MAE Program Outcomes)

Objective 1: To teach students the basic principles underlying the dynamics of linear electrical circuits (1a, 11k).

Objective 2: To train students to formulate and solve the equations describing electrical circuits (1a, 5e, 11k).

Objective 3: To introduce students to active circuits and to provide them with an understanding of their application to signal conditioning, acquisition and filtering. (1a, 3c, 5e, 11k).

Course Topics:

- 1. Circuit variables, units, symbols
- 2. Ideal elements resistor, switch, voltage source, current source, capacitor, inductor
- 3. Kirchoff's laws
- 4. Elements in series and parallel, wye and delta
- 5. Nodal analysis; mesh analysis
- 6. Properties of linear circuits proportionality, superposition
- 7. Thevenin and Norton equivalent circuits
- 8. RLC circuits
- 9. The operational amplifier (OP-AMP), analysis and design of circuits using OP-AMPS
- 10. Signal conditioning: offset removal, scaling, anti-aliasing
- 11. Signal acquisition by analog-to-digital converter
- 12. Using Laplace transform to solve constant-coefficient, ordinary differential equations of electrical circuits subject to known inputs and initial conditions
- 13. Filtering: low-pass, high-pass, band pass filters

Syllabus prepared by: Alan Schneider, March 2000. Modified by Robert Bitmead, April 2000 **Last Revised:** Miroslav Krstic and Robert Bitmead, April 2008 via Teaching Work Group Meeting

Reviewed and Revised: TWG, June 2010

Reviewed: TWG, August 2011 **Reviewed:** TWG, August 2012