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