ECE 3540 Advanced Circuit Analysis & Design
Course Outline – Winter 2013

Course Objectives

During the first part of the course, formal methods of electrical circuit analysis and relevant network theorems will be covered. This includes an in-depth study of state-equation formulations and methods of obtaining them from a circuit's graph. Extensive use of the Laplace Transform for the analysis of linear time-invariant networks will be made and it is expected that a student will have the methematical background related to Laplace Transform techniques. The second part of the course (roughly, the second half) will be devoted to the study of network functions: poles, zeros, and frequency response; natural frequencies; filtering; and two-port networks. We will study classical and computer methods for filter design. Transmission lines will be covered and analysed both in the frequency-domain as well as the time-domain. Computer techniques for analysing and designing electrical circuits, using Matlab and Spice as exemplary tools, will be used throughout the course. Laboratory sessions and a final group design project will provide a means of applying theoretical concepts and computer tools to solve practical problems and create useful circuit designs. This is a core-course in the Electrical Engineering Program and is a prerequisite for several other technical electives.

Prerequisites

ECE 2262 Electric Circuits
MATH 3132 Engineering Mathematical Analysis 3

Course Content

The following topics will be covered:

- Methods of electrical circuit analysis: formal methods, network theorems
- State-equation formulations and graph-theoretic methods
- Application of Laplace Transform techniques for circuit analysis
- Computer techniques for solving electrical circuits using Matlab & Spice
- Network Functions: poles, zeros, frequency response, and two-ports
- Design of electrical filters
- Transmission lines as circuit elements

Total Accreditation Units: 46.5

Mathematics: 0
Natural Science: 0
Complementary Studies: 0
Engineering Science: 75%
Engineering Design: 25%

Web Page

https://universityofmanitoba.desire2learn.com/

Textbook

Selected chapters from R.A. De Carlo & P.-M. Lin, *Linear Circuit Analysis - Time, Domain, Phasor and Laplace Transform Approaches*, 2nd Edition, Oxford University Press, 2001 [available from the University of Manitoba's Fort Garry Book Store] and the course notes [available from the course web page].

Evaluation Details

Students who are unable to write the mid-term exam for medical (or other acceptable) reasons will have their final examination weighted to include the mid-term weighting. Students must complete all the laboratories and the

group design project in order to be eligible to receive a passing grade.

Mid-Term(s)

Friday, February 8th, 2013 at 6:00 pm
Friday, March 8th, 2013 at 6:00 pm

Instructor

Puyan Mojabi
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Office Hours

11:30-12:30 M/W/F (after classes) or by appointment.

Teaching Assistants

Mehdi Daryabak: umdaryab@cc.umanitoba.ca
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Mohammad Asefi: asefim@cc.umanitoba.ca

Voluntary Withdrawal Date

Wednesday, March 20th, 2013.

Requirements/Regulations

- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor *in a timely manner* if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism or any other form of cheating in examinations, assignments, laboratory reports or term tests is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty.

Learning Outcomes (approximately 5 recommended)

1. Analyze linear electrical circuits using the modified nodal analysis, mesh analysis, and state space methods, and apply the state space method in conjunction with graph-theoretic approaches.
2. Use the Laplace transform to analyze linear electrical circuits, to evaluate their stability, and to synthesize transfer functions/impedances with given amplitude frequency responses.
3. Analyze the input-output properties of interconnected two-port networks.
4. Analyze Butterworth filters and perform frequency transformation as well as low-pass/high-pass/band-pass/band-reject transformation.
5. Comprehend the Telegrapher's equations and calculate the propagation constant, reflection coefficient, and input impedance in transmission line circuits.

Expected Competency Level **

Learning Outcome	Attribute*											
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**
1	4	6	4	4	4							4
2	5	5	4	5	4							4
3	4	4	3	3	3							3
4	4	4	4	5	4	3	3					3
5	2	3	1	1	1							2

***Attributes*:**
A1 A knowledge base for engineering
A2 Problem analysis
A3 Investigation
A4 Design
A5 Use of engineering tools
A6 Individual and team work
A7 Communication skills
A8 Professionalism
A9 Impact of engineering on society/ environment
A10 Ethics and equity
A11 Economics and project management
A12 Life-long learning

***Competency Levels*:**
1 - Knowledge (Able to recall information)
2 - Comprehension (Able to rephrase information)
3 - Application (Able to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships)
5 - Synthesis (Able to combine separate elements into whole)
6 - Evaluation (Able to judge of the worth of something)

Student Contact Time (Hrs)

Lectures: 3 hrs lecture/week × 13 weeks/term = 39 hrs
Laboratories: 3 hrs laboratory × 5 weeks = 15 hrs
Tutorials: 0 hr tutorial × 0 weeks = 0 hrs

Evaluation

Component	Value (%)	Methods of Feedback *	Learning Outcomes Evaluated
Assignments			
Quizzes			
Laboratories	15	F, S	1, 2, 3, 4
Mid-Term Tests	35	S	1, 2, 3, 4, 5
Final Examination	50	S	1, 2, 3, 4, 5

* Methods of Feedback: **F** - *formative* (written comments and/or oral discussion)**, S** - *summative* (number grades)