University of Manitoba | Price Faculty of Engineering
Department of Electrical and Computer Engineering

Course Outline

Instructor

- Prof. Vladimir Okhmatovski, P.Eng
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Office Hours
- After lectures or by appointment.

Teaching Assistant
- Iman Kaffashan
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- Barzan Tabei
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Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 12 weeks = 36 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- ENG 2262 Electric Circuits
- MATH 3132 Engineering Mathematical Analysis 3

Course Website:
http://umanitoba.ca/umlearn

Important Dates

- **Term Test**
  Thursday, March 18th, 2021
  6:00PM – 9:00PM
- **Voluntary Withdrawal Deadline**
  March 31st, 2021
- **Louis Riel Day**
  February 15th, 2021
  No classes or examinations
- **Spring Break**
  February 16th – 19th, 2021
  No classes or examinations
- **Good Friday**
  April 2nd, 2021
  No classes or examinations

ECE 3540 – Advanced Circuit Analysis and Design

Winter 2021

IMPORTANT NOTICE – Mandatory Requirement to Report

This course will be conducted using remote instruction. Students who are accessing the course from outside of Canada or the USA ***must notify the instructor*** and indicate in which country they are located. Access to software may be restricted from some countries and failure to comply with these restrictions may result in criminal prosecution.

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 mathematical 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.

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.

Textbook

Basic Engineering Circuit Analysis, J. David Irwin and R. Mark Nelms, 11th Edition, Wiley, 2015. [available from the University of Manitoba's Fort Garry Book Store]
Course notes [available from the course web page].

Learning Outcomes

1. Analyze linear electrical circuits using the modified nodal analysis, tableau formulation, 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 and design 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

Accreditation Details

Accreditation Units

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

Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/ environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability rephrase information)
3 - Application (Ability 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 a whole)
6 - Evaluation (Able to judge the worth of something)

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	4	6	4		4							4
2	5	5	4		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

CEAB Graduate Attributes Assessed

PA.4 – Evaluates a solution to a complex engineering problem.

DE.3 – Develops/implements possible solutions to an open-ended design problem, leading to an appropriate recommendation

Evaluation

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, and must pass the final examination ($\geq$ 50%) in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Laboratories	10	F, S	1, 2, 3, 4
Project	5	F, S	1, 2, 3, 4
Homework	20	F, S	1, 2, 3, 4, 5
Term Test	20	S	1, 2, 3
Final Examination	45	S	1, 2, 3, 4, 5

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

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* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Copyright Notice

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

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 passing 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 the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic Regulations* dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

 *Supplemental Information*