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

Course Outline

Instructor
- Prof. Colin Gilmore, E.I.T.
  E3–517 EITC
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Office Hours
- Wednesdays, 2:30PM–3:30PM
  Fridays, 10:30AM–12:30PM
  or by appointment.

Teaching Assistant
- Hannah Fogel
  fogelh@myumanitoba.ca
- Max Hughson
  hughsonm@myumanitoba.ca

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 2132 Engineering Mathematical Analysis 2
- COMP 1012 Computer Programming for Scientists and Engineers

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

Important Dates

- **Term Test**
  Thursday, March 11th, 2021
  6:00PM – 8:00PM
- **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 2240 – Numerical Methods for Engineers

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

To obtain an understanding of numerical methods and how they can be used to solve electrical and computer engineering problems. To apply this knowledge by solving practical engineering problems using MATLAB.

Course Content

The following topics will be covered:

- Introduction to numerical methods.
- Solving systems of linear equations.
  a) Gaussian elimination, matrix decomposition, ill-conditioned systems
- Systems of non-linear equations.
- Interpolation and curve fitting.
  a) Least-squares regression
  b) Interpolation using polynomials and splines
- Numerical differentiation.
- Numerical integration methods (quadrature) and their associated errors.
- Solutions of ordinary differential equations (ODEs): initial value problems.
  a) First-order ODEs: Euler, Heun's and Runge-Kutta methods
  b) Systems of ODEs and higher-order ODEs
- Introduction to numerical solutions of partial differential equations and boundary value problems.
- Optimization. – *Time permitting*.

Textbook (optional)

Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven Chapra, McGraw-Hill, 3rd edition, 2011.

Lecture Notes by Dr. Ian Jeffrey.

Learning Outcomes

By the end of this course students will be able to:

1. State and define common terms associated with numerical analysis, e.g. analytic solution, numerical solution, mathematical model, approximation error.
2. Use approximations to develop known numerical methods and quantify the effects of these approximations on accuracy and computational cost via complexity and error analysis.
3. Define, explain, compare and contrast different procedures for numerically solving common problems including but not limited to: approximating functions, derivatives and integrals; root-finding; solving linear systems of equations, ODEs, and PDEs; performing regression and interpolation.
4. Implement numerical solutions to common problems in software (Matlab) and report the details of these implementations and their performance in an organized and clear fashion.
5. Demonstrate the effects of numerical parameters and problem size on the performance (accuracy and computational time) of software-implemented numerical methods.

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 100%
- Engineering Design: 0%

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	2											
2	3	4		2								2
3	4	4										2
4	4	3	3	3	5	3						2
5	4	4	3	3	6	3						

CEAB Graduate Attributes Assessed

IN.2 – Devises and/or implements an appropriate plan / methodology for gathering information required to solve a complex engineering problem.

ET.3 – Adapts or creates tools to meet specific analysis or design needs.

Evaluation

The final course grade will be determined by performance in laboratories, on assignments and examinations. Lab attendance, a passing grade on the final examination and completion of all labs and assignments is compulsory for this course.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Term Quiz	10	F, S	2, 3
Laboratories	20	F, S	1, 2, 3, 4
Term Test	20	F, S	2, 3, 4
Final Examination	50	S	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.

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

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.