GINA CODY
SCHOOL OF ENGINEERING
AND COMPUTER SCIENCE

ENGR 213
Applied Ordinary Differential Equations
Fall 2025

Course Instructor:
E-mail :

Office Hours:
Lecture Hours:
Course Coordinator: Alexandre Paradis, alexandre.paradis@concordia.ca

Tutorials: Please see your class schedule for details
Tutorial
Tutorial

Labs: N/A

Course Calendar Description:
This course introduces Engineering students to the theory and application of ordinary differential equations. Definition and terminology, initial-value problems, separable differential equations, linear equations, exact equations, solutions by substitution, linear models, orthogonal trajectories, complex numbers, form of complex numbers: powers and roots, theory: linear equations, homogeneous linear equations with constant coefficients, undetermined coefficients, variation of parameters, Cauchy-Euler equation, reduction of order, linear models: initial value, review of power series, power series solutions, theory, homogeneous linear systems, solution by diagonalization, non-homogeneous linear systems. Eigenvalues and eigenvectors.

Prerequisites: *MATH 204* (cégep Mathematics 105) previously or concurrently; *MATH 205* (cégep Mathematics 203).
Co-requisites: N/A

Specific Knowledge and Skills Needed for this Course:
Students taking this course are expected to have sufficient knowledge of the following topics. Should you have difficulties in any of these topics, you are strongly encouraged to review them before the DNE deadline.
- Fundamental Algebraic Manipulation
- Calculus of a Single Variable (Differentials and Integrals)
- Basic Matrix and Vector knowledge

Course materials
- **Required Textbook**: *Required textbook(s):* Advanced Engineering Mathematics, by Dennis G. Zill and Warren S. Wright, **7th Edition**[1], Published by Jones and Bartlett.
- **Instructor's lecture notes:** *will be posted in Moodle course management site*
- **OtherTextbook**: *Not required:* Advanced Engineering Mathematics, by Kreyszig, **10th Edition**, Published by Wiley.

[1] Please note that 5th and 6th editions have very minimal difference with the 7th section. Some exercises at the end of each section might have been re-ordered.

Grading

Assessment Tool	Weight
Midterms during tutorials (2- 10% each)	20%
Final	60%
Projects* - 2 team projects, in tutorial	5%
Quizzes* - individual (in lecture/online)	10%
WebWork* - online evaluation	10%
Total	100%

***The grading scheme implies 5% bonus. However, the maximum combined mark for the three components (WebWork + Quizzes + Project) is 20%.**

Passing Criteria:

- In order to pass the class, both your cumulative score and the final examination must be **above 50%**
- In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

WeBWorK: Every student will be given access to an online system called WeBWorK. Students are expected to submit assignments online using WeBWorK. Late assignments will not be accepted. Assignments contribute 10% to your final grade. Working regularly on the assignments is essential for success in this course. Students are also strongly encouraged to do as many problems as their time permits from the chapters of the textbooks listed below in this outline.

- The WeBWorK administrator can be reached at the following email: webwork.engr@concordia.ca, any questions related to WeBWorK assignments should be directed to him.
- **Students are also responsible for topics covered in assignments that have not been presented in either the regular lectures or during tutorials.**

General rules:

- If the student misses one mid-term test for a valid reason, acceptable by the course instructor, including illness, then the final examination will count for 70% of the total grade. If a student miss both mid-terms**, the final exam will still be 70%.**
- There will **be no replacements for missed quizzes** for any reason, including illness.
- Students are responsible for finding out the date of the final exam. The Examination Office posts the time and place of the final exam once the schedule becomes available. Any conflicts or problems with the scheduling of the final exam must be reported directly to the Examination Office. Students are expected to be available until the end of the final examination period. Conflicts due to travel plans will not be accommodated.

NOTE: Electronic communication devices (including cellphones and smartwatches) **will not be allowed** during examinations and are prohibited in the examination rooms. Only "Faculty Approved Calculators" will be allowed for midterm and final exams [SHARP EL-531 or CASIO FX-300MS]. See Moodle site for an extensive list of the calculators.

Tentative Course Schedule; suggested problems are from the 7ed of the book

Topics	Week
Review of the following topics: 1.1 Definition and Terminology; problems: 1,3,5,6,8,10,11,13,14,21,23 1.2 Initial Value Problems; problems: 7,9,11,12, 35, 38 2.1 Solution curves without a solution; problems: 3, 4, 26, 27	1
2.2 Separable Equations; problems: 1,7,9,13,19,25,27, 31 2.3 Linear Equations; problems: 4,7,9,23,27,31 2.4 Exact Equations, integrating factors; problems: 3,5,9,15,27,29, 33,35, 39	2
2.5 Solutions by Substitution (Bernoulli, homogeneous, linear substitution); problems: 5,7,9,13,17,19,21,23,25,27 1.3 Differential Equations as Mathematical Models; problems: 1,2,5,9,10,13,16,19 2.7 Linear models (growth/decay, heating/cooling, circuits, mixtures); problems: 3,5,9,15,17,23,25,29,31,35	3
2.8 Non-linear models (Population dynamics, logistic equation, leaking tank); problems: 2,3,5,13,15,17	4

17.1 Complex numbers; problems: 1,3,7,11,15,25,27,29,31,35,39	
17.2 Powers and Roots; problems: 3,7,9,15,21,30,31,33,35 3.1 Theory of Linear Equations; problems: 1,9,23,27	5
3.3 Homogeneous Linear Equations with Constant Coefficients problems: 3,5,9,13,15,17,21 3.4 Undetermined Coefficients; problems: 1,3,7,11,15,19,23,31	6
3.5 Variation of Parameters; problems: 1,13,15,23 3.6 Cauchy Euler Equations; problems: 5,7,11,23,45	7
3.7 Nonlinear Equations, Reduction of Order; problems: 3,7,9 3.8 Linear Models. Initial Value Problems (mass-spring systems, free motion) problems: 1,7,12,21,27	8
3.8 Linear Models. Initial Value Problems (driven motion and LRC-circuits) problems: 31,33,35,45,47 5.1.2 Power Series Solutions; problems: 19, 21, 25, 27, 31	9
10.1 Theory of Linear Systems; problems: 1,3,7,18	10
10.2 Homogeneous Linear Systems; problems: 1,3,7,9,21,31,35,37,48	11
10.4 Non-Homogeneous Linear Systems; problems: 1,3,7,17,30	12

Lab Details
N/A

Engineering Tools
N/A

Details on Assessment Tools:
N/A

Other relevant information
N/A

Graduate Attributes:
The following is the list of graduate attributes (skills) that students use, learn and/or apply throughout the term.

Graduate Attribute	**Indicators**	**Level of Coverage**	**Assessment Results Reported**
Knowledge base for engineering	Knowledge base of mathematics	Introductory	Yes
Problem Analysis	Problem Identification and Formulation Modeling Problem Solving	Introductory	Yes
Team Work	Ability to work in a team	Introductory	Yes

Course Learning Outcomes (CLOs):
By the end of this semester, students are expected to master the following concepts.

Course Learning Outcome	Related Graduate Attributes
Apply calculus to engineering problems. Extract all the pertinent information *vis-à-vis* the physics and practicality of the problem. This component is	• Knowledge base of mathematics • PA/Problem Identification and Formulation • PA/Modeling

examined through applied problems in the final exam.	• PA/Problem Solving
Learn how to work within a team. This is done through one or two Team Projects.	• Knowledge base of mathematics • PA/Problem Identification and Formulation • PA/Modeling Analysis • Team-Work
Develop the ability to work as part of a team: this is done through the participation in a team project and through some interactive tutorials	• Team-Work

Health and Safety Guidelines

All health and safety rules specific to this course can be found in the lab manual. General health and safety instructions and available health and safety trainings are discussed at:
Safety Programs - Concordia University

ON CAMPUS RESOURCES

Student may find the full list of available resources at:

- Important Services & Resources - Concordia University
- A-Z Student Services - Concordia University

While they are included in above mentioned two links, following list includes frequently searched services and resources available for students.

1. Academic Resources - Concordia University
    a. Academic integrity - Concordia University
    b. Undergraduate Calendar - Concordia University
    c. Graduate Calendar - Concordia University (For Graduate Classes)
    d. Academic dates – Undergraduate - Concordia University
    e. Important dates – Graduate - Concordia University (For Graduate Classes)
    f. Learning services - Concordia University
    g. Advocacy - Concordia University
2. Health & Wellness - Concordia University
    a. Access Centre for Students with Disabilities - Concordia University
    b. Mental health - Concordia University
3. Safety & security - Concordia University
    a. Security services - Concordia University
    b. Environmental Health and Safety - Concordia University
    c. Safety Training - Concordia University
4. International students - Concordia University