

Ordinary Diff. Eqs. and Boundary Value Pbs. - MATH 230

(CRN 10471)

Department of Mathematics & Statistics,
University of Northern British Columbia

January 2022, MWF 3:30 pm — 4:20 pm, Agora 7–150

ESSENTIALS

INSTRUCTOR:	Dr. Mohammad El Smaily
EMAIL:	mohammad.elsmaily@unbc.ca
TEL:	250-960-6624
OFFICE:	T&L, 10-2044
OFFICE HOURS:	TBA, or by appointment (email)
Note:	office hours are held online due to COVID-19

LECTURES:

Agora 7–150, Mon-Wed-Fri 3:30 pm — 4:20 pm.

COURSE DESCRIPTION:

This course introduces basic theory and application of ordinary differential equations and boundary value problems. Topics include: first order differential equations (separable, linear, homogeneous, Bernoulli and exact equations); linear second order and higher order equations (linear independent solutions, method of undetermined coefficients and variation of parameters); linear systems of ordinary differential equations; basic numerical methods (Euler and Runge-Kutta methods); and solutions to linear partial differential equations (heat, wave, Laplace's equation) using separation of variables and Fourier series.

Prerequisites: (MATH 200 Minimum Grade of C⁻ and MATH 220 Minimum Grade of C⁻).

TEXTBOOK:

The textbook we will use is open source (free download)– see item 2 on this webpage <http://ramanujan.math.trinity.edu/wtrench/texts/index.shtml>

Textbook info: *Elementary Differential Equations with Boundary Value Problems*, by **William Trench**.

COURSE WEB PAGES:

- We will use Blackboard <https://learn.unbc.ca> to post all materials for this course and make announcements.
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PRACTICE PROBLEMS

Each section in this book is followed by several exercises and problems which vary from easy to challenging. Feel free to work out the exercises which are relevant to each lecture on your own. I will solve some of these

exercises during the semester. And will assign some others as homework. Remember that the homework is mainly to assess your understanding of the material and prepare you for the exams as well.

GRADING SCHEME:

Your Math 230 final grade is computed according to the following scheme:

Assignments: **15%**

Midterm Exam 1: **25%**

Midterm Exam 2: **25%**

Final Exam: **35%**

ASSIGNMENTS:

Assignments will be given/posted on Blackboard and will be **handed in online–Blackboard**. There will be approximately 6 class assignments.

The due dates will be written on the assignments. Assignments must be handed in on time. Late assignments will only be accepted for medical or compassionate reasons.

MIDTERM EXAMS:

There will be **two midterm exams**. Midterm Exam 1 will be on **Monday February 14** and Midterm Exam 2 will be on **Wednesday March 16**. The midterm exams will be held in class and will start at 3:30 pm and will be 50 minutes in duration. If you have an unavoidable conflict with a scheduled exam, it is your responsibility to inform me as soon as possible (preferably one week in advance); decisions in this regard will be made on a case-by-case basis.

FINAL EXAM:

The final exam will be held online (Blackboard). TBA by the Registrar's Office. Final exam will be **comprehensive and will include all the material covered in the course**.

IMPORTANT DATES:

First day of classes: Wed 5 January

Midterm 1: Monday, Feb. 14

Midterm 2: Wednesday, March 16

Add/Drop Date: Wednesday January 19

Family Day: Mon 21 February

Mid-Semester Break: Tuesday 22 February - Friday 25 February

Withdrawal Date: Thursday 24 February

Final Exam Period: Fri 8 April - Fri 22 April

TENTATIVE SYLLABUS

- **Introduction:** 1.1 Applications Leading to Differential Equations, 1.2 First Order Equations, 1.3 Direction Fields for First Order Equations.

- **Chapter 2—First Order Equations:** 2.1 Linear First Order Equations, 2.2 Separable Equations, 2.3 Existence and Uniqueness of Solutions of Nonlinear Equations, 2.4 Transformation of Nonlinear Equations into Separable Equations, 2.5 Exact Equations, 2.6 Integrating Factors.
 - **Chapter 5—Linear Second Order Equations:** 5.1 Homogeneous Linear Equations, 5.2 Constant Coefficient Homogeneous Equations, 5.3 Nonhomogeneous Linear Equations, 5.4 The Method of Undetermined Coefficients I, 5.5 The Method of Undetermined Coefficients II, 5.6 Reduction of Order, 5.7 Variation of Parameters.
 - **Chapter 7—Series Solutions of Linear Second Order Equations.**
 - **Chapter 10—Linear Systems of Differential Equations:** 10.1 Introduction to Systems of Differential Equations, 10.2 Linear Systems of Differential Equations, 10.3 Basic Theory of Homogeneous Linear Systems, 10.4, 10.5, 10.6 Constant Coefficient Homogeneous Systems.
 - **Chapter 11—Boundary Value Problems and Fourier Expansions:** 11.1 Eigenvalue Problems for $y'' + \lambda y = 0$, 11.2 Fourier Series I, 11.3 Fourier Series II
 - **Chapter 12—Fourier Solutions of Partial Differential Equations:** 12.1 The Heat Equation, 12.2 The Wave Equation, 12.3 Laplace's Equation in Rectangular Coordinates.
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EXPECTATIONS:

- It is recommended that you devote at least 6 extra hours of personal work per week to this course. Solve all problems from the assigned homework and the suggested problems posted weekly on the Blackboard course webpage. Discussion with your classmates is encouraged. However keep in mind that on the exams you work independently.
 - Do not let yourself fall behind on assignments. Do not postpone getting help until the last minute. The main help in this course is provided by the instructor during office hours.
 - Attend all lectures and lab sessions. Please be considerate of your classmates; try not to be late for class and do not use cell phones or laptop computers during class.
 - Review your notes soon after class and prior to the next class.
 - During the lecture, participate by answering questions and feel free to interrupt the instructor to ask questions.
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SPECIAL ARRANGEMENTS:

Students with disabilities who would like to receive access and academic accommodations through the Access Resource Centre (ARC) need to self-identify and register with the centre. Please see <http://www.unbc.ca/access-resource-centre>. The students who have registered for accommodations with the ARC must ensure that the instructor is informed of the necessary arrangements as soon as possible.

ACADEMIC REGULATIONS:

It is the students' responsibility to familiarize themselves with the regulations concerning academic integrity and ensure that their course work conform to the principles of academic integrity. Please read the academic regulations found at:

<http://www.unbc.ca/calendar/undergraduate/general/regulations.html>.

In particular, read sections 40, 41, 42, 43, 44, and 45.

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¹https://libguides.unbc.ca/ld.php?content_id=35082396