

## MATH 3705\*A Winter 2021 Course Outline

Last updated: December 17, 2020.

### Mathematical Methods I

**Instructor:** Dr. Elena Devdariani

**Contact:** email: [elenad@math.carleton.ca](mailto:elenad@math.carleton.ca)

**Office hours:** online by appointment. Please email the instructor to schedule.

**Textbook:** Mathematical Methods and Boundary Value Problems, Fifth Edition, by S. Melkonian. Hardcopy is available at the Campus Bookstore. The fourth edition may be used. Any earlier edition is very different for the last two.

Ebook at <https://campusebookstore.com/EBooks/Book.aspx?ID=9689104>

**Lectures:** Asynchronous, posted on CULearn, beginning on January 12, every Tuesday & Thursday. Lectures end on April 13.

**Tutorials:** Live online, beginning January 26, Tuesdays, 16:35 - 17:25. On the tutorial sessions the students are expected to work individually on specific problems. A Teaching Assistant (TA) will be present, to answer questions and to administer the tests. The class will be subdivided into tutorial groups alphabetically, according to the last names. The subdivision and the names of the TAs will be posted later.

#### Evaluation:

(1) Term Mark 45% (4 tests, 3 best count)

(2) Final Examination 55%.

**Term mark :** There will be four "open book" tests online in the regular tutorial hours: on **February 2, March 2, March 23, April 6**. Further instructions will be provided a week prior to the date of each test.

There will be **ABSOLUTELY NO** make-up tests as we do not have the resources to provide such services. This is the reason why the students are allowed to miss one test without penalty. **The instructor will not answer any emails from the students asking about the possibilities of make-up tests.**

**Final Examination:** This is a 3-hour "open book" exam scheduled by the University. The exam is taking place during the period of April 16 to 27 (including weekends). It is each student's responsibility to be available at the time of the examination.

**Calculators:** Non-programmable calculators are allowed for tests and the exam.

**Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. You can visit the Equity Services web site to view the policies and to obtain more detailed information on academic accommodation at <http://carleton.ca/equity/accommodation>

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

#### List of topics:

1 The Laplace Transform, Lectures 1 – 5

1.1 Introduction

1.2 Further Properties and Initial-Value Problems

### 1.3 Convolutions and Generalized Functions

## 2 Series Solutions of Ordinary Differential Equations, Lectures 6 – 10

### 2.1 Basic Concepts

### 2.2 Solutions About Ordinary Points

### 2.3 Solutions About Regular Singular Points

#### 2.3.1 Cauchy-Euler Equations

#### 2.3.2 The General Equation $y'' + p(x)y' + q(x)y = 0$

#### 2.3.3 Bessel's Equation

## 3 Fourier Series, Lectures 11 – 12

### 3.1 Periodic Functions

### 3.2 Functions Defined on Finite Intervals

## 4 Partial Differential Equations, Lectures 13 – 17

### 4.1 The Heat Equation

#### 4.1.1 The Bar with Zero Boundary Conditions

#### 4.1.2 The Bar with Nonzero Boundary Conditions

#### 4.1.3 The Bar with Insulated Ends

### 4.2 The Wave Equation

### 4.3 Laplace's Equation

#### 4.3.1 Solutions Within Rectangular Regions, Polynomial Solutions

#### 4.3.2 Regions with Circular Boundaries, Solutions Inside a Circle, Solutions Outside a Circle, Solutions Within an Annulus

## 5 Sturm-Liouville Problems, Lectures 18 – 21

### 5.1 Regular and Periodic Problems

#### 5.1.1 General Theory

### 5.2 Singular Problems

#### 5.2.1 Bessel's Equation

#### 5.2.2 The Vibrating Membrane

## 6 The Fourier Transform, Lectures 22 – 24

### 6.1 Fundamental Properties

### 6.2 Applications

#### 6.2.1 Partial Differential Equations, The Heat Equation on $(-\infty, \infty)$

## Exercises

Section 1.1: 1-7

Section 1.2: 1-23

Section 1.3: 1-11

Section 2.1: 1-3

Section 2.2: 1-11

Section 2.3: 1-15

Section 3.1: 1-8

Section 3.2: 1-17

Section 4.1: 1-9

Section 4.2: 1-5

Section 4.3: 1-11

Section 5.1: 1-13

Section 5.2: 1-14

Section 6.1: 1-22

Section 6.2: 1-4