



MAT290H1F: ADVANCED ENGINEERING MATHEMATICS - COURSE SYLLABUS FOR FALL 2014

COURSE OBJECTIVES

This is a course designed to prepare students for use of essential mathematical concepts and techniques for Electrical and Computer Engineering applications. It includes basics of Complex Analysis, Differential Equations and Laplace Transforms.

INSTRUCTORS

Lecture Section	Instructor	Office	Email
LEC01	Lacra Pavel	GB343A	pavel@ece.utoronto.ca
LEC02	Soheil Homayouni		homayoun@math.toronto.edu
LEC03	Shai Cohen		cohen@math.toronto.edu

TEXTBOOK

The **required** book for this course is:
 Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, 5th Ed
 Jones and Bartlett Publishers.

COURSE MARKS

Final Exam - 40%, Midterm - 30%, Best 8 out of 10 marked quizzes 30%.

MIDTERM

- There will be one 110 minute Midterm exam on October 21, 6-8pm. Details will be posted on the course Blackboard website before the exam date. Please note: there will be no make-up exam.

TUTORIALS, HOMEWORK PROBLEMS AND QUIZZES

- Tutorials will be two hours long and are held weekly, and **will start the week of September 15th**.
- In the first part of the tutorials, you'll discuss the assigned problems for that week with the teaching assistant. **It is essential for your success in the course, and for your learning experience, that you work through all the homework problems assigned that week before coming to the tutorials.** There will be a quiz at the end every tutorial consisting of two problems identical or very close to ones from the homework set. There will be no make-up quizzes offered.

WEEKLY READING ASSIGNMENTS

- In each week's problem set a reading assignment will be included. The lectures in this course are designed to complement the textbook, so not every detail of the material for which you are responsible will be discussed in lectures.
- The weekly readings will also help you keep up in this course, which covers a great deal of material. It is a small investment that will make a big difference when you go to write your quizzes, midterm, and final exam.

COURSE WEBSITE

The course Blackboard website is accessible through the main UofT portal. Look for [Fall-2014-MAT290H1-F-LEC0101.LEC0102.LEC0103: ADVANCED ENG. MATHEMATICS/ADVANCED ENG. MATHEMATICS](#) which addresses all the lecture sections together. Most of the communication, handouts, and homework assignments we'll have will be posted there. From time to time, your instructors or TAs may wish to contact you with announcements via email. You are required to maintain a working utoronto.ca email address for this course. It is crucial that your email on ROSI (which appears on Blackboard) is a utoronto.ca email address.

MAT290 Syllabus

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Introduction to Complex Numbers.

Chapter 17: Functions of a Complex Variable

17.1 Complex Numbers

17.2 Powers and Roots (polar form)

17.6 Exponential and Logarithmic Functions

17.7 Trigonometric and Hyperbolic Functions

Chapter 1: Introduction to Ordinary Differential Equations.

1.1 Definitions and Terminology

1.2 Initial-Value Problems

1.3 Differential Equations as Mathematical Models

Chapter 2: First-Order Differential Equations

2.1, 2.1.1, 2.1.2 Introduction, Direction Fields, Autonomous DEs

2.2 Separable Equations

2.3 Linear Equations

2.7 Linear Models (Series Circuits)

Chapter 3: Higher-Order Differential Equations

3.1.1 Initial Value and Boundary Value Problems

3.1.2 Homogeneous Equations

3.1.3 Nonhomogeneous Equations

3.2 Reduction of Order

3.3 Homogeneous Linear Equations with Constant Coefficients

3.4 Method of Undetermined Coefficients

3.5 Variation of parameters.

3.8.4 Series Circuits

Chapter 4: The Laplace Transform

4.1 Definition of the Laplace Transform

4.2 The Inverse Transform and Transforms of Derivatives

4.3 Translation Theorems

4.4 Additional Operational Properties of the Laplace Transform

Laplace Transforms and Initial Value Problems.

4.5 The Dirac Delta Function

Chapter 17: Functions of a Complex Variable (cont'd)

17.3 Sets in the complex plane.

17.4 Functions of a Complex Variable. Limits of complex functions.

Continuity and derivatives of complex functions. Analyticity.

17.5 Cauchy-Riemann Eqns.

Chapter 18 Integration in the Complex Plane

- 18.1 Contour Integrals.
- 18.2 The Cauchy-Goursat Theorem.
- 18.3 Independence of path and deformation of contours.
- 18.4 Cauchy's Integral Formulas.

Chapter 19 Series and Residues

- 19.1 Sequences and series.
 - 19.2 Taylor Series.
 - 19.3 Laurent Series.
 - 19.4 Zeros and poles.
 - 19.5 Residues and the Residue Theorem.
 - 19.6 Evaluation of real integrals.
- Residues and Inverse Laplace transform.

MAT290 Syllabus (with Examples)

Lacra Pavel

Introduction to complex numbers and the complex plane.

The polar form, powers and roots.

The complex exponential and logarithm.

Complex trigonometric functions.

Examples: Electrical Circuits: Phasors (ECE212) (steady-state solutions).

Introduction to Ordinary Differential Equations.

First Order ODEs. Direction Fields.

Autonomous differential equations and phase portraits.

Separable equations.

Linear ODEs. Linear Models.

Examples: Telegraph equations (PDEs) (ECE320), Electrical Circuits (systems of first order ODEs): (ECE212)

Higher-Order ODEs.

Initial Value and Boundary Value Problems.

Homogeneous and Nonhomogeneous equations.

Reduction of order.

Homogeneous linear ODEs with constant coefficients.

Method of Undetermined coefficients.

Variation of Parameters.

Examples: 2nd order ODEs: RLC Series/Parallel Circuits: (ECE212), mass-spring system (ECE311), wave equation (ECE320)

Laplace Transforms.

Examples: RLC Series Circuits: (ECE212) (transient and steady-state solutions for piecewise continuous inputs).

Inverse transforms and transforms of derivatives.

Laplace Transforms and Initial Value Problems.

Dirac delta function.

Examples: RLC Series Circuits: (ECE212), signal & systems (ECE216), communication systems/periodic signals (ECE316), transfer function of LTI systems (ECE311), impulse response of RLC circuits (ECE212)

Sets of points in the complex plane. Limits of complex functions.

Continuity and derivatives of complex functions.

Analyticity, the Cauchy-Riemann Eqns. Contour integrals.

Examples: electromagnetic cloaking (ECE221)

The Cauchy-Goursat Theorem.

Independence of path and deformation of contours.

Cauchy's Integral Formula.

Examples: use in Nyquist stability criterion for LTI systems (ECE311)

Sequences and series.

Examples: use in inverse Laplace transform, Z- transform, control/systems (ECE311)

Taylor Series, Laurent Series.

Zeros and poles.

Examples: Filter design (circuits): TF of a band-pass filter (ECE212)

Residues and the Residue Theorem.

Evaluation of real integrals.

Residue theory and Inverse Laplace transform.

Examples: Residue application in Inverse Transforms: Fourier (signal & systems) (ECE216), Laplace (LTI systems) (ECE311), Z-Transform (ECE411)