

# MA3511: ORDINARY DIFFERENTIAL EQUATIONS

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## Effective Term

Semester A 2023/24

## Part I Course Overview

### Course Title

Ordinary Differential Equations

### Subject Code

MA - Mathematics

### Course Number

3511

### Academic Unit

Mathematics (MA)

### College/School

College of Science (SI)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

MA2508 Multi-variable Calculus; and MA2503 Linear Algebra;  
OR MA2001 Multi-variable Calculus and Linear Algebra

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

## Part II Course Details

### Abstract

This course introduces fundamental mathematical methods and analysis in ordinary differential equations and basic knowledge of partial differential equations. It will help students develop skills in solving ordinary differential equations by analytical methods and solving simple partial differential equations by the method of separation of variables. It trains students in the ability to think quantitatively and analyze problems critically.

### Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1 solve several classes of first order ordinary differential equations, higher order equations with constant coefficients, and systems of linear differential equations.	10	x		
2 develop skills in making mathematical development for objects which cannot be solved analytically, through the study of solutions of second order ordinary differential equations with varying coefficients.	20	x	x	
3 evaluate series solutions of ordinary differential equations.	20	x	x	
4 solve simple partial differential equations by the method of separation of variables.	20	x	x	
5 explain at high levels concepts and ideas from differential equations, and create advanced mathematical models to a range of problems in science and engineering involving differential equations.	30		x	x

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Teaching and Learning Activities (TLAs)

TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1 Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total

2	Take-home assignments	Learning through take-home assignments helps students understand fundamental mathematical methods and analysis in ordinary differential equations and solve simple partial differential equations by the method of separation of variables.	1, 2, 3, 4, 5	after-class
3	Online applications	Learning through online examples for applications helps students create and formulate mathematical models by means of differential equations and apply to some problems in science and engineering.	5	after-class
4	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 3, 4	after-class

**Assessment Tasks / Activities (ATs)**

ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)	
1	Test (Midterm Exam)	1, 2	15	Questions are designed for the first part of ordinary differential equations to see how well the students have learned the basic concepts, fundamental theory, analytical methods and recognized the applications.
2	Hand-in assignments	1, 2, 3, 4, 5	15	These are skills based assessment to enable students to demonstrate the basic concepts, techniques and fundamental theory of differential equations and identify the related applications.
3	Formative take-home assignments	1, 2, 3, 4	0	The assignments provide students chances to demonstrate their achievements on differential equations learned in this course.

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

2

**Additional Information for ATs**

30% Coursework

70% Examination (Duration: 2 hours, at the end of the semester)

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

**Assessment Rubrics (AR)**

**Assessment Task**

1. Test

**Criterion**

Ability to understand the fundamental theory, analytical methods of ordinary differential equations and recognize the applications

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

**Assessment Task**

2. Hand-in assignments

**Criterion**

Ability to learn the basic concepts, techniques and fundamental theory of differential equations and identify the related applications

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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**Assessment Task**

3. Examination

**Criterion**

Ability to solve problems in ordinary differential equations and elementary partial differential equations

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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**Assessment Task**

4. Formative take-home assignments

**Criterion**

Ability to demonstrate students' achievements on differential equations learned in this course

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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## Part III Other Information

### Keyword Syllabus

- First order ordinary differential equations. Linear equations. Separable equations. Homogeneous equations. Exact equations and integrating factors.
- Second and higher order linear equations. Initial value problems. Existence and uniqueness. Wronskian and linear dependence. Reduction of order. Method of variation of parameters. Constant coefficient equations. Method of undetermined coefficients.
- Series solutions of second order linear equations. Euler equations. Bessel's equations.
- Systems of differential equations. Phase portraits (if time permits).
- Fourier series. Separation of variables for simple partial differential equations (if time permits).

### Reading List

#### Compulsory Readings

Title	
1	W. Boyce and R. DiPrima, "Elementary Differential Equations", Springer 2008, ISBN: 978-0-387-71275-8

#### Additional Readings

Title	
1	Nil