MA3511: ORDINARY DIFFERENTIAL EQUATIONS

Effective Term
Semester A 2024/25

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.

Learning and Teaching Activities (LTAs)

	LTAs	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	Quizzes/Test/Midterm	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. Quizzes/Test/Midterm

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

Assessment Task
3. 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

Assessment Task
4. 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

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