

MA2181: MATHEMATICAL METHODS FOR ENGINEERING

Effective Term

Semester A 2024/25

Part I Course Overview

Course Title

Mathematical Methods for Engineering

Subject Code

MA - Mathematics

Course Number

2181

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

MA1201 Calculus and Basic Linear Algebra II / MA1301 Enhanced Calculus and Linear Algebra II; or equivalent

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

MA2177 Engineering Mathematics and Statistics

Part II Course Details

Abstract

This course aims to develop a basic understanding of a range of mathematics tools with emphasis on engineering applications. It is intended for students to solve problems with techniques from advanced linear algebra, ordinary differential equations and multi-variable differentiation. Fourier series and Laplace transforms are also introduced. The course helps students develop skills to think quantitatively and analyse problems critically.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain at high levels concepts from advanced linear algebra and multi-variable differentiation.	15	x	x	
2	compute eigenvalues and eigenvectors of matrices, and solve first- and higher order ordinary differential equations.	25	x	x	
3	evaluate partial derivatives of multivariate functions.	25	x	x	
4	implement basic operations in Fourier series and Laplace transforms.	20	x	x	
5	apply mathematical and computational methods to a range of problems in science and engineering.	15	x	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	Lectures	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total
2	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	2	2 hours
3	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	3	2 hours

4	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	4	2 hours
5	Tutorials	Learning through tutorials is primarily based on interactive problem solving allowing instant feedback.	5	1 hour
6	Assignments	Learning through take-home assignments helps students understand basic concepts and techniques of advanced linear algebra, ordinary differential equations and multi-variable differentiation, and some applications in science and engineering.	1, 2, 3, 5	after-class
7	Online applications	Learning through online examples for applications helps students apply mathematical and computational methods to some problems in engineering applications.	5	after-class
8	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, 3	15	Questions are designed for the first part of the course to see how well the students have learned concepts and techniques of advanced linear algebra, ordinary differential equations and multi-variable differentiation.

2	Hand-in assignments	1, 2, 3, 4, 5	15	These are skills based assessment to see whether the students are familiar with advanced concepts and techniques of linear algebra, ordinary differential equations, multi-variable differentiation, Laplace transforms, Fourier series and some applications in engineering.
3	Formative take-home assignments	1, 2, 3, 4, 5	0	The assignments allow students to demonstrate their achievements on advanced linear algebra, ordinary differential equations, multi-variable differentiation and their applications in engineering 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

Utilize concepts from advanced linear algebra, ordinary differential equations and eigenvalues and eigenvectors to solve problems relevant to engineering.

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

Evaluate and implement Fourier series, Laplace transforms and techniques from multivariate calculus.

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

Select and apply various methods to solve problems relevant to engineering.

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

Design solution strategies and then utilize appropriate methods to solve science and engineering problems.

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

Eigenvalues and eigenvectors. First- and higher order ordinary differential equations. Partial differentiation. Laplace transforms. Fourier series.

Reading List**Compulsory Readings**

Title	
1	Calculus - Early Transcendentals (7th Ed.) by C. Henry Edwards & David E. Penny
2	Linear Algebra - A Pure and Applied First Course (1st Ed.) by Edgar G. Goodaire
3	Differential Equations and Boundary Value Problems (4th Ed.) by C. Henry Edwards & David E. Penny

Additional Readings

Title	
1	Advanced Engineering Mathematics (9th Ed.) by Erwin Kreyszig