MA2181: MATHEMATICAL METHODS FOR ENGINEERING

Effective Term
Semester A 2022/23

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.

Teaching and Learning Activities (TLAs)

	TLAs	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	Test	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. Test

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