

Module code

SPM-3412

Type of module

Undergraduate: Mathematical Sciences – Elective

Engineering Mathematics



Modular credits

4

Total student engagement

56 hours

Prerequisite

SPM-2201 (Advanced Mathematical Methods for the Sciences)

Anti-requisite

None

Aims

To develop students' ability to analyse, model, and solve complex engineering problems using advanced mathematical methods, including differential equations, transforms, linear algebra, Fourier analysis, and partial differential equations.

Module learning outcomes (MLO)

On successful completion of this module, a student will be expected to be able to:

MLO 1

Analyse and solve ordinary differential equations and Laplace transform problems, including oscillatory, discontinuous, and impulsive systems.

MLO 2

Evaluate and apply linear algebra methods (eigenvalue analysis, diagonalisation, modal analysis) to engineering models.

MLO 3

Formulate and interpret Fourier and spectral representations for signals and engineering systems.

MLO 4

Apply and extend separation of variables and Sturm–Liouville theory to solve classical partial differential equations.

MLO 5

Justify and critically assess mathematical approaches for modelling and solving complex engineering problems.

Module contents

Ordinary Differential Equations: Higher-order ODEs with constant and variable coefficients. Qualitative analysis and applications

Laplace Transforms: Standard and advanced transforms, inverse transforms. Convolution theorem, and applications to differential and integral equations

Linear Algebra for Engineering Applications: Matrices and linear systems, LU decomposition, eigenvalue/eigenvector problems, diagonalization, and modal analysis of engineering systems

Fourier and Spectral Analysis: Fourier coefficients and series. Fourier transforms and discrete Fourier transforms. Applications to heat conduction, vibration, and signal processing

Partial Differential Equations: Heat, wave, and Laplace equations. Separation of variables, Use of Fourier/Bessel functions. Introduction to Sturm-Liouville problems

Assessment

60% **40%**
Examination Coursework



■ Examination — 60% ■ Class tests — 20% ■ Online quizzes — 10% ■ PBL assignment — 10%

Formative assessment

Weekly discussion and feedback

Summative assessment

COMPONENT	WEIGHTING
Examination	60%
Coursework	40%
Individual	30%
Class tests	20%
Online quizzes	10%
Group	10%
PBL assignment	10%

Graduate attributes and skills

Programme learning objectives (PLO) addressed

1 PLO 1 (Core Mathematical Knowledge)

2 PLO 2 (Analytical Problem-Solving)

4 PLO 4 (Mathematical Communication)

5 PLO 5 (Collaboration, Project Management and Industry Engagement)

6 PLO 6 (Adaptability and Lifelong Learning)

Sustainability concept addressed

4

SDG 4 Quality Education

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SDG 9 Industry, Innovation and Infrastructure

Digital skills/software used (not limited to)

- Computer Algebra Systems (e.g. Mathematica, Desmos)
- Scientific Computing and Numerical Analysis Software (e.g. MATLAB, Python)
- Learning Management Systems (e.g. Canvas)
- Word Processing Software (e.g. Microsoft Word)
- Presentation Software (e.g. PowerPoint, Canva)

Micro-credentialling option

No

Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes

No

Document details

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