ADVANCED MATHEMATICS FOR ENGINEERS - 2024/5

Module code: ENG1104

Module Overview

Engineers frequently use mathematical models, and in particular differential equations in one or more variables and matrices are common in this context. This is a further first level engineering mathematics module designed to support teaching in other engineering science modules by introducing students to concepts and solution methods in these areas.
Statistics and probability also play a significant role in the assessment of real-life engineering problems and an introduction to key concepts in this area is also included.

Module provider

Mechanical Engineering Sciences

Module Leader

KUEH Audrey (Maths & Phys)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 4

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 62

Lecture Hours: 33

Tutorial Hours: 11

Guided Learning: 11

Captured Content: 33

Module Availability

Semester 2

Prerequisites / Co-requisites

n/a

Module content

Indicative content includes:
Functions of several variables: Partial derivatives for functions of several variables, total derivative, application to small changes in a function and errors. Extrema of functions of two variables. Simple double integrals. Simple vector functions of several variables and basic vector calculus- grad, div and curl
Ordinary differential equations: First order, first degree ODE's of separable type and the integrating factor method.
Second order ODE's with constant coefficients (complementary solution and particular integrals). Initial and boundary value problems.
Matrices, determinants, eigenvalues: Matrix addition, multiplication, etc., determinants, Cramer's rule. Matrix operations involving transpose, inverse, rank of matrix. Solving systems of equations using matrices, esp.
Gaussian elimination. Eigenvalues and eigenvectors; applications to systems of linear differential equations and normal modes.
Partial differential equations Introduction to PDE's, separation of variables method using trial solution.
Probability and statistics: Descriptive statistics: numerical (mean, mode, median, variance etc).. Basic Probability: elementary laws, random variables, mean and variance. Probability distributions: Discrete probability distributions (binomial, Poisson); continuous probability distributions (normal)

Assessment pattern

Assessment type	Unit of assessment	Weighting
School-timetabled exam/test	Test (1 hour duration)	20
Examination	Exam (2 hours duration)	80

Alternative Assessment

N/A

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate their ability to recognise problem types, select appropriate solution methods and carry out various solution techniques.

Formative assessment and feedback

Formative assessment is a regular ongoing process all semester through work on the tutorial questions. Formative feedback is provided orally on a one-to-one basis and to the whole group in tutorial/problems classes, and through the issuing of selected samples of fully worked solutions to tutorial problems.

Summative assessment

Summative assessment is in the form of:

Online class test (Learning outcomes 2,4 & 6)

Final examination (Learning outcome 1-8)

Module aims

- Enable a further understanding and knowledge of mathematical and statistical concepts and techniques
- Develop skills in the selection and implementation of mathematical techniques to engineering problems

- Gain an appreciation of the importance of mathematical modelling of physical problems and the interpretation of mathematical results.

Learning outcomes

		Attributes Developed
001	Select and apply appropriate techniques of differential and integral calculus to engineering problems;	CK
002	Solve straightforward ordinary differential equations as encountered in engineering problems	CKP
003	Discuss the role of mathematical modelling and be able to produce and explain simple mathematical models of physical problems;	CPT
004	solve typical engineering-related second order partial differential equations;	CK
005	Manipulate matrices in appropriate contexts and use matrix methods to solve sets of linear algebraic equations;	CK
006	Determine matrix eigenvalues and eigenvectors, use to solve engineering systems modelled by differential equations and relate the results to characteristics of the physical system;	CKP
007	Present and summarise simple statistical data graphically and numerically;	CKPT
008	Recognise appropriate probability distributions and use them to calculate probabilities and apply to e.g. simple ideas of quality control.	CKP

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to familiarise students with mathematical concepts and techniques, supported by extensive use of examples and applications, in which students themselves are engaged in both lectures and, more extensively, in tutorials/problems classes. The learning and teaching methods include: Lectures to introduce new concepts and techniques and provide illustrative examples and applications; students are engaged with performance of examples, questioning on concept and observations. Recommended wider reading of matching sections of relevant recommended texts. Problem sheets of examples for technique selection and skill development. Tutorials/problems classes for the development of skills in technique application and also in selection of appropriate techniques, using the above problems sheets; assistance is given both at individual level, and for the group on common areas of difficulty.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENG1104

Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in Employability, Digital Capabilities, Global and Cultural Capabilities, Sustainability, and Resourcefulness and Resilience. This module is designed to allow students to develop knowledge, skills, and capabilities in the following areas: Digital Capabilities: Stundets are required to complete the summative class test using a digital assessment tool. Students will therefore gain skills in using digital tools to present mathematical solutions.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Aerospace Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Aerospace Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biomedical Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Biomedical Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering BEng (Hons)	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering MEng	2	Compulsory	A weighted aggregate mark of 40% is required to pass the module