MATH0027 Mathematical Methods 5

Year:	2023–2024
Code:	MATH0027
Level:	6 (UG)
Normal student group(s):	UG: Year 3 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Assessment:	90% examination, 10% coursework
Normal Pre-requisites:	MATH0056
Lecturer:	Dr K Dunlop

Course Description and Objectives

The majority of integral and differential equations, arising from problems in applied mathematics, cannot be solved exactly or have their solutions explicitly expressed in terms of known functions. The aim of this course is to develop analytical techniques which enable insight into the structure and properties of solutions of differential equations.

Recommended Texts

1. A C King, J Billingham and S R Otto, *Differential Equations - Linear, Nonlinear, Ordinary, Partial*;
2. Barry Spain and M G Smith,*Functions of Mathematical Physics*;
3. C M Bender and S A Orszag, *Advanced Mathematical Methods for Scientists and Engineers* (McGraw-Hill);
4. Steven H Strogatz, *Non-linear Dynamics and Chaos.*

Detailed Syllabus

Linear ordinary differential equations
Reduction of order. Variation of parameters. Comparison principles. Solutions in the form of a complex integral.

Asymptotic behaviour (at infinite) of integral solutions to differential equations
Asymptotic expansions of Laplace and Fourier-type integral functions with large parameter using integration by parts, Laplace's method and Watson's lemma, the method of stationary phase, and the method of steepest descent.

Non-linear ordinary differential equations
First-order systems with two unknowns; steady states, linearisation and phase plane analysis. Second-order differential equations with damping terms; Free and forced oscillations. Limit cycles.