

MATH0027 Mathematical Methods 5

<i>Year:</i>	2021–2022
<i>Code:</i>	MATH0027
<i>Level:</i>	6 (UG)
<i>Normal student group(s):</i>	UG: Year 3 Mathematics degrees
<i>Value:</i>	15 credits (= 7.5 ECTS credits)
<i>Term:</i>	2
<i>Assessment:</i>	90% examination, 10% coursework
<i>Normal Pre-requisites:</i>	MATH0056
<i>Lecturer:</i>	Dr S Cooper

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.