MATH0016 (Mathematical Methods 3)

Year:	2019–2020
Code:	MATH0016
Old code:	MATH2401
Level:	5 (UG)
Normal student group(s):	UG: Year 2 Mathematics degrees and Year 3 Mathematics and Statistical Science degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	1
Structure:	3 hour lectures and 1 hour problem class per week, weekly assessed coursework, and fortnightly 1 hour small group classes.
Assessment:	90% examination, 10% coursework.
Normal Pre-requisites:	MATH0011 (previously MATH1402)
Lecturer:	Prof NR McDonald
Problem class teacher:	Dr R Bowles

Course Description and Objectives

The aim of this course is to provide students with an introduction to four mathematical topics (a) Fourier theory, (b) the calculus of variations, and (c) partial differential equations and (d) vector calculus.

In (a), we develop tools to decompose a periodic function as a (possibly infinite) sum of sine and cosine modes. In (b), the fundamental problem is to determine a function which either maximizes or minimizes an integral when specified end conditions are satisfied. In (c), linear and quasilinear partial differential equations of the first and second order are considered. In (d) the divergence and curl are defined. Proofs of the divergence and Stokes' theorem are presented.

Recommended Texts

(i) F Ayres, *Differential Equations*, Schaum Outline Series.

(ii) M R Spiegel, *Fourier Analysis*, Schaum Outline Series.

(iii) M L Boas, *Mathematical Methods in the Physical Sciences*, Wiley.

(iv) Advanced Calculus (Schaum Outline Series)

Detailed Syllabus

– Fourier series of periodic functions; Parseval's theorem and application to summation of series.

– Euler-Lagrange equation for an extremal function. Problems with and without constraints.

– First-order linear partial differential equations. Characteristics. Quasilinear equations.

– One-dimensional wave equation. D'Alembert's solution. I

– Definition of devergence and curl, proof of divergence and Stokes' theorems. Examples including non-planar surfaces and in cylindical and spherical coordinates. Vector calculus, product rules.