The University of Southern Queensland

Course Specification

Description: Partial Differential Equations						
Subject	Cat-Nbr	Class	Term	Mode	Units	Campus
MAT	3105	21260	1, 2003	ONC	1.00	TWMBA

Academic Group: FOSCI
Academic Org: FOS003
HECS Band: 2
ASCED Code: 010101

STAFFING

Examiner: Tony Roberts
Moderator: Dmitry Strunin

PRE-REQUISITES

Pre-requisite: MAT2100

RATIONALE

This course develops methods needed to apply the mathematics of partial differential equations. An understanding of their qualitative behaviour provides a structure for the analysis of wide ranging problems. The methods of systematic approximation introduced with Fourier series and power series. Computer algebra is a necessary tool of modern mathematics which is here introduced to perform routine tedious algebra. The application of conservation principles in mechanics enable the modelling of physical problems as partial differential equations.

SYNOPSIS

This course establishes properties of the basic partial differential equations (PDEs) that arise commonly in applications such as the heat equation, the wave equation and Laplace's equation. It also develops the mathematical tools of Fourier transforms and special functions necessary to analyse such PDEs. The theory of infinite series is used to introduce special functions for solutions of ODEs and the general Sturm-Louiville theory. These methods are implemented in computer algebra. A modelling part introduces the use of partial differential equations to mathematically model the dynamics of cars, gases and blood. The analysis is based upon conservation principles, and also emphasises mathematical and physical interpretation. This course is offered only in even numbered years.

OBJECTIVES

On completion of this course students will be able to:

- use Fourier analysis to approximate periodic functions and to help solve differentail equations;
- classify partial differential equations;
- use separation of variables to solve basic partial differential equations;
- construct speical functions needed to understand differential equations;
- work with infinite series in one or many dimensions;
- investigate the convergence of a Taylor series;
- find approximate power series solutions of differential equations;
- use computer packages to perform tedious algebraic manipulations;
- appreciate the properites of the families of special functions engendered from differential equations;
- use conservation principles to mathematically model one-dimensional dynamics of car traffic, gas and blood flow.

TOPICS

Description	Weighting (%)
1. Fourier Analysis: Fourier series for functions with arbitrary period; half-range expansions; Fourier integrals; approximation by eigenfunction expansions; computer algebra; evaluates integrals.	16.00
2. Classify Partial Differential Equations: PDE's model physical systems; the wave equation; the heat equation; Laplace's equation; classification of PDE's; waves on a membrane.	16.00
3. Series Solutions of Differential Equations: power series, radius and interval of convergence; Power series method leads to Legendre polynomials; Frobenius methods is needed for Bessel functions; orthogonal solutions to second order differential equations; orthogonal eigenfucntion expansions; computer algebra for repetitive tasks.	20.00
4. Methods for PDEs: circular membranes and Bessel functions; Laplacian in polar and spherical coordinates.	16.00
5. Describing the conservation of material: the motion of a continuum, Eulerian description, the material derivative, conservation of material, car traffic & nonlinear characteristics.	18.00
6. Dynamics of momentum: conservation of momentum, sound in ideal gases, dynamics of quasi-one-dimensional blood flow.	14.00

TEXT and MATERIALS required to be PURCHASED or ACCESSED:

Books can be ordered by fax or telephone. For costs and further details use the 'Book Search' facility at http://bookshop.usq.edu.au by entering the author or title of the text.

Study package (purchased from the Bookshop).

access to computer or internet facilities for computer algebra.

Kreyszig, E. 1999, *Advanced Engineering Mathematics*, 8th edition, Wiley, Roberts, A.J. 1994, *A one-dimensional introduction to continuum mechanics,*

REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

Mathematics and Computing CDROM Set, S1, 2003, Dept Maths & Computing, University of Southern Queensland (purchased from the USQ Bookshop).

' ' (Available:) .

(Some electronic resources for this course may be available via its home page: http://www.sci.usq.edu.au/courses/mat3105)

Haberman, R. 1987, *Elementary applied partial differential equations*, Prentice-Hall,

Highham, N.J. 1998, *Handbook of writing for the mathematical sciences*, 2nd edition, SIAM,

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	30
Examinations	3
Lectures	48
Private Study	65
Workshops	24

ASSESSMENT DETAILS

Description	Marks Out of	Wtg(%)	Required	Due Date
ASSIGNMENT 1	9.00	9.00	Y	04 Mar 2003 (see note)
ASSIGNMENT 2	9.00	9.00	Y	04 Mar 2003 (see note)
ASSIGNMENT 3	9.00	9.00	Y	04 Mar 2003 (see note)
HOMEWORK	9.00	9.00	Y	04 Mar 2003 (see note)
EXAM 3 HOUR RESTRICTED	64.00	64.00	Y	END S1 (see note)

NOTES:

. Further details about the due dates will be advised by the Examiner.

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- Examination dates will be available during the Semester. Please refer to Examination timetable when published.