The University of Southern Queensland

Course Specification

Description: Applied Mathematics						
Subject	Cat-Nbr	Class	Term	Mode	Units	Campus
MAT	2101	10385	1, 2002	ONC	1.00	TWMBA

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

STAFFING

Examiner: Tony Roberts
Moderator: Bruce Meakins

PRE-REQUISITES

Pre-requisite: MAT 2100

RATIONALE

This course develops methods of algebra and calculus needed to apply mathematics in general situations. Differential equations and an understanding of their qualitative behaviour provide a structure for the analysis of wide ranging problems. The concepts are used in the application of conservation principles in mechanics enable the modelling of physical problems as differential equations. Infinite series are fundamental in the derivation of approximate solutions. The algebra of vector spaces and eigenvalues underlies the decomposition of problems into simpler parts. Developing technical communication is also essential as preparation for the workplace.

SYNOPSIS

This course is broadly divided into two interrelated parts. A part on the differential modelling introduces basic dynamical systems theory which lays the foundation for chaos. It also leads onto the use of 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. The second part develops the theory of infinite series which then is used to introduce special functions for solutions of ODEs and the general Sturm-Liouville theory. These are then placed the basic structure of abstract vector spaces and linear transformations to be able to solve linear problems in a convenient basis. Throughout the course basics of technical communication are taught.

OBJECTIVES

On successful completion of this course students will be able to:

- solve many linear differential equations;
- analyse the dynamics of systems of differential equations to determine stability, sketch phase portraits, and draw qualitative conclusions;
- use conservation principles to mathematically model one- dimensional dynamics of car traffic, gas and blood flow;
- work with Taylor and infinite series in one or many variables;
- find approximate power series solutions of differential equations;
- appreciate the properties of families of special functions engendered from differential equations;
- investigate general vector spaces and solve problems by an eigenvector decomposition;
- [D only] structure, prepare and deliver small documents and presentations of technical material. [X only] structure, prepare and deliver small documents of technical material.

TOPICS

Description	Weighting (%)
1. In the following, citations in [] refer to relevant section numbers in the text: K=Kreyszig, 8th ed; R=Roberts, "+" denotes some supplementary material.	0.00
2. Systems of differential equations: The solution of linear DE's, the conversion of higher- order linear DE's to first-order systems [K3.1-2]; fixed points and phase portraits, especially in 2-D [K3.3-4+]; qualitative solution of nonlinear, first-order DE's, especially in the region of fixed points [K3.5+].	16.00
3. Describing the conservation of material: The motion of a continuum [R1.1-2], Eulerian description [R1.3], the material derivative [R1.4], conservation of material [R2.1], car traffic & nonlinear characteristics [R2.2].	18.00
4. Dynamics of momentum: Conservation of momentum [R3.1], sound in ideal gases [R3.2], dynamics of quasi-one-dimensional blood flow [R5.1-2].	14.00
5. Infinite Series: Tests for convergence, absolute and conditional convergence [K14.1]; power series, radius and interval of convergence [K4.2,K14.2]; Taylor series and truncation error [+]; {n}-dimensional Taylor's theorem [+].	14.00
6. Series Solutions of Differential Equations: Power series method leads to Legendre polynomials [K4.1- 3]; Frobenius method is needed for Bessel functions [K4.4- 5]; orthogonal solutions to second order differential equations [K4.7]; computer algebra for repetitive tasks [+].	18.00
7. Inner product spaces & eigenanalysis: Inner product spaces and the nature of linear transformations [K6.8], adjoint [+], revision of eigenproblems [K7.1-2], diagonalisation transformation, adjoint eigenvectors, orthogonal	20.00

diagonalisation, invariant spaces and Jordan form [K7.5], orthogonal eigenfunction expansions [K4.8].

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.

Access to computer or internet facilities for computer algebra and mathematical typesetting.

Kreyszig, E., 1999 *Advanced Engineering Mathematics*, 8th edn, Wiley, NY.

Roberts, A.J., 1994 *A One-Dimensional Introduction to Continuum Mechanics*, World Sci., Singapore.

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.

USQ Mathematics and Computing CD-ROM Set 1 (course material), S1, 2002, Department of Mathematics and Computing, University of Southern Queensland (Purchased from the USQ Bookshop).

Some electronic resources for this unit may be available via its home page: http://www.sci.usq.edu.au/courses/MAT2101

Anton, H. & Rorres, C., 1994 *Elementary linear algebra (applications version)*, 7th edn, Wiley, NY.

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

Noble B. & Daniel, J.W., 1988 *Applied linear algebra*, 3rd edn, Prentice-Hall, Englewood Cliffs.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	40
Examinations	3
Lectures	52
Private Study	62
Tutorial	13

ASSESSMENT DETAILS

Description	Marks Out of	Wtg(%)	Required	Due Date
ASSIGNMENT 1	6.00	6.00	Y	04 Mar 2002 (see note 1)
ASSIGNMENT 2	6.00	6.00	Y	04 Mar 2002 (see note 2)
ASSIGNMENT 3	6.00	6.00	Y	04 Mar 2002 (see note 3)
HOMEWORK	6.00	6.00	Y	04 Mar 2002
3 HOUR RESTRICTED EXAMINATION	76.00	76.00	Y	END S1 (see note 5)

NOTES:

1. Further details about the due dates are detailed in the assessment section of the Course Specifications.
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5. Examination dates will be available during the Semester. Please refer to Examination timetable when published.

OTHER REQUIREMENTS

1 Each assignment will contain at least one question whose answer is to be typeset using LaTeX: the answer will not only be assessed mathematically, but also on the English expression and the demonstrated LaTeX typesetting.

2 [D only] Students will be required, as part of the Homework assessment, to make a number of short presentations on technical material studied in the course.

3 It is the student's responsibility to participate in classes, if a D student, or to study all materials sent, if an X student, to ensure the best chance to meet the objectives of the course and to be informed of course-related activities and administration.

4 To be certain of obtaining a passing grade in this course, students must : (a) obtain an overall mark of at least 50%; (b) obtain at least 50% in the examination(s); and (c) obtain at least 50% in the assignments as a whole.

5 If a student obtains an overall passing mark, but does not gain 50% of the mark in an examination, the student may, at the discretion of the examiner, be granted a supplementary examination.

6 A student will normally not be granted a deferred examination unless he/she gains 50% of the marks available in each of the other components of the assessment.

7 A final grade will be allocated as follows: raw marks for the assessments will be summed with weightings specified in the Assessment Details; performance demonstrated in the examination will be reviewed with reference to the course's objectives and a scaling decided; the scaled marks then determine the final grade.

8 Any supplementary or deferred examinations for this course will normally be held at the end of the semester of the next offering of this course.

9 The due date for assessments is the date by which a student must dispatch an assignment to the USQ. The onus is on the student to provide proof of the dispatch date, if requested by the Examiner.

10 Students must retain a copy of all assignments which must be produced within five days if and when required by the Examiner.

11 In accordance with the University's Policy on Assignments (Regulation 5.6.1), the examiner of a course may grant an extension of the due date of an assignment in extenuating circumstances. This policy may be found in the USQ Handbook, the Distance Education Student Guide and the Faculty of Sciences' Orientation Handbook for on-campus students. All students are advised to study and follow the guidelines associated with this policy. An assignment, submitted after the due date without an extension approved by the examiner, will attract a penalty of 20 percent of the assigned mark for each working day (or part thereof) that the assignment is late.

12 Restricted Examination: only specific materials may be brought into a restricted examination. The only materials that students may bring into the examination room and use in the restricted examination are normally: (a) writing materials (non-electronic and free from material which could give the student an unfair advantage in the examination); (b) calculators which cannot hold textual information (students must indicate on their examination paper the make and model of any calculator(s) they use during the examination).

13 Students should be aware that the University has policies and regulations about the use of unfair means and electronic devices in an examination and they should refer to them to determine whether or not actions they intend to take are acceptable to the University.
