The University of Southern Queensland

Course Specification

Description: Advanced Engineering Mathematics A						
Subject	Cat-Nbr	Class	Term	Mode	Units	Campus
MAT	3102	14400	2, 2002	ONC	1.00	TWMBA

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

STAFFING

Examiner: Patricia Cretchley
Moderator: Sergey Suslov

PRE-REQUISITES

Pre-requisite: STA 2300 and CSC 2403

RATIONALE

Engineers involved in model construction and analysis, simulation and computation, require a wide range of skills. This course addresses the following areas of fundamental importance to engineering and science: the modelling and analysis of random processes in applications like queuing, Markov chains and birth/death processes; applications of time series, and techniques for forecasting; recognizing real life problems such as image compression and reconstruction, and the extraction of essential information from noisy data sets, as problems which are solvable using techniques such as singular value decomposition; the numerical solution of equations modelling heat and fluid flow, chemical transport, wave propagation, electrical and mechanical applications etc. using finite difference techniques; and multigrid, finite element and weighted residual methods for partial differential equations generally, that arise in science and engineering.

SYNOPSIS

This course comprises five modules. Each student must complete modules 1, 2, and 3, and either module 4 or module 5. The modules are: 1 the numerical solution of partial differential equations. 2 the modelling of random processes: queues, multi-state devices and birth/death systems. 3 time series analysis and forecasting. 4 geometric insight into high dimensional engineering problems. 5 numerical methods in engineering and science: multigrid and finite element methods.

OBJECTIVES

To develop an awareness of the way in which mathematics is used to solve engineering problems. To gain a proficiency in applying mathematics to engineering problems. The following specific objectives relate to individual numbered parts; students should be able to:

- form discrete formulations of elliptic, parabolic and hyperbolic partial differential equations and solve them computationally; apply numerical techniques to the modelling and solution of problems in engineering;
- understand random processes of various types including discrete time Markov chains, the Poisson process and birth/death process; apply Markov queue techniques engineering problems;
- demonstrate understanding and application of various time series and forecasting techniques;
- view as geometric vector transformations large scale engineering processes such as image compression and recognition, filtering and Fourier transformation;
- understand and use multigrid, finite element and weighted residual methods.

TOPICS

Description	Weighting (%)
1. Students will study Topics 1, 2 and 3 and their own choice of one of Topics 4 and 5: Topic 5 has a lot to offer Civil and Mechanical Engineers; whereas Topic 4 is particularly valuable to Electrical Engineers. It supports the analysis typically needed in Mechatronics and Control. Topic 1 Numerical Partial Differential Equations - the Poisson equation - iterative methods - boundary conditions - parabolic and hyperbolic systems, stability of numerical	25.00
2. Topic 2 Stochastic Processes Modelling - discrete time Markov chains - the Poisson process - birth and death processes - Markov queues and applications	25.00
3. Topic 3 Time Series and Forecasting - nonstationary models (ARIMA) - model identification - Box Jenkins forecasting methods - z transforms - applications	25.00
4. Topic 4 Geometric Approach to High Dimensional Engineering Problems 25% - the rogues gallery problem - principal components and singular value decomposition - image classification, reconstruction and compression - vectors spaces - Fourier series, DFT, convolution, avoiding noise OR Topic 5 Advanced Numerical Methods 25% - multigrid methods for PDE's - finite element methods - weighted residuals	25.00

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.

Department of Mathematics and Computing CDROM SET 1, S2, 2002 (available from the USQ Bookshop). This CD set contains course material, Windows and Linux Software for this and various other courses. For more information about the CD sets and their use, please refer to http://www.sci.usq.edu.au/cdrom.

Introductory Book 2002, *Course MAT3102 Advanced Engineering Mathematics A*, USQ Distance Education Centre, Toowoomba.

Study Books I and II 2002, *Course MAT3102 Advanced Engineering Mathematics A*, USQ Distance Education Centre, Toowoomba.

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.

2002, 'Mathematics and Computing CD-ROM Set, S2' (Available: Department of Mathematics & Computing, University of Southern Queensland (purchased from the Bookshop).) .

Some electronic resources for this course may be available via its home page: http://www.sci.usq.edu.au/courses/MAT3102

Box, G.E.P. & Jenkins, G.M. 1976, *Time Series Analysis Forecasting and Control*, Holden Day, San Francisco.

Greenberg, M.D. 1998, *Advanced Engineering Mathematics*, Prentice Hall, Upper Saddle River.

Jain, P.K., Ahuja, O.P. & Ahmed, K 1995, *Functional Analysis*, John Wiley & Sons, New York.

Kreyszig, E 1999, *Advanced Engineering Mathematics*, 8th edition, Wiley, New York.

Makridakis, S. & Wheelwright, S.C. 1989, *Forecasting Methods for Management*, 5th edition, Wiley & Sons.

Mehdi, J. 1994, *Stochastic Processes*, John Wiley & Sons, New York.

Naylor, A.W. & Sell, G.R. 1971, *Linear Operator Theory in Engineering and Science*, Holt, Rinehart and Winston, New York.

Oden, J.T. & Demkowicz, L.S. 1979, *Applied Functional Analysis*, CRC, Boca Raton.

Papoulis, A. 1991, *Probability, Random Variables and Stochastic Processes*, McGraw Hill, New York.

Solomon, F. 1987, *Probability and Stochastic Processes*, Prentice Hall, Englewood Cliffs.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	25
Directed Study	75
Examinations	3
Private Study	66

ASSESSMENT DETAILS

Description	Marks Out of	Wtg(%)	Required	Due Date
ASSIGNMENT 1	10.00	10.00	Y	30 Aug 2002
ASSIGNMENT 2	10.00	10.00	Y	13 Sep 2002
ASSIGNMENT 3	10.00	10.00	Y	25 Oct 2002
ASSIGNMENT 4	10.00	10.00	Y	25 Oct 2002
3 HOUR OPEN EXAMINATION	60.00	60.00	Y	END S2 (see note 5)

NOTES:

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

OTHER REQUIREMENTS

1 Attendance: It is the student's responsibility to participate actively in all classes scheduled for them, and to study all materials provided to them or required to be accessed by them to maximise their chance of meeting the objectives of the course and to be informed of course-related activities and administration.

2 Minimum Requirements to Pass the Course: To be assured of a pass in the course, students must: (a) obtain an overall mark of at least 50%; (b) obtain at least 50% in the examination(s); and (c) attain at least 50% in the assignments as a whole.

3 Grading: Final grades for students will be determined by the addition of the marks obtained in each assessment item, weighted as in the Assessment Details.

4 Assignments: The due date for an assignment is the date by which a student must despatch it to USQ. The onus is on the student to provide proof of the despatch date, if requested by the examiner. Students must retain a copy of all assignments which must be produced within five days if and when required by the examiner. In accordance with University's Assignment Extension Policy (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 Study 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.

5 Supplementary and Deferred Examinations: If a student obtains an overall passing mark, but does not perform satisfactorily in an examination, the student may, at the discretion of the examiner, be granted a supplementary examination. A student will normally not be granted a deferred examination unless he/she performs satisfactorily in the other components of the assessment. 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.

6 Examinations: Open Examination: an open examination indicates that the candidate may have access to any material during the examination except the following: electronic communication devices, bulky material, devices requiring mains power and anything likely to disturb other students.
