



The University of Southern Queensland

## Course Specification

### Description: Advanced Engineering Mathematics A

Subject	Cat-Nbr	Class	Term	Mode	Units	Campus
MAT	3102	24401	2, 2003	ONC	1.00	TWMBA

<b>Academic Group:</b>	FOSCI
<b>Academic Org:</b>	FOS003
<b>HECS Band:</b>	2
<b>ASCED Code:</b>	010101

### STAFFING

Examiner: Sergey Suslov  
Moderator: Chris Harman

### PRE-REQUISITES

Pre-requisite: STA2300 and CSC2403 or ENG3103 or ENG4104

### 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 to 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.	25.00
1.1. Topic 1 Numerical Partial Differential Equations - the Poisson equation - iterative methods - boundary conditions - parabolic and hyperbolic systems, stability of numerical methods	
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	25.00
4.1. Topic 5 Advanced Numerical Methods 25% - multigrid methods for PDE's - finite element methods - weighted residuals	

### **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 2003, *Course MAT3102 Advanced Engineering Mathematics A*, USQ Distance Education Centre, Toowoomba.

Study Books I and II 2003, *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.

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. & Reinsel, G.C. 1994, *Time Series Analysis Forecasting and Control*, 3rd edition, Prentice Hall, Englewood Cliffs, New Jersey.

Greenberg, M.D. 1998, *Advanced Engineering Mathematics*, 2nd edition, 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, New York.

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. 1996, *Applied Functional Analysis*, CRC, Boca Raton,

Papoulis, A. 1991, *Probability, Random Variables and Stochastic Processes*, 3rd edition, 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	29 Aug 2003
ASSIGNMENT 2	10.00	10.00	Y	12 Sep 2003
ASSIGNMENT 3	10.00	10.00	Y	24 Oct 2003
ASSIGNMENT 4	10.00	10.00	Y	24 Oct 2003
3 HOUR OPEN EXAMINATION	60.00	60.00	Y	END S2 (see note )

### NOTES:

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

## IMPORTANT ASSESSMENT INFORMATION

- Attendance requirements:**  
It is the students' responsibility to attend and participate appropriately in all activities (such as lectures, tutorials, laboratories and practical work) scheduled for them, and to study all material 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.
- Requirements for students to complete each assessment item satisfactorily:**  
To complete each of the assessment items satisfactorily, students must obtain at least 50% of the marks available for each assessment item.
- Penalties for late submission of required work:**  
If students submit assignments after the due date without prior approval then a penalty of 20% of the total marks gained by the student for the assignment will apply for each working day late.
- Requirements for student to be awarded a passing grade in the course:**  
To be assured of receiving a passing grade a student must attempt all of the summative assessment items, achieve at least 50% in the examination, achieve an aggregated mark of at least 50% in the total marks allocated for the assignments, and at least 50% of the available weighted marks for the summative assessment items.
- Method used to combine assessment results to attain final grade:**  
The final grades for students will be assigned on the basis of the aggregate of the weighted marks obtained for each of the summative assessment items in the course.
- Examination information:**  
In an Open Examination, candidates may have access to any material during the examination except the following: electronic communication devices, bulky materials, devices requiring mains power and material likely to disturb other students
- Examination period when Deferred/Supplementary examinations will be held:**  
Any Deferred or Supplementary examinations for this course will be held during the next examination period.

8 University Regulations:

Students should read USQ Regulations 5.1 Definitions, 5.6. Assessment, and 5.10 Academic Misconduct for further information and to avoid actions which might contravene University Regulations. These regulations can be found at the URL <http://www.usq.edu.au/SECARIAT/calendar/Part5/> or in the printed version of the current USQ Handbook.

## **ASSESSMENT NOTES**

- 9 Students must retain a copy of each item submitted for assessment. If requested, students will be required to provide a copy of assignments submitted for assessment purposes. Such copies should be despatched to USQ within 24 hours of receipt of a request being made. The due date for an assignment is the date by which a student must despatch the assignment to the USQ. The onus is on the student to provide proof of the despatch date, if requested by the Examiner. The examiner may grant an extension of the due date of an assignment in extenuating circumstances. The Faculty will normally only accept assessments that have been written, typed or printed on paper-based media. The Faculty will NOT accept submission of assignments by facsimile. Students who, for medical, family/personal, or employment-related reasons, are unable to complete an assignment or to sit for an examination at the scheduled time may apply to defer an assessment in a course. Such a request must be accompanied by appropriate supporting documentation. One of the following temporary grades may be awarded IDS (Incomplete - Deferred Examination; IDM (Incomplete Deferred Make-up); IDB (Incomplete - Both Deferred Examination and Deferred Make-up).