The University of Southern Queensland

Course Specification

Description: Mathematical Modelling						
Subject	Cat-Nbr	Class	Term	Mode	Units	Campus
MAT	3101	21250	1, 2003	EXT	1.00	TWMBA

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

STAFFING

Examiner: Dmitry Strunin
Moderator: Sergey Suslov

PRE-REQUISITES

Pre-requisite: MAT2102 or USQ64622 and MAT2100

RATIONALE

Mathematical modelling is a process of fundamental importance to the practising mathematician. This course uses the mathematical tools developed in the Program so far and introduces dimensional analysis and similarity solutions. It continues the development of continuum modelling to viscous fluid flow as these are of common importance in industrial problems.

SYNOPSIS

This course is broadly divided into two interrelated strands. One strand, on modelling in general, uses mathematical tools developed so far to model a variety of situations. It also introduces the important topics of dimensional analysis and similarity solutions. The other strand further develops the modelling of fluid dynamics by presenting basic Newtonian viscous fluid flow. Applications to slow flows and to similarity solutions in fast flows are also developed. Many flow demonstrations are presented and analysed mathematically.

OBJECTIVES

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

- demonstrate an understanding of the process of mathematical modelling applied to a wide range of problems and using mathematical content from previous studies;
- demonstrate the ability to apply the modelling process to real-life problems;

- use and demonstrate an understanding of the Navier-Stokes equations describing fluid flow;
- mathematically analyse and interpret fluid flows involving thin films, viscous flows around bodies, or boundary layers.

TOPICS

Description	Weighting (%)
1. Catastrophe theory: Potentials, Bifurcation, Catastrophe	10.00
2. Dimensions: Scaling, Dimensional Analysis	10.00
3. Growth and Relaxation: Exponential growth and decay, Autoregulation	10.00
4. Aspects of the following topics will be covered: Free Vibrations, Mechanical Vibrations, Nonlinear Oscillations, Coupled Oscillators, Forced Vibrations, Linear and Nonlinear Response, Resonance	20.00
5. Inviscid Fluid Flow: Review of the Continuity and Euler Equations, Stream Function, Complex Potential, Water Waves	10.00
6. Mathematical Modelling of Viscous Flow: Viscosity, Navier-Stokes Equations, Non-dimensionalisation, Vorticity, Some Exact Solutions.	10.00
7. Boundary Layers in Fast Flow: Asymptotics, Flat Plates, Wakes & Jets	10.00
8. Slow Flow: Low Reynolds Number, Flow Past Sphere, Lubrication, Thin Films	20.00

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.

Ockendon, H. & Ockendon, J.R 1995, *Viscous flow*, CUP, Cambridge.

Svobodny, T 1998, *Mathematical Modeling for Industry and Engineering*, Prentice Hall, Upper Saddle River, NJ.

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.

Flow Visualisation, Britannica Education Services, Castle Hill, NSW, Australia.

(Recommended video recordings)

Fluid Dynamics of Drag: Part II, Britannica Education Services, Castle Hill, NSW, Australia.

(Recommended video recordings)

1987, *Fundamentals of Boundary Layers*, Encyclopedia Britannica Educational Corporation, Artarmon, NSW, Australia.

(Recommended video recordings)

Low Reynolds Number Flow, Britannica Cassettes, England.

(Recommended video recordings)

UMAP Modules (Undergraduate mathematics and its applications project), COMAP, USA.

' ' (Available:) .

(Some electronic resources for this course may be available via its home page: http://www.sci.usq.edu.au/courses/MAT3101.)

Barker, Andrew (producer) 1985, *Engineering Mechanics: solids and fluids*, BBC TV Production for the Open University,

(Recommended video recordings)

Fowkes, N.D. & Mahony, J.J 1994, 'An Introduction to Mathematical Modelling' (Available:) .

Giordano, F.R. & Weir, M.D 1997, *A First Course in Mathematical Modelling*, 2nd edition, Brooke/Cole, Pacific Grove, CA.

Hughes, W.F. & Brighton, J.A 1999, *Schaum's Outline of Theory and Problems of Fluid Dynamics*, 3rd edition, McGraw-Hill, New York.

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

National Committee for Fluid Mechanics Films 1963, *Pressure Fields and Fluid Acceleration*, Encyclopedia Britannica Educational Corporation, Castle Hill, NSW, Australia.

(Recommended video recordings)

Schlichting, H 1979, *Boundary-layer theory*, 7th edition, McGraw-Hill, New York.

Van Dyke, M 1982, *An Album of Fluid Motion*, The Parabolic Press, Stanford, California.

White, F.M 1994, *Fluid Mechanics*, 3rd edition, McGraw-Hill, New York.

STUDENT WORKLOAD REQUIREMENTS

ACTIVITY	HOURS
Assessment	45
Examinations	3
Private Study	127

ASSESSMENT DETAILS

Description	Marks Out of	Wtg(%)	Required	Due Date
STRAND 1, HOMEWORK	100.00	5.00	Y	04 Mar 2003 (see note)
STRAND 2, HOMEWORK	171.00	15.00	Y	04 Mar 2003 (see note)
STRAND 1, 2 ASSIGNMENT 1	200.00	30.00	Y	04 Apr 2003
STRAND 1, ASSIGNMENT 2	100.00	15.00	Y	09 May 2003
STRAND 1, ASSIGNMENT 3	100.00	15.00	Y	30 May 2003
3HR OPEN EXAM	100.00	20.00	Y	END S1 (see note)

NOTES:

. Further details about the due dates are given in the Study Schedule of the Introductory Book.

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

IMPORTANT ASSESSMENT INFORMATION

1 Attendance requirements:
There are no attendance requirements for this course. However, it is the students' responsibility 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. If external students can make it to the lectures they are most welcome to do so.

2 Requirements for students to complete each assessment item satisfactorily:
To complete each of the assignments satisfactorily, students must obtain at least 50% of the marks available for each assignment and homework. To complete the examination satisfactorily, students must obtain at least 50% of the marks available for the examination.

3 Penalties for late submission of required work:
An assignment submitted after the due date without an extension approved by the examiner, will attract a penalty of 20% of the assigned mark for each day (or part thereof) that the assignment is late. The course assessment includes weekly homework.

4 Requirements for student to be awarded a passing grade in the course:
To be assured of a passing grade in this course, students must satisfactorily complete each assessment item.

5 Method used to combine assessment results to attain final grade:
Final grades for students will be determined by the addition of the marks obtained in each assessment item, weighted as in the Assessment Details.

6 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.

7 Examination period when Deferred/Supplementary examinations will be held:
Students who obtain an overall passing mark, but who do not perform satisfactorily in an examination, may, at the discretion of the examiner, be granted a supplementary examination. Students will be granted a deferred examination only if they perform satisfactorily in all other assessment items. Any supplementary or deferred examinations for this course will be held during the examination period at the end of the semester of the next offering of this course.

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.

OTHER REQUIREMENTS

1 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. Students must retain a copy of each item submitted for assessment. This must be produced within five days if 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.