USC

Course Outline

Code: MTH381
Title: Applied Systems Modelling

School: Science and Engineering
Teaching Session: Semester 1
Year: 2020
Course Coordinator: Dr Aaron Wiegand Email: awiegand@usc.edu.au
Course Moderator: Dr Neil Tindale

Please go to the USC website for up to date information on the teaching sessions and campuses where this course is usually offered

1. What is this course about?

1.1 Description

This course will introduce you to key concepts and techniques that are needed for the development and use of computer models for the simulation of dynamic systems. The model development process is illustrated using a selection of environmental and engineering systems. Mathematical thinking, tools and techniques, as used in the development, validation and application of models, are also taught. By applying a systems modelling approach to a variety of case-studies, you will acquire the theoretical knowledge and practical skills required to simulate real-world dynamic systems.

1.2 Field trips, WIL placements or activities required by professional accreditation

Activity	Details
N/A	N/A

2. What level is this course?

300 level Graduate - Independent application of graduate knowledge and skills. Meets AQF and professional requirements. May require pre-requisites and developing level knowledge/skills. Normally taken in the 3rd or 4th year of an undergraduate program

3. What is the unit value of this course?

12 units

4. How does this course contribute to my learning?

Specific Learning Outcomes On successful completion of this course, you should be able to:	**Assessment tasks** You will be assessed on the learning outcomes in task/s:	**Graduate Qualities or Professional Standards mapping** Completing these tasks successfully will contribute to you becoming:
"Translate" a description of a dynamic system and associated data into a computational model for that system.	2: Model Creation 3: Practical Exam	Creative and critical thinkers. Empowered.
Assess the qualitative and quantitative validity of models, with respect to their intended purpose.	1: Model Validation 2: Model Creation 3: Practical Exam 4: Theory Exam	Creative and critical thinkers. Empowered.
Recall, explain and apply relevant theory, tools and techniques of mathematical systems modelling	1: Model Validation 2: Model Creation 3: Practical Exam 4: Theory Exam	Knowledgeable. Empowered.
Communicate concepts and techniques relevant to mathematical systems modelling, both verbally and using written English, with appropriate mathematical notations.	1: Model Validation 2: Model Creation 3: Practical Exam 4: Theory Exam	Knowledgeable. Empowered.

5. Am I eligible to enrol in this course?

Refer to the USC Glossary of terms for definitions of "pre-requisites, co-requisites and anti-requisites".

5.1 Enrolment restrictions

Nil

5.2 Pre-requisites

MTH202 or MTH104

5.3 Co-requisites

Nil

5.4 Anti-requisites

ENS381

5.5 Specific assumed prior knowledge and skills (where applicable)

Differential and Integral Calculus as per MTH202 or MTH104 prerequisite, especially methods for the solution of first-order Ordinary Differential Equations; Ability to use spread-sheets (such as Excel) effectively.

6. How am I going to be assessed?

6.1 Grading scale

Standard – High Distinction (HD), Distinction (DN), Credit (CR), Pass (PS), Fail (FL)

6.2 Details of early feedback on progress

The first four weeks lay foundations for later material and is not suitable for early assessment. However, students will be able to judge the progress of their learning through their development of knowledge, understanding and skill in the computer workshops, which are very hands-on and interactive.

6.3 Assessment tasks

Task No.	Assessment Product	Individual or Group	Weighting	What is the duration / length?	When should I submit?	Where should I submit it?
1	Model Validation Exercise	Individual	15 %	60 minutes	Week 5 computer workshop	In Class
2	Model Creation and Use	Group	25 %	- 15 min presentation & questions - Briefing notes (2 pages) - computer model	- Issued Wk 4 - Due Wk 11	In Class
3	Practical Exam	Individual	20%	90 min	Wk 12 computer workshop.	In Class
4	Theory Exam	Individual	40 %	90 min	Wk 13 Lecture.	In Class

Assessment Task 1: Model Validation Exercise

Goal:	This task will give you an opportunity to develop and demonstrate your growing skills in model use and to provide critical evaluation of a model's performance. You will apply, interpret and communicate quantitative validation techniques to justify your conclusions regarding the validity of a model.
Product:	In-class practical exercise with a summary report, written entirely in the computer workshop.
Format:	Hardcopy (paper) submission to the class tutor. **Full specifications for the task and how it will be evaluated will be provided on Blackboard by the end of week 3.**
Criteria:	• Correct use of the provided model. • Correct use of appropriate quantitative analysis methods. • Completeness and quality of the validation process. • Clarity of the reasoning and discussion, that leads to a conclusion. • General presentation and communication (language, spelling, conciseness). A comprehensive description of the requirements and criteria, against which this assessment item will be evaluated, will be provided .

Generic skill assessed	**Skill assessment level**
Applying technologies	Developing
Communication	Developing

Assessment Task 2: Model Creation and Use

Goal:	To develop, in a team, marketable skills in the design, creation, validation and communication of a computer model of a complex dynamic system(s), and to use the model to answer a specific question or explore a case study. This task will also require you to demonstrate graduate level communication skills that are concise, informative and professional.
Product:	A computer model of a complex dynamic system, a formal presentation, and a briefing document.
Format:	• Group presentation, with opportunity to answer questions • Electronic copy of the model to be sent to the course coordinator • Hardcopy (paper) submission of briefing document to the course coordinator. Standard FoSHEE assignment coversheet, signed by all group members. **Full specifications for the model, the presentation, and the briefing document will be provided on Blackboard.**
Criteria:	• Evidence of review of the literature for any models that already exist. • Appropriate model development and model structure for the selected dynamic system • Appropriate model validation • Appropriate use of the model to answer the stated problem, or case study. • Group presentation as per detailed specifications provided on Blackboard • Briefing document structure and content as per detailed specifications provided on Blackboard • General presentation and communication (layout, language, spelling, conciseness, delivery). A comprehensive description of the requirements and criteria, against which the model, presentation and briefing document will be assessed, will be provided at the time that this assessment item is issued. **Please note:** The course coordinator reserves the right to adjudicate in the event that there is disagreement within group members regarding individual contributions and equitable distribution of marks. However, it is the responsibility of individual members to identify such problems at an early stage and inform the course coordinator in a timely manner so that appropriate remedial action may be taken.

Generic skill assessed	**Skill assessment level**
Problem solving	Graduate
Applying technologies	Graduate
Communication	Graduate

Assessment Task 3: Practical Examination

Goal:	The end of semester practical examination gives you an opportunity to demonstrate your knowledge, understanding and skills associated with all the learning outcomes of this course. You will **apply** modelling theory, tools and techniques as presented in this course.
Product:	Exam, to be run in a computer laboratory. Student results and responses will be typed into a template word document by the student, and saved by the tutor.
Format:	Individual Practical modelling tasks .
Criteria:	Students will be assessed on their ability to: • recall and apply the theoretical and practical components of the course materials covered in both the lectures, tutorials and readings from weeks 1-12 • apply the theory to particular examples • derive modelling solutions to particular problems • create simple models of described dynamic systems • evaluate examples of poor modelling practice

Generic skill assessed	**Skill assessment level**
Problem solving	Graduate
Information literacy	Graduate

Assessment Task 4: Theory Examination

Goal:	The end of semester theory examination gives you an opportunity to demonstrate your knowledge, understanding and skills associated with all the learning outcomes of this course. You will describe and apply modelling theory and techniques as presented in this course.
Product:	Exam (written)
Format:	Individual Theoretical written questions (Week 13 Lecture). Practical modelling tasks (Week 13 Computer Workshop)
Criteria:	Students will be assessed on their ability to: • recall the theoretical and practical components of the course materials covered in both the lectures, tutorials and readings from weeks 1-12 • apply the theory to particular examples • derive solutions to particular problems • create simple models of described dynamic systems

Generic skill assessed	**Skill assessment level**
Problem solving	Graduate
Information literacy	Graduate

7. Directed study hours

The directed study hours listed here are a portion of the workload for this course. A 12-unit course will have total of 150 learning hours which will include directed study hours (including online if required), self-directed learning and completion of assessable tasks. Directed study hours may vary by location. Student workload is calculated at 12.5 learning hours per one unit.

Location:	**Directed study hours for location:**
USC Sunshine Coast	2 hours lecture per week 2 hours computer workshop per week

7.1 Course content

Teaching Week / Module	What key concepts/content will I learn?	What activities will I engage in to learn the concepts/content?	
		Directed Study Activities	**Independent Study Activities**
1	Introduction to dynamic systems and mathematical modelling. Types of models. Introduction to STELLA notation.	L: Lecture. CW: Computer workshop.	Read STELLA help files and in-built tutorials
2	Introduction to systems thinking. Quantitative validation of dynamic models.	L CW	Practice with STELLA & Excel.
3	Model development and reporting. Empirical data: sources, problems and validation. Sensitivity analysis of a model.	L CW	Practice with STELLA & Excel.
4	Generation of first and second order DEs. Steady state (Equilibrium). Introduction to Numerical Integration. Common patterns of model behaviour.	L CW	General reading. Practice with STELLA & Excel.
5	System 1: Simple population dynamics. • reason: feedback; carrying capacity System 2: Predator-Prey Systems. • reason: linking systems	L **CW: Assessment item 1 - Model use and validation (test)**	General reading. Group assignment.
6	System 3: Air pollutant emissions from vehicles. • reason: cohort models	L CW	General reading. Group assignment.
7	System 4: Infectious diseases. • reason: cyclic model; use of probability Miscellaneous Mathematical techniques • 2-D Interpolation (linear, $1/r^2$)	L CW	General reading. Group assignment.
8	Estimation (L). Coupled DEs (chaotic systems) (CW).	L CW	General reading. Group assignment.
9	Randomness and Probability. The Monte-Carlo modelling approach. Markov chains.	L CW	General reading. Group assignment.
10	Public speaking and professional communication.	L only (No CW)	Group assignment
11	System 5: Rheological Modelling. • reason: surrogate components to represent observed behaviour	L **CW: Assessment item 2 - Presentations**	Revise all lecture and workshop content
12	System 6: Weather and Climate systems • GUEST LECTURER – Dr Neil Tindale	L **CW: Practical Exam**	Revise all lecture and workshop content
13	Theory exam (L)	**L: Theory Exam** (No CW)	Revise all lecture and workshop content

NOTE: The above schedule is a guide to Course topics. While every endeavour will be made to keep to the schedule, timing and treatment of material may vary without notice in order to accommodate student needs, availability of staff, resources, events of significance and extreme weather events.

8. What resources do I need to undertake this course?

Please note that course information, including specific information of recommended readings, learning activities, resources, weekly readings, etc. are available on the course Blackboard site. Please log in as soon as possible.

A computer with internet access, in order to be able to use course software off-campus, but which is available on https://anywhere.usc.edu.au , will be of benefit.

8.1 Prescribed text(s)

Nil

8.2 Specific requirements

Nil

9. Risk management

Health and safety risks have been assessed as low.

It is your responsibility as a student to review course material, search online, discuss with lecturers and peers, and understand the health and safety risks associated with your specific course of study. It is also your responsibility to familiarise yourself with the University's general health and safety principles by reviewing the online Health Safety and Wellbeing training module for students, and following the instructions of the University staff.

10. What administrative information is relevant to this course?

10.1 Assessment: Academic Integrity

Academic integrity is the ethical standard of university participation. It ensures that students graduate as a result of proving they are competent in their discipline. This is integral in maintaining the value of academic qualifications. Each industry has expectations and standards of the skills and knowledge within that discipline and these are reflected in assessment.

Academic integrity means that you do not engage in any activity that is considered to be academic fraud; including plagiarism, collusion or outsourcing any part of any assessment item to any other person. You are expected to be honest and ethical by completing all work yourself and indicating in your work which ideas and information were developed by you and which were taken from others. You cannot provide your assessment work to others. You are also expected to provide evidence of wide and critical reading, usually by using appropriate academic references.

In order to minimise incidents of academic fraud, this course may require that some of its assessment tasks, when submitted to Blackboard, are electronically checked through SafeAssign. This software allows for text comparisons to be made between your submitted assessment item and all other work that SafeAssign has access to.

10.2 Assessment: Additional requirements

Eligibility for Supplementary Assessment

Your eligibility for supplementary assessment in a course is dependent of the following conditions applying:

a) The final mark is in the percentage range 47% to 49.4%
b) The course is graded using the Standard Grading scale
c) You have not failed an assessment task in the course due to academic misconduct

10.3 Assessment: Submission penalties

Late submission of assessment tasks will be penalised at the following maximum rate:

- 5% (of the assessment task's identified value) per day for the first two days from the date identified as the due date for the assessment task.
- 10% (of the assessment task's identified value) for the third day
- 20% (of the assessment task's identified value) for the fourth day and subsequent days up to and including seven days from the date identified as the due date for the assessment task.
- A result of zero is awarded for an assessment task submitted after seven days from the date identified as the due date for the assessment task.

Weekdays and weekends are included in the calculation of days late.
To request an extension, you must contact your Course Coordinator and supply the required documentation to negotiate an outcome.

10.4 Study help

In the first instance, you should contact your tutor, then the Course Coordinator. Additional assistance is provided to all students through Academic Skills Advisers. To book an appointment or find a drop-in session go to Student Hub.

Contact Student Central for further assistance: +61 7 5430 2890 or studentcentral@usc.edu.au

10.5 Wellbeing Services

Student Wellbeing Support Staff are available to assist on a wide range of personal, academic, social and psychological matters to foster positive mental health and wellbeing for your success. Student Wellbeing is comprised of professionally qualified staff in counselling, health and disability Services.

Ability Advisers ensure equal access to all aspects of university life. If your studies are affected by a disability, mental health issue, learning disorder, injury or illness, or you are a primary carer for someone with a disability, AccessAbility Services can provide assistance, advocacy and reasonable academic adjustments.

To book an appointment with either service go to Student Hub, email studentwellbeing@usc.edu.au or accessability@usc.edu.au or call 07 5430 1226

10.6 Links to relevant University policy and procedures

For more information on Academic Learning & Teaching categories including:

- Assessment: Courses and Coursework Programs
- Review of Assessment and Final Grades
- Supplementary Assessment
- Administration of Central Examinations
- Deferred Examinations
- Student Academic Misconduct
- Students with a Disability

Visit the USC website:
http://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching

10.7 General Enquiries

In person:

- **USC Sunshine Coast** - Student Central, Ground Floor, Building C, 90 Sippy Downs Drive, Sippy Downs
- **USC Moreton Bay** – Service Centre, Ground Floor, Foundation Building, Gympie Road, Petrie
- **USC SouthBank** - Student Central, Building A4 (SW1), 52 Merivale Street, South Brisbane
- **USC Gympie** - Student Central, 71 Cartwright Road, Gympie
- **USC Fraser Coast -** Student Central, Student Central, Building A, 161 Old Maryborough Rd, Hervey Bay
- **USC Caboolture -** Student Central, Level 1 Building J, Cnr Manley and Tallon Street, Caboolture

Tel: +61 7 5430 2890

Email: studentcentral@usc.edu.au