



COURSE OUTLINE

MTH381 Applied Systems Modelling

Course Coordinator: Aaron Wiegand (awiegand@usc.edu.au) **School:** School of Science, Technology and Engineering

2021 | Semester 1

USC Sunshine Coast

ON CAMPUS

Most of your course is on campus but you may be able to do some components of this course online.

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. How will this course be delivered?

ACTIVITY	HOURS	BEGINNING WEEK	FREQUENCY
ON CAMPUS			
Lecture	2hrs	Week 1	13 times
Laboratory	2hrs	Week 1	13 times

1.3. Course Topics

Teaching Week / Module	What key concepts/content will I learn?
1	Introduction to dynamic systems and mathematical modelling. Types of models. Introduction to STELLA notation.
2	Introduction to systems thinking. Quantitative validation of dynamic models.
3	Model development and reporting. Empirical data: sources, problems and validation. Sensitivity analysis of a model.
4	Generation of first and second order DEs. Steady state (Equilibrium). Introduction to Numerical Integration. Common patterns of model behaviour.
5	System 1: Simple population dynamics. <ul style="list-style-type: none"> • reason: feedback; carrying capacity System 2: Predator-Prey Systems. <ul style="list-style-type: none"> • reason: linking systems
6	System 3: Air pollutant emissions from vehicles. <ul style="list-style-type: none"> • reason: cohort models
7	System 4: Infectious diseases. <ul style="list-style-type: none"> • reason: cyclic model; use of probability Miscellaneous Mathematical techniques <ul style="list-style-type: none"> • 2-D data interpolation (linear, $1/r^2$)
8	Estimation Coupled DEs (chaotic systems)
9	Randomness and Probability. The Monte-Carlo modelling approach. Markov chains (brief introduction).
10	Public speaking and professional communication.
11	System 5: Rheological Modelling. <ul style="list-style-type: none"> • reason: surrogate components to represent observed behaviour
12	System 6: Weather and Climate system

2. What level is this course?

300 Level (Graduate)

Demonstrating coherence and breadth or depth of knowledge and skills. Independent application of knowledge and skills in unfamiliar contexts. Meeting professional requirements and AQF descriptors for the degree. May require pre-requisites where discipline specific introductory or developing knowledge or skills is necessary. Normally undertaken in the third or fourth full-time study 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?

COURSE LEARNING OUTCOMES	GRADUATE QUALITIES
On successful completion of this course, you should be able to...	Completing these tasks successfully will contribute to you becoming...
1 "Translate" a description of a dynamic system and associated data into a computational model for that system.	Creative and critical thinker Empowered
2 Assess the qualitative and quantitative validity of models, with respect to their intended purpose.	Creative and critical thinker Empowered
3 Recall, explain and apply relevant theory, tools and techniques of mathematical systems modelling	Knowledgeable Empowered
4 Communicate concepts and techniques relevant to mathematical systems modelling, both verbally and using written English, with appropriate mathematical notations.	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. Pre-requisites

MTH202 or MTH104

5.2. Co-requisites

Not applicable

5.3. Anti-requisites

ENS381

5.4. 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 Grading (GRD)

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

DELIVERY MODE	TASK NO.	ASSESSMENT PRODUCT	INDIVIDUAL OR GROUP	WEIGHTING %	WHAT IS THE DURATION / LENGTH?	WHEN SHOULD I SUBMIT?	WHERE SHOULD I SUBMIT IT?
All	1	Written Piece	Individual	15%	60 minutes	Week 5	In Class
All	2	Artefact - Technical and Scientific, and Written Piece	Group	25%	- 10 min presentation & questions - Briefing notes (2 pages) - computer model	Week 11	In Class
All	3	Practical / Laboratory Skills	Individual	20%	90 min	Week 12	In Class
All	4	Examination	Individual	40%	90 min	Week 13	In Class

All - 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:	Written Piece		
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:	No.		Learning Outcome assessed
	1	Correct use of the provided model.	
	2	Correct use of appropriate quantitative analysis methods.	
	3	Completeness and quality of the validation process.	
	4	Clarity of the reasoning and discussion, that leads to a conclusion.	
	5	General presentation and communication (language, spelling, conciseness).	
	6	Assessment criteria are mapped to the course learning outcomes.	1 2 3 4

All - 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:	Artefact - Technical and Scientific, and Written Piece
FORMAT:	Group presentation (live, or pre-recorded, depending on circumstances), 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 USC assignment coversheet, signed by all group members. Full specifications for the model, the presentation, and the briefing document will be provided on Blackboard. 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.

CRITERIA:	No.	Learning Outcome assessed
	1	Evidence of review of the literature for any models that already exist.
	2	Appropriate model development and model structure for the selected dynamic system
	3	Appropriate model validation
	4	Appropriate use of the model to answer the stated problem, or case study.
	5	Group presentation as per detailed specifications provided on Blackboard
	6	Briefing document structure and content as per detailed specifications provided on Blackboard
	7	General presentation and communication (layout, language, spelling, conciseness, delivery).

All - Assessment Task 3: Practical Exam

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:	Practical / Laboratory Skills	
FORMAT:	Individual Practical modelling tasks. 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.	
CRITERIA:	No.	Learning Outcome assessed
	1	recall and apply the theoretical and practical components of the course materials covered in both the lectures, tutorials and readings from weeks 1-12
	2	apply the theory to particular examples
	3	derive modelling solutions to particular problems
	4	create simple models of described dynamic systems
	5	evaluate examples of poor modelling practice

All - Assessment Task 4: Theory Exam

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:	Examination
FORMAT:	Individual Theoretical written questions (Week 13 Lecture). Practical modelling tasks (Week 13 Computer Workshop)

CRITERIA:	No.	Learning Outcome assessed
	1	recall the theoretical and practical components of the course materials covered in both the lectures, tutorials and readings from weeks 1-12
	2	apply the theory to particular examples
	3	derive solutions to particular problems
	4	create simple models of described dynamic systems

7. Directed study hours

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.

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

Please note: 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.

8.1. Prescribed text(s) or course reader

There are no required/recommended resources for this course.

8.2. Specific requirements

Must have own computer with reasonable internet access to be able to access STELLA at home via USC Anywhere.

9. How are risks managed in this course?

Health and safety risks for this course have been assessed as low. It is your responsibility 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 and to familiarise yourself with the University's general health and safety principles by reviewing the [online induction training 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:

The final mark is in the percentage range 47% to 49.4%

The course is graded using the Standard Grading scale

You have not failed an assessment task in the course due to academic misconduct

10.3. Assessment: Submission penalties

Late submission of assessment tasks may 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 to negotiate an outcome.

10.4. Study help

For help with course-specific advice, for example what information to include in your assessment, you should first contact your tutor, then your course coordinator, if needed.

If you require additional assistance, the Learning Advisers are trained professionals who are ready to help you develop a wide range of academic skills. Visit the [Learning Advisers](#) web page for more information, or contact Student Central for further assistance: +61 7 5430 2890 or studentcentral@usc.edu.au.

10.5. Wellbeing Services

Student Wellbeing provide free and confidential counselling on a wide range of personal, academic, social and psychological matters, to foster positive mental health and wellbeing for your academic success.

To book a confidential appointment go to [Student Hub](#), email studentwellbeing@usc.edu.au or call 07 5430 1226.

10.6. AccessAbility Services

Ability Advisers ensure equal access to all aspects of university life. If your studies are affected by a disability, learning disorder mental health issue, injury or illness, or you are a primary carer for someone with a disability or who is considered frail and aged, [AccessAbility Services](#) can provide access to appropriate reasonable adjustments and practical advice about the support and facilities available to you throughout the University.

To book a confidential appointment go to [Student Hub](#), email AccessAbility@usc.edu.au or call 07 5430 2890.

10.7. 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>

10.8. 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