

MTH381 Applied Systems Modelling

School: School of Science, Technology and Engineering

2025 | Semester 1

UniSC Sunshine Coast
UniSC Moreton Bay

**BLENDED
LEARNING**

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

Please go to usc.edu.au 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 |
|---|-------|----------------|-----------|
| BLENDED LEARNING | | | |
| Tutorial/Workshop 1 – On campus workshop | 2hrs | Week 1 | 10 times |
| Laboratory 1 – on-campus laboratory | 2hrs | Week 1 | 10 times |

1.3. Course Topics

Software: STELLA, MATLAB, Excel (including fundamental programming techniques and use of MATLAB). The model development process. Systems thinking. First and second-order differential equations. Accumulation and steady state (Equilibrium). Quantitative validation of dynamic models. Simple population dynamics. Predator-Prey Systems. Cohort models. Infectious diseases dynamics. Monte-Carlo modelling. Markov processes (introductory). Estimation. Chaotic systems (introductory). Some miscellaneous numerical tools that are useful in modelling activities.

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 [UniSC 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 | Practical / Laboratory Skills, and Written Piece | Individual | 30% | Up to six hours per Thing (except thing #1). Perhaps longer if you really enjoy it! | Throughout teaching period (refer to Format) | In Class |
| All | 2 | Artefact - Technical and Scientific | Group | 20% | Week 9: Task issued. Week 12: 30 minute meeting (or as required). | Week 12 | In Class |
| All | 3 | Examination - not Centrally Scheduled | Individual | 50% | 100 minutes (or longer, or as needed to complete practical questions in the computer laboratory). Depending on venue, the exam may be run as two parts. More information will be provided as needed. | Week 10 | In Class |

All - Assessment Task 1: Do Three Things

| GOAL: | This task will give you an opportunity to develop and demonstrate your growing skills with the tools, approaches, and creativity that are used in the development and exploration of mathematical models (and associated topics). | | | | | | | | | | | | | |
|------------------------|--|---------------------------|--|---------------------------|---|--|-----|---|---|-----|---|---|-------|--|
| PRODUCT: | Practical / Laboratory Skills, and Written Piece | | | | | | | | | | | | | |
| FORMAT: | <p>A list describing at least three Things will be provided in week 1. These will range from keeping good notes and examples of all your learning materials (folio), to exploring a specific topic using MATLAB or STELLA, or even an option to explore relevant things that interest you personally!</p> <p>Two of these Things will be compulsory (Weekly Folio Thing worth 10%, and Model Validation Thing worth 10%). You may attempt up to two additional Things (or more, with course coordinator permission) and the best one of those will count towards the remaining 10%.</p> <p>With the exception of the folio, you will have up to one week (or as specified) to work on, and complete, each Thing. Unless negotiated otherwise, all submissions will be by hardcopy (paper) submission to the class tutor. Full specifications for this task and the Things that comprise it, and how it will be evaluated, will be provided on Canvas by the end of week 1.</p> | | | | | | | | | | | | | |
| CRITERIA: | <table border="1"> <thead> <tr> <th>No.</th> <th></th> <th>Learning Outcome assessed</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>To maintain an organised folio of relevant material that supports learning and application of course material.</td> <td>3 4</td> </tr> <tr> <td>2</td> <td>To use appropriate theoretical and software tools and techniques to determine the validity of a model against empirical data.</td> <td>2 4</td> </tr> <tr> <td>3</td> <td>To apply relevant technologies for the exploration and analysis of topics that are relevant to mathematics modelling.</td> <td>1 3 4</td> </tr> </tbody> </table> | No. | | Learning Outcome assessed | 1 | To maintain an organised folio of relevant material that supports learning and application of course material. | 3 4 | 2 | To use appropriate theoretical and software tools and techniques to determine the validity of a model against empirical data. | 2 4 | 3 | To apply relevant technologies for the exploration and analysis of topics that are relevant to mathematics modelling. | 1 3 4 | |
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| 3 | To apply relevant technologies for the exploration and analysis of topics that are relevant to mathematics modelling. | 1 3 4 | | | | | | | | | | | | |
| GENERIC SKILLS: | Communication, Problem solving, Applying technologies | | | | | | | | | | | | | |

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 | | | | | | | | | | | | | |
| FORMAT: | <p>Formal 30-minute discussion meeting with the whole group present and the course coordinator, possibly other selected participants as well. The group must present their model and findings in a formal meeting environment and field a discussion and questions. Electronic copy of the model to be sent to the course coordinator. Standard UniSC assignment coversheet, signed by all group members. Full specifications for the model and the the discussion meeting will be provided on Canvas.</p> <p>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.</p> | | | | | | | | | | | | | |
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| No. | | Learning Outcome assessed | | | | | | | | | | | | |
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| 2 | Appropriate model validation, use, and interpretation. | 2 | | | | | | | | | | | | |
| 3 | General presentation and communication (layout, language, spelling, conciseness, delivery). | 4 | | | | | | | | | | | | |
| GENERIC SKILLS: | Communication, Collaboration, Problem solving, Organisation, Applying technologies, Information literacy | | | | | | | | | | | | | |

All - Assessment Task 3: Theory and Practical Exam

| | | | |
|------------------------|---|--|----------------------------------|
| GOAL: | The examination gives you an opportunity to demonstrate your knowledge, understanding and skills associated with all the theoretical and practical learning outcomes of this course. You will describe and apply modelling theory and techniques as presented in this course. | | |
| PRODUCT: | Examination - not Centrally Scheduled | | |
| FORMAT: | Individual, theoretical and practical written questions (week 10 classes). | | |
| CRITERIA: | No. | | Learning Outcome assessed |
| | 1 | recall the theoretical and practical components of the course materials covered in both the workshops, laboratories and readings from weeks 1-12 | 1 2 3 4 |
| | 2 | apply the theory to particular examples | 1 3 4 |
| | 3 | derive solutions to particular problems related to the course material | 1 3 4 |
| | 4 | create simple models of described dynamic systems | 1 3 4 |
| GENERIC SKILLS: | Communication, Problem solving, Applying technologies, Information literacy | | |

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. 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 Canvas 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 UniSC Anywhere, and also have MATLAB installed (further information on these will be provided).

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 Canvas, are electronically checked through Turnitin. This software allows for text comparisons to be made between your submitted assessment item and all other work to which Turnitin has access.

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. SafeUniSC

UniSC is committed to a culture of respect and providing a safe and supportive environment for all members of our community. For immediate assistance on campus contact SafeUniSC by phone: [07 5430 1168](tel:0754301168) or using the [SafeZone](#) app. For general enquires contact the SafeUniSC team by phone [07 5456 3864](tel:0754563864) or email safe@usc.edu.au.

The SafeUniSC Specialist Service is a Student Wellbeing service that provides free and confidential support to students who may have experienced or observed behaviour that could cause fear, offence or trauma. To contact the service call [07 5430 1226](tel:0754301226) or email studentwellbeing@usc.edu.au.

10.5. 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.

10.6. 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.

10.7. 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.

10.8. 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
- Central Examinations
- Deferred Examinations
- Student Conduct
- Students with a Disability

For more information, visit <https://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching>

10.9. Student Charter

UniSC is committed to excellence in teaching, research and engagement in an environment that is inclusive, inspiring, safe and respectful. The [Student Charter](#) sets out what students can expect from the University, and what in turn is expected of students, to achieve these outcomes.

10.10.General Enquiries

In person:

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

Tel: +61 7 5430 2890

Email: studentcentral@usc.edu.au