AMSI ACE

**ACE Network Subject Information Guide**

**Mathematical Epidemiology**

**Semester 2, 2024**

**Administration and contact details**

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| **Host Department** | **School of Science (Mathematical Sciences)** |
| **Host Institution** | **RMIT University** |
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| **Name of lecturer** | **Associate Professor Stephen Davis** |
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| **Name of Honours coordinator** | **Associate Professor Stephen Davis** |
| **Phone number** | **03 9925 2278/0404 35 1812** |
| **Email Address** | **stephen.davis@rmit.edu.au** |

**Subject details**

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| **Handbook entry URL** | NA |
| **Subject homepage URL** | NA |
| **Honours student hand-out URL** | NA |
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| **Start date:** | **TBA** |
| **End date:** | **TBA** |
| **Contact hours per week:** | **Two 1-hour lectures + 3 hours independent study** |
| **Lecture day and time:** | **TBA** |
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| **Description of electronic access arrangements for students (for example, WebCT)** | **Course materials will be shared via DropBox; lectures and lectorials will have dual delivery face to face at the RMIT city campus (the Access Grid Room) and Zoom. Students living in Melbourne or nearby are all welcome to come on campus for the face-to-face teaching, regardless of whether you are an RMIT student.** |

**Subject content**

1. **Subject content description**

This course will immerse students in the epidemic theory that underpins our management of infectious diseases of humans and animals, including of course the ongoing global pandemic caused by the SARS-CoV-2 virus. The course will cover simple models for closed populations of hosts, compartment models, multi-host pathogens, spatial dynamics, within-host dynamics and the type reproduction number.

1. **Week-by-week topic overview**

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| --- | --- | --- | --- |
| RMIT Week | Week starting (Monday) | Topics covered | Sections of the Lecture Notes |
| 1 | TBA | - |  |
| 2 | TBA | R0; r; doubling time | 1.1 -- 1.1.5 |
| 3 | TBA | SIR model; final size equation | 1.2 -- 1.2.1 |
| 4 | TBA | Solving the SIR model; SIR model with births and deaths; stability analysis | 1.2.2 --1.2.3, 2.1--2.2.3 |
| 5 | TBA | Mean age at infection; SEI model for canine rabies | 2.2.4 |
| 6 | TBA | Probability of extinction; the dispersion parameter k; heterogeneity and superspreaders | 3 |
| Mid-Semester Break |  |  |  |
| 7 | TBA | Multi-host disease systems; Next Generation Matrix | 4.1--4.2 |
| 8 | TBA | Type reproduction number; NGM recipe for compartment models | 4.3--4.4 |
| 9 | TBA | Waning immunity | - |
| 10 | TBA | Seasonality; Cyprinid Herpes Virus 3 | 5.1 -- 5.2.2 |
| 11 | TBA | Spatial spread; percolation; plague in Kazakhstan | 6.1 -- 6.4.3 |
| 12 | TBA | Within-host infection dynamics | - |
| 13 | TBA | Models of Mosquito-borne disease | - |

1. **Assumed prerequisite knowledge and capabilities**

Students will be assumed to be familiar with systems of differential equations and the techniques used to analyse their behaviour and dynamics; it is advantageous to have completed an undergraduate course in differential equations or modelling with differential equations.

It is also assumed that students are comfortable with writing/modifying code in one or more programming environments such as R or Matlab.

1. **Learning outcomes and objectives**

Students will acquire a working knowledge of the mathematical techniques used to generate insight into biological systems. They will gain experience in translating the known biological properties of a system into a set of mathematical equations (a model) and vice versa be able to interpret equations in terms of the biology they capture. Students will be able to use epidemiological reasoning to characterise a pathogen in terms of its basic reproduction ratio and understand the usefulness and limitations of this quantity. Students will be able to numerically solve systems of differential equations to explore their behaviour and dynamics and draw biological conclusions.

**AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):**

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| --- | --- |
| **AQF Program Learning Outcomes addressed in this subject** | **Associated AQF Learning Outcome Descriptors for this subject** |
| **Problem Solving - You will have the ability to apply knowledge and skill to characterise, analyse and solve a wide range of problems**. | **S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence**  **S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas**  **A2: to adapt knowledge and skills in diverse contexts** |
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**Learning Outcome Descriptors at AQF Level 8**

**Knowledge**

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

**Skills**

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

**Application of Knowledge and Skills**

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

1. **Learning resources**

Lecture notes, recommended journal articles and recommended books will be made available over the course of the semester.

1. **Assessment**

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| **Exam/assignment/classwork breakdown** | | | | | |
| **Exam** | **40%** | **Assignment** | **20%+20%+20%** | **Class work** | **-** |
|  | | | | | |
| **Assignment due dates** | | **TBA** | **TBA** | **TBA** |  |
|  | | | | | |
| **Approximate exam date** | | | | **TBA** | |

**Institution Honours program details**

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| **Weight of subject in total honours assessment at host department** | **12.5%** |
| **Thesis/subject split at host department** | **37.5% thesis/62.5% course work** |
| **Honours grade ranges at host department:** |  |
| **H1** | **80-100 %** |
| **H2a** | **75-79 %** |
| **H2b** | **70-74 %** |
| **H3** | **65-69 %** |