# MAST30030 Applied Mathematical Modelling

**Credit Points:** 12.5

**Level:** 3 (Undergraduate)

**Dates & Locations:**

2015, Parkville

This subject commences in the following study period/s:
Semester 1, Parkville - Taught on campus.

**Time Commitment:** Contact Hours: 36 one-hour lectures (three per week); 12 one-hour practice classes (one per week) Total Time Commitment: 170 hours

**Prerequisites:**

| Subject | Study Period Commencement: | Credit Points: |
|---|---|---|
| MAST20009 Vector Calculus | Semester 1, Semester 2 | 12.50 |

plus one of

| Subject | Study Period Commencement: | Credit Points: |
|---|---|---|
| MAST20030 Differential Equations | Semester 2 | 12.50 |
| MAST20029 Engineering Mathematics | Summer Term, Semester 1, Semester 2 | 12.50 |

MAST30029 Partial Differential Equations (prior to 2014)

(MAST20029 Engineering Mathematics must have a result grade of H2A or above)

**Corequisites:** None

**Recommended Background Knowledge:** None

**Non Allowed Subjects:** None

**Core Participation Requirements:**

<p>For the purposes of considering request for Reasonable Adjustments under the Disability Standards for Education (Cwth 2005), and Student Support and Engagement Policy, academic requirements for this subject are articulated in the Subject Overview, Learning Outcomes, Assessment and Generic Skills sections of this entry.</p> <p>It is University policy to take all reasonable steps to minimise the impact of disability upon academic study, and reasonable adjustments will be made to enhance a student's participation in the University's programs. Students who feel their disability may impact on meeting the requirements of this subject are encouraged to discuss this matter with a Faculty Student Adviser and Student Equity and Disability Support: <a href="http://services.unimelb.edu.au/disability">http://services.unimelb.edu.au/disability</a></p>

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**Subject Overview:**

This subject demonstrates how the mathematical modelling process naturally gives rise to certain classes of ordinary and partial differential equations in many contexts, including the infectious diseases, the flow of traffic and the dynamics of particles and of fluids. It advances the student’s knowledge of the modelling process, as well addressing important mathematical ideas in deterministic modelling and the challenges raised by system nonlinearity.

# Infectious disease models and other contexts leading to systems of autonomous first-order differential equations; initial value problem, phase space, critical points, local linearization and stability; qualitative behaviour of plane autonomous systems, structural stability; formulation, interpretation and critique of models.

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|---|---|
| | # Conservation laws and flux functions leading to first-order quasilinear-linear partial differential equations; characteristics, fans, shocks and applications including modelling traffic flow.<br># Introduction to continuum mechanics: basic principles; tensor algebra and tensor calculus; the ideal fluid model and potential flow; the Newtonian fluid, Navier-Stokes equations and simple solutions. |
| **Learning Outcomes:** | On completion of this subject, students should:<br># understand the nature of deterministic mathematical modelling, including model formulation, selection of appropriate mathematical formalism, solution strategies and interpretation of results;<br># know contexts in which systems of autonomous ordinary differential equations or quasilinear first-order partial differential equations provide relevant models and appreciate general features of such models and what may be learned from them;<br># be able to find and classify critical points in two-dimensional autonomous ODE problems, and be able to infer qualitative behaviour in the phase plane;<br># be able to solve quasilinear PDEs in two variables using the method of characteristics, including the construction of weak solutions (fans and shocks);<br># understand the fundamental principles of classical continuum mechanics and develop facility in related vector and tensor analysis;<br># understand the assumptions underlying the ideal fluid model and the Newtonian fluid model and be able to find and interpret solutions for simple flows. |
| **Assessment:** | Three written assignments amounting to a total of up to 50 pages, due at regular intervals during semester (30%); 3-hour written examination in the examination period (70%) |
| **Prescribed Texts:** | None |
| **Breadth Options:** | This subject is not available as a breadth subject. |
| **Fees Information:** | Subject EFTSL, Level, Discipline & Census Date, http://enrolment.unimelb.edu.au/fees |
| **Generic Skills:** | In addition to learning specific skills that will assist students in their future careers in science, they will have the opportunity to develop generic skills that will assist them in any future career path. These include:<br># mathematical modelling skills: the ability to formulate a mathematical model, select an appropriate solution strategy and interpret solutions;<br># analytical skills: the ability to construct and express logical arguments and to work in abstract or general terms to increase the clarity and efficiency of analysis;<br># time-management skills: the ability to meet regular deadlines while balancing competing commitments. |
| **Related Majors/Minors/ Specialisations:** | Applied Mathematics<br>Applied Mathematics<br>Applied Mathematics<br>Applied Mathematics<br>Applied Mathematics (specialisation of Mathematics and Statistics major)<br>Science-credited subjects - new generation B-SCI and B-ENG.<br>Selective subjects for B-BMED |