

Module Outline

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Course codes: MATH60011 (year 3), MATH70011 (year 4 and MSc).

Sessions:

Monday 12noon-1pm (weeks 2-11) starting Monday 10 October. Huxley 139 (Huxley 213 (Clore) in week 2).

Thursday 11am-12noon (weeks 1-10), Huxley 340.

Friday 9am-10am (weeks 1-10), Huxley 139.

The Monday sessions will usually be problems classes. The Thursday and Friday sessions will be lectures.

Content

Lecture notes will be available on Blackboard.

8 problem sheets (with solutions) will be distributed throughout the term.

Office hour: Huxley 6M26, time to be confirmed.

The module is structured as follows:

Primer on the Calculus of Variations (with worked examples)

1. Dynamics; Problem Sheet 1
2. Lagrangian Mechanics; Problem Sheets 2&3
3. Hamiltonian Mechanics; Problem Sheets 4&5
4. Integrability and Symmetries; Problem Sheets 6&7
5. Rigid Bodies; Problem Sheet 8.

Assessment

1. In-class test 12noon Monday 28th October.

2. In-class test 12noon Monday 25th November.

Each test contributes 5% to your final mark for Classical Dynamics. The duration of each test is 40 minutes. Tests from previous years are available on Blackboard. *If you have reasonable adjustments please contact the UG Office or MSc Administrator in advance of the tests.*

3. Final exam in Summer 2025.

The exam represents 90% of your final mark. For year three undergraduates (MATH60011) the exam has four questions (2 hours). For year four undergraduates and MSc students (MATH70011) the exam has five questions (2 hours and 30 minutes).

Classical Dynamics Ed Discussion Board

Users may post questions, answers and comments.

Textbooks

Goldstein's classic textbook covers the material at an appropriate level:

1. 'Classical Mechanics' by H. Goldstein, C.P. Poole and J.L. Safko (3rd Edition), Pearson (2002).

However, the book is like an encyclopedia and best used to study specific topics rather than to read cover to cover. Goldstein's main strength is that it includes a large number of problems.

Another classic textbook at an appropriate level is

2. 'Mechanics: Volume 1 of Course of Theoretical Physics' by L.D. Landau and E.M. Lifshitz (3rd Edition), Elsevier (1976).

This is much more concise than Goldstein. In some places arguments are hard to follow as too many steps are left to the reader.

Another text is

3. 'Mathematical Methods of Classical Mechanics' by V. I. Arnold, Springer (1989).

This renowned textbook is at a higher level than this module. Parts of the book are relevant to this course. Later parts use ideas from differential geometry (this is relevant to Darryl Holm's Spring term module on Geometric Mechanics).

A further resource is David Tong's online lecture notes and problem sheets on 'Classical Dynamics'

<https://www.damtp.cam.ac.uk/user/tong/dynamics.html>

Mastery

Question 5 on the Summer 2025 exam will be on additional content relating to rigid body motion. This Mastery content will be provided as a pdf on blackboard during the term, and is only examinable for MATH70011 students. In previous years the set Mastery topics were:

2019-2020 Adiabatic Invariance

2020-2021 Hamiltonian Chaos

2021-2022 Routhian Dynamics

Note that Adiabatic Invariance, discussed in section 4.3 of the notes, is examinable (including for year 3) in 2024-2025. Hamiltonian Chaos and Routhian Dynamics are not examinable in 2024-2025.