School of Information and Physical Sciences

PHYS2111: Classical Physics 1

Callaghan
Semester 1 - 2024

COURSE OUTLINE

OVERVIEW

Course Description

Applications of classical mechanics to the motion of large-scale systems are fundamental to the engineering and technology of structures, machines, and devices, from rocket launching to satellite orbiting. This course will also help to understand the flow of liquids and gases, from weather systems to swimming plankton; and why a cup of tea left on a counter always cools down and never heats up. At its core Classical Physics 1 studies the motion of particles, fluids and energy using the concepts of Newtonian mechanics. This course requires an intermediate level of calculus to analyse systems in mechanics, fluid mechanics and thermodynamics. Blended problem-based conceptual learning (lectorials) will be used to gain an understanding of key developments, ideas and theories covered in Classical Physics 1. Blended problem-based hands-on learning (laboratory workshops) will be used to gain an understanding of key experiments, models and analysis covered in Classical Physics 1. Students will complete written reports, oral presentations, and a poster presentation related to the laboratories.

Academic Progress Requirements

Nil

Requisites

Students must have successfully completed PHYS1210, and at least one of MATH1120, MATH1210 or MATH1220 to enrol in this course. Students cannot enrol in this course if they have previously successfully completed PHYS2250

Contact Hours

Callaghan
Laboratory
Face to Face On Campus
3 hour(s) per week(s) for 11 week(s) starting Week 2

Lectorial
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1
Lectorials will use a combination of online and face-to-face content.
Tutorial
Face to Face On Campus
1 hour(s) per week(s) for 12 week(s) starting Week 1

Unit Weighting Workload

10
Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator **Callaghan**
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Consultation: By appointment (P-114 or via zoom)

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SYLLABUS

Course Content

Classical mechanics

- Motion in a uniform force field
- Motion in a central force field, gravitation and Kepler's laws
- Rigid body motion and moments of inertia
- Rotating coordinates and non-inertial reference frames
- Lagrangian and Hamiltonian formulation

Thermal physics

- Definition of thermodynamics
- Zeroth, First and Second Law of thermodynamics
- Multiplicity, Entropy and the origin of irreversibility
- Temperature, pressure and chemical potential
- Ideal gases, two-state systems, Einstein solid

Fluid mechanics

- Conservation of mass, momentum and energy in a fluid
- Incompressible flow, irrotational flow, and Bernoulli's equation
- Viscous flows; the Navier-Stokes equation and Reynolds number
- Fluids modelling, turbulence and non-Newtownian fluids

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Describe how the basic concepts of classical mechanics, fluid mechanics and thermal physics are used to develop models of motion and energy transfer.

2. Solve qualitative and quantitative problems, using mathematics and computer programming.

3. Perform experiments, in laboratory and in computer models, keeping an accurate record of experimental work and analysing results and reaching non-trivial conclusions from them.

4. Communicate the results of both theoretical and experimental work in various forms including written reports, oral presentations and poster presentations.

5. Contribute to team and group work for scientific investigations and for the process of learning.

Course Materials

Lecture Materials:

- Video recordings, notes and lab notes will be available via Canvas. Supplemental readings will also be placed on Canvas.

Recommended Reading:

- **Recommended Textbooks:**
  Classical Mechanics module: "Classical Mechanics" by J.R. Taylor
  Thermodynamics module: "An Introduction to Thermal Physics" by D. Schroeder. Also available online through the UON library: https://go.exlibris.link/MtNyLCr0
  Fluids module: "Fluid Mechanics" by P.K Kundu et al (online via UON library) and "Introductory Fluid Mechanics for Physicists and Engineers" by G.J. Pert (online via UON library)

SCHEDULE

Week	Week Begins	Topic	Learning Activity	Assessment Due
1	26 Feb	Classical mechanics: Review of basics of motion	Lectorial Tutorial	Quiz 1 due Wednesday 28th 11:59pm.
2	4 Mar	Classical mechanics: Motion in force fields; rectilinear motion; gravitation (central forces); orbits and planetary motion; Keplers' laws on planetary motion	Lectorial Tutorial Workshop: projectile motion	Quiz 2 due Sunday 3rd 11:59pm.
3	11 Mar	Classical Mechanics: Calculus of variation; Lagrangian mechanics	Lectorial Tutorial Workshop: friction	Quiz 3 due Sunday 10th 11:59pm.
4	18 Mar	Classical mechanics: Non-inertial reference frames; rotating frames	Lectorial Tutorial Workshop: problem solving	Quiz 4 due Sunday 17th 11:59pm. Classical mechanics lab submission due Monday 11:59pm (10%). **Take-home assignment 1 due Friday 11:59pm (5%)**
5	25 Mar	Thermo: Definitions and revision of first year; statistical mechanics	Lectorial Workshop: adiabatic exponent lab (No tutorial: Good Friday!)	Quiz 5 due Sunday 24th 11:59pm.
6	1 Apr		Tutorial (No lectorial or workshop: Easter Monday!)	Adiabatic exponent lab due Monday 11:59pm (5%).
7	8 Apr	Thermo: Microstates, macrostates, multiplicity and entropy; the second law	Lectorial Tutorial Workshop: computer lab on multiplicity and entropy	Quiz 6 due Sunday 7th 11:59pm. Multiplicity lab due Monday 15th 11:59pm during recess (5%).
Mid-Semester Recess				
Mid-Semester Recess				

8	29 Apr	Thermo: Temperature defined from statistics; the 0th law	Lectorial Tutorial Workshop: computer lab on Einstein solids and the definition of temperature	Quiz 7 due Sunday 28th 11:59pm. **Take-home assignment 2 due Friday 11:59pm (5%).**
9	6 May	Fluids: Definitions; conservation laws, plotting and visualisation in python	Lectorial Tutorial Workshop: computer lab on visualising fluid flows	Quiz 8 due Sunday 5th 11:59pm.
10	13 May	Fluids: The material derivative; Euler's equation; Bernoulli's equation	Lectorial Tutorial Workshop: Water Column experiment	Quiz 9 due Sunday 12th 11:59pm. Visualising Fluid Flows lab due Monday 11:59pm (3.33%).
11	20 May	Fluids: Viscosity; Navier-Stokes equation; Reynolds number	Lectorial Tutorial Workshop: Investigate boundary layer flows	Quiz 10 due Sunday 19th 11:59pm. Water Column lab due Monday 11:59pm (3.33%).
12	27 May	Fluids: Modelling of fluid flow; turbulent flows, non-Newtonian fluids	Lectorial Tutorial Workshop: complete boundary layer flows	Quiz 11 due Sunday 26th 11:59pm. Boundary layers lab due Monday 11:59pm (3.33%).
13	3 Jun			**Take-home assignment 3 due Monday 11:59pm (5%).**
Examination Period				
Examination Period				

ASSESSMENTS

This course has 4 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Quizzes	Typically 11:59pm Sunday in advance of lectorial class (see Schedule for the 11 due dates)	Individual	15%	1, 2
2	Take-home Written Assignment	11:59pm Friday of Week 4 and 8; 11:59pm Monday of Week 13	Individual	15%	1, 2
3	Tutorial/Laboratory Exercises	Typically within 1 week of the associated lab, see Schedule for details	Combination	30%	3, 4, 5
4	Formal Examination	Formal exam period	Individual	40%	1, 2

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Quizzes

Assessment Type Quiz
Purpose To test that students have a conceptual understanding of the week's content, plus that they are keeping current with their work.
Description 12 online quizzes
Weighting 15%

Length	Done at own pace
Due Date	Typically 11:59pm Sunday in advance of lectorial class (see Schedule for the 12 due dates)
Submission Method	Online
Assessment Criteria	Each online quiz tests students' understanding on the course materials released each week.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Take-home Written Assignment

Assessment Type	Written Assignment
Purpose	The three take-home assignments are designed to test the students' individual knowledge of the course material and their ability to calculate, describe, analyse and hypothesise from this material. They occur at the end of each 4-week module, to keep students up-to-date in the course and ready to tackle the next module.
Description	Three take home assignments will cover classical mechanics, thermodynamics and fluid mechanics.
Weighting	15%
Length	Done at own pace at home
Due Date	11:59pm Friday of Week 4 and 8; 11:59pm Monday of Week 13
Submission Method	Online
Assessment Criteria	Demonstrate a level of conceptual understanding of course content, and quantitative problem solving abilities.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Tutorial/Laboratory Exercises

Assessment Type	Tutorial / Laboratory Exercises
Purpose	To test the theoretical models that students learn in the lectorials. To improve communication, computational, record-keeping, analysis and experimental skills.
Description	The activities include theoretical derivation, experimental testing and computer modelling. Students will work in a group for the lab work and learn to write scientific reports. The labs in each module are worth 10% each.
Weighting	30%
Length	3 hours in each of 11 weeks
Due Date	Typically within 1 week of the associated lab, see Schedule for details
Submission Method	Online
Assessment Criteria	Demonstrate a level of conceptual understanding of course content, and quantitative problem solving abilities. Communicate effectively. Demonstrate competency in performing experiments, keeping records, running/writing computer codes and analysing results.
Return Method	Online
Feedback Provided	Online - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - Formal Examination

Assessment Type	Formal Examination
Purpose	The final formal examination is designed to test the individual student's knowledge of the course material and their ability to calculate, describe, analyse and hypothesise from this material. See the UoN Course Management and Assessment Procedure Manual for more information: https://policies.newcastle.edu.au/document/view-current.php?id=183
Description	The final exam is composed of short answer questions covering classical mechanics, thermodynamics and fluid mechanics. Non-programmable calculators are permitted.
Weighting	40%
Length	2 hours
Due Date	Formal exam period
Submission Method	Formal Exam

Assessment Criteria	Demonstrate a level of conceptual understanding of course content, and quantitative problem solving abilities.
Return Method	Not Returned
Feedback Provided	No Feedback - .
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Attendance

Attendance/participation will be recorded in the following components:

- Laboratory (Method of recording: Attendance/participation will be recorded in the following components:
  - Laboratory (Method of recording: Lab sign-in sheet or electronic card sign-in))

Communication Methods

Communication methods used in this course include:

- Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site.
- Email: Students will receive communications via their student email account.
- Face to Face: Communication will be provided via face to face meetings or supervision.

Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

Oral Interviews (Vivas)

As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.

Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35.

Adverse Circumstances

The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where:

1. the assessment item is a major assessment item; or
2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system;
3. you are requesting a change of placement; or
4. the course has a compulsory attendance requirement.

Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at:
https://policies.newcastle.edu.au/document/view-current.php?id=236

Important Policy Information

The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

Other Information

If you miss a lab or quiz you must submit a “Missed/Late Assessment Form” immediately by email to CESE-SIPS-Admin@newcastle.edu.au with supporting documentation as per the Adverse Circumstances Policy which can be viewed at http://www.newcastle.edu.au/policy/000939.html. This must be done within three calendar days of the missed assessment unless your circumstances do not permit it.
Missed/Late Assessment Forms are available on Canvas. If possible, consult with the Course Coordinator before making your formal request.

This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.