PHYS388

Advanced Physics III

FY1 Day 2014

Physics and Astronomy

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General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
PHYS188 and PHYS201(P) and PHYS202(P) and GPA of 3.20

Corequisites

Co-badged status
This unit is co-badged with phys246

Unit description
This unit offers extended insight into unifying core principles of physics. Alternate years will focus on two key concepts that permeate nearly all of physics - probability (even years) and symmetry (odd years). These two key concepts affect much of modern physics including quantum mechanics, astronomy and astrophysics, lasers and photonics, and biophysics. Students are expected to engage in a research-related activity and produce a report in scientific format on their findings.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Be able to identify how symmetry/probability is used in many sub areas of physics, in sometimes vastly different contexts

Be able to explain how symmetry/probability unifies many sub areas of physics and provides a common structure

Be able to apply symmetry/probability to solve problems from particular sub areas of physics

Assessment Tasks

Name	Weighting	Due
Assignments	20%	Weeks 4 and 7
Projects	30%	Week 13
Exams	40%	End of Semester
Mini Lecture	10%	To be determined

Assignments

Due: **Weeks 4 and 7**
Weighting: **20%**

As for all physics units, problem solving is an essential aid to understanding the physical concepts involved. There will be 4 assignments, two in each semester. They will be issued on approximately the following dates: Assignment 1 & 3 – Week 2 of each semester, due Week 4; Assignment 2 & 4 – Week 4 of each semester, due week 7.

Two assignments will be set each semester with problem sets to enguage the students in the lecture material. The assignments will include more challenging questions over and above the questions for phys246. The assignment record will be used when considering requests for special consideration. Informal group discussion regarding the assignment problems is encouraged, but students should present their own solutions and should explicitly acknowledge those they have worked with on the assignment. You should also note that the examination in general contains material related to the assignment work.

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Projects

Due: **Week 13**
Weighting: **30%**

At the end of each semester the students will complete a research project on a topic that fits the theme focus of the unit (either symmetry or probabilities in physics) and is negotiated with the lecturer. Lecturers will provide a list of suggested topics and starting points for reading, but students are free to pick their own topics and in any case, will need to read more broadly than the suggestions provided.

Each research project will have two components: a report to be handed in and an in-class presentation by the student. The report will be in the style of a 10 page international refereed journal article. Students will also provide a short (10 minutes + 5 minutes for questions) presentation on the project.

Presentation assessment will be based on the clarity and effectiveness of presentation, your explanation of the essential physics in your chosen area, and your discussion of why this area is significant. You may use aids such as PowerPoint or overhead transparencies but this is not required. Some of the most effective presentations use nothing more than the whiteboard. We are more interested in seeing how you can be creative and effective in your communication, than the degree to which you have mastered fancy software tricks.

Specific marking criteria will be made available prior the commencement of the projects.

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Exams

Due: **End of Semester**
Weighting: **40%**

A one and a half hour written closed book exam will be set at the end of each semester.

You should have a scientific calculator for use during the final examination. Note that calculators with text retrieval are not permitted for the final examination. You are expected to present yourself for the examination at the time and place designated. The only exception to not sitting the examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to apply for Special Consideration (see ‘Special Consideration’ in this Guide). If a supplementary examination is granted as a result of the special

consideration process the examination will be scheduled after the conclusion of the official examination period. You are advised that it is the policy of the University not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, i.e. the final day of the examination period.

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Mini Lecture

Due: **To be determined**
Weighting: **10%**

Each PHYS388 student will also prepare and present a 30 minute combined lecture/tutorial on a topic within the unit's curriculum (course notes will be supplied). This will include preparing three short assignment questions together with model answers. These questions will go towards a bank of examples and practice questions that will be available to all the students to practice the problem solving techniques of the unit.

Though the course notes will be supplied, to successfully give a lecture the student will have to understand the material at a deep level.

Delivery and Resources

Requirements in order to complete the unit satisfactorily

Satisfactory performance in all assessment components of this unit. In the overall assessment it is possible for some compensation of, for example, a poorer exam marks by a very good assignment marks to yield a passing grade but it is not possible to pass the unit without performing satisfactorily in all components.

Required Text

There is no required textbook for the unit.

Recommended Readings

Recommended reading material will be provided during the unit.

Technologies Used

The presentation of the material will mostly be through lecture slides and worked examples and

explanations on the whiteboard. Demonstrations will be used were appropriate and all notes will be available electronically.

Teaching Strategy

This unit is taught through lectures and tutorials and through undertaking assignments, mini research projects and examinations. We strongly encourage students to attend lectures because they provide a much more interactive and effective learning experience than studying a book or article. Questions during and outside lectures are strongly encouraged in this unit – please do not be afraid to ask as it is likely that your classmates will also wantto know the answer. You should aim to read the relevant sections of the indicated texts before and after lectures and discuss the content with classmates and lecturers.

This unit includes two small compulsory projects, one in each semester. Some lectures in the second semester will be accompanied by practical laboratory experiments as well. These are stand alone investigations and may include topics not fully covered by the lecture content of this course – They are an important part of the learning for this unit and the skills learned are essential for a well rounded physics graduate.

Workload

You should aim to spend around 3 hours per week working on the assignments and projects. You may wish to discuss your assignment problems with other students and the lecturers, but you are required to hand in your own work (see the note on plagiarism below). Assignments are provided as one of the key learning activities for this unit, they are not there just for assessment but to encourage you to actively engage with the subject. It is by applying knowledge learned from lectures and textbooks to solve problems that you are best able to test and develop your skills and understanding of the material.

Unit Schedule

This is a full-year 3 cpt unit, offering extended insight into unifying core principles of physics. Alternate years will focus on two key concepts that permeate nearly all of physics - probability (even years) and symmetry (odd years). These two key concepts affect much of modern physics including quantum mechanics, astronomy and astrophysics, lasers and photonics, and biophysics. Students are expected to engage in a research-related activity and produce a report in scientific format on their findings.

Semester 1

Weeks	Odd Years (2015)	Even Years (2014)
1-2	Introduction and overview, general concepts such as phase-space, reversibility and conservation laws. What kind of laws describe nature. Review of classical physics using Newton's laws.	Traditional 'frequentist' interpretation of probabilities. Probability distributions
3-4	Principle of least action and the calculus of variations. Local vs global laws. Euler-Lagrange equations. Examples.	Hypothesis testing. Deductive reasoning.
5-6	The Lagrangian. Using the Lagrangian. 'Derivation' of Newton's laws. Generalised coordinates, forces and momenta.	Plausibility reasoning. Bayesian Inference

7-8	Change of coordinates. First look at conservation laws. QED (non examinable).	Priors and maximum entropy.
9-10	Conservation Laws. Cyclic Coordinates. Symmetries and Noether's theorem	Measurements
11-12	Legendre Transforms. Hamilton's Equations. Phase Space	Probability in experimental sciences
13	*Review*	*Review*

Semester 2

Weeks	Odd Years (2013)	Even Years (2014)
1-2	Poisson Brackets. Liovilles theorem. SHO revisited.	Information theory
3-4	Cannonical transformatinos. Electromagnetism	Information theory
5-6	Continuous Systems	Statistical Mechanics
7-8	Classical field theory	Statistical Mechanics
9-10	Introduction to symmetries and Group theory	Quantum Mechanics
11-12	Introduction to symmetries and Group theory	Quantum Mechanics
13	*Review*	*Review*

Learning and Teaching Activities

Lecture tutorials

There will be two informal lectures per week where the students are actively encouraged to participate

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to

handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Assessment task

- Projects

Learning and teaching activity

- There will be two informal lectures per week where the students are actively encouraged to participate

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

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Assessment tasks

- Assignments
- Projects
- Exams

Learning and teaching activities

- There will be two informal lectures per week where the students are actively encouraged to participate

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where

relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

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- Exams

Learning and teaching activities

- There will be two informal lectures per week where the students are actively encouraged to participate

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

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Learning and teaching activities

- There will be two informal lectures per week where the students are actively encouraged to participate

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

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Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

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Learning and teaching activities

- There will be two informal lectures per week where the students are actively encouraged to participate

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

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- Projects
- Exams

Learning and teaching activities

- There will be two informal lectures per week where the students are actively encouraged to participate

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should

have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Assessment task

- Projects

Learning and teaching activity

- There will be two informal lectures per week where the students are actively encouraged to participate

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Assessment task

- Projects

Learning and teaching activity

- There will be two informal lectures per week where the students are actively encouraged to participate

Changes since First Published

Date	Description
16/01/2014	The Prerequisites was updated.