School of Physics

Course Outline 2020

PHYS9140

MODERN AND THERMAL PHYSICS FOR TEACHERS

School of Physics

Faculty of Science

Term 3, 2020

Faculty of Science - Course Outline

1. Information about the Course

NB: Some of this information is available on the UNSW Handbook[1]

Year of Delivery	2020
Course Code	PHYS9140
Course Name	Modern and Thermal Physics for Teachers
Academic Unit	School of Physics
Level of Course	Postgraduate
Units of Credit	6UOC
Term(s) Offered	Term 3
Assumed Knowledge, Prerequisites or Co-requisites	PHYS9110, PHYS9120, PHYS9130 are pre-requisites Calculus (3 unit mathematics) is required
Hours per Week	12 hours per week
Number of Weeks	10 weeks
Commencement Date	14th September 2020
Component	**Details**
Lectures	These are available online through Openlearning. Lectures consist of short videos followed by questions and activities.
Experiments	You will conduct experiments at home/school and write them up for submission. You will need to adapt the experiment to suit the equipment you have access to.
Tutorial problems	Each topic will have tutorial problems available for you. These are to give you practice using the content of the lectures to solve the types of problems you will get in the final examination. These can be found through the Openlearning lessons.
Online discussions	You will be expected to contribute to online discussions in Openlearning throughout the course.
Quizzes	There will be three online quizzes during the course, you may attempt these as many times as you like. Your highest mark will count. These are to give you practice answering exam style questions during the course.

[1] UNSW Online Handbook: http://www.handbook.unsw.edu.au

2. Staff Involved in the Course

Staff	Role	Name	Contact Details	Consultation Times
Course Convenor		*A. Prof. Elizabeth Angstmann*	*e.angstmann@unsw.edu.au* *Room G61F, OMB* *School of Physics*	*Email to arrange a time*
Additional Teaching Staff	Teaching assistants	*Liz is also tutoring this course*		
	Other Support Staff	Seda Cokcetin	s.cokcetin@unsw.edu.au School of Physics office, G06 in the old main building	

3. Course Details

Course Description (Handbook Entry)	This is an online course covering thermal and modern physics. Lecture material and tutorial problems will be presented online. This is the fourth course in the graduate certificate for physics teachers. This course will cover thermal physics, and introduce quantum mechanics including the Schrodinger equation for simple situations, the standard model will be discussed and applications of quantum mechanics considered. **Assumed knowledge**: Students need to be able to differentiate and integrate polynomials and write and solve simple differential equations to complete the course. A good understanding of HSC level extension 1 mathematics is recommended. Knowledge from the pre-requisites: PHYS9110, 9120 and 9130 is assumed.
Course Aims	This course aims to give students an understanding of thermal physics, quantum mechanics and applications of these fields. After undertaking this course students should be confident in their ability to present ideas covered in this course to high school students. Students will be able to relate observations to what is taking place at a microscopic level. They will have an understanding of the basis of quantum mechanics and be able to solve simple problems in this field. After completing this course students will be able to relate different branches of physics to each other, describing the similarities and differences between the branches. Students will also be able to apply what they have learnt in this course to give a description of the basic workings of modern devices.
Student Learning Outcomes	By the end of this course students should be able to: 1. Relate macroscopic observations to phenomena occurring on microscopic scales. 2. State and solve problems using the first and second laws of thermodynamics, relate these to conservation of energy and the irreversibility of natural processes. 3. Recognise and solve problems relating to different thermodynamic processes, including adiabatic, isothermal, isobaric and isovolumetric processes. Put these processes together in cycles and use these to give a basic explanation of how a heat pump and refrigerator works. 4. Discuss and explain (qualitatively and quantitatively) the key observations and events that led to the development of quantum mechanics, relate these to our understanding of thermal physics and mechanics. 5. Be able to state the Schrödinger equation and use it to calculate energy levels in the simple case for a particle in a box. 6. Relate emission and absorption spectra to the energy change of electrons between states in an atom, calculate the energy levels of electrons in Hydrogen like atoms, relate this to quantum mechanical

	laws. 7. Describe and explain the physics relating modern devices and technologies including semiconductors, transistors, LEDs and solar cells. 8. Describe the different families of matter making up the universe and described by the standard model, recognise the similarities and differences between these families and state physical laws that they obey. 9. Relate different branches of physics by being able to recognise similarities and differences between them, recognise that there are four fundamental forces that can describe all interactions and a number of conservation laws that apply under different conditions. 10. Recognise that physics is an experimental science, have skills to plan and conduct experiments and analyse the outcomes, include estimates of the uncertainty in measurements.
Relationship to Other Courses within the Program	PHYS9110, 9120 and 9130 are pre-requisites for this course.

4. Rationale and Strategies Underpinning the Course

This course is delivered entirely online. Each week the students will have a series of videos to view that will cover some aspects of thermal or modern physics. Videos will include the presentation of theory, demonstrations and worked examples. After watching each video students will consolidate their knowledge by answering a question or completing an activity. Students will have a set of tutorial problems so solve each week to check that they are able to apply the theory presented to them to solve problems. They will have access to solutions and a discussion board if they need assistance with this.

Assessment:

The Dunlosky et. al. meta-analysis showed that the best study techniques students could use to prepare for an exam was to practice answering a lot of questions over the course. The assessments for this course have been designed with this in mind. Students are given quizzes every three weeks with an unlimited number of attempts to ensure that they are confident answering questions on course material.

The final exam is used to ensure that students are able to solve problems quickly and correctly. As exams are used to access high school physics this also gives teachers an opportunity to experience these from a student perspective.

Labs are also assessed, as physics is an experimental science, students need to be able to conduct measurements to test models. Students are asked to adapt the three lab exercises they complete so that they can be used with a high school class. This lends authenticity to the assessment as the students end up with resources that they can directly use in the classroom.

5. Course Schedule

Week (starts on)	Work through (watch videos, answer tutorial questions, try activities) the module on:	Assignment and Submission dates (see also 'Assessment Tasks & Feedback')
Week 1 14th September	Thermodynamics of solids and liquids	
Week 2 21st September	Thermodynamics of ideal gasses	
Week 3 28th September	The first law of thermodynamics and thermal processes	Experiment 1 due Sunday
Week 4 5th October	Entropy and second law of thermodynamics	Online test 1 HECs census date 11th October
Week 5 12th October	An introduction to quantum mechanics	
Week 6 19th October	Schrödinger's equation	Experiment 2 due Sunday
Week 7 26th October	Models of Hydrogen and atomic physics	Online test 2
Week 8 2nd November	Nuclear Physics	
Week 9 9th November	The Standard model	Experiment 3 due Sunday
Week 10 16th November	Cosmology	Online test 3

6. Assessment Tasks and Feedback

Task	Knowledge & abilities assessed	Assessment Criteria	% of total mark	Date of		Feedback		
				Release	Submission[2]	WHO	WHEN	HOW
Online tests	Assesses ability to solve problems based on first five learning outcomes	Students need to correctly perform calculations and recall a few facts	6.67 % × 3 = 20%	02/10/20 23/10/20 13/11/20	11/10/20 01/11/20 22/11/20 At 11:59 PM	*Automated through Moodle*	*Immediately after quiz closes*	*Marks on Moodle and written solutions given in quiz*
Experiments and experiment reports	Be able to investigate the physics behind phenomenon and develop skills associated with good experimental technique	Will be given at the end of each exercise.	3 × 10% = 30%	13/09/20 13/09/20 13/09/20	04/10/20 25/10/20 15/11/20 At 11:59 PM	Course staff	12/10/20 02/11/20 23/11/20	Through rubric on Turnitin
Final exam	Be able to solve problems based on the content covered in this course	Students will receive marks for correctly answering questions	50%	Held during exam period, 27th Nov-10th Dec		Convener	Mark included in final grade	

[2] All times and dates are given for Sydney. If a student is submitting from overseas it is their responsibility to check that they submit it by the due time.

7. Additional Resources and Support

Text Books	Halliday, D., Resnick, R., & Walker, J. (2014). Fundamentals of Physics, John Wiley & Sons. Note: the library has an eBook subscription to this. The link is provided on the Moodle site. The book can be purchased from the publisher here: http://www.wileydirect.com.au/buy/fundamentals-of-physics-10th-edition/
Course Manual	Experiments will be available through Openlearning
Required Readings	All required resources made available through Openlearning
Additional Readings	Most calculus based introductory physics text books are suitable. Physics Vol 1 by Serway, Jewett, Wilson and Wilson is an example of one of these.
Recommended Internet Sites	Will be made available on Moodle and Openlearning

8. Required Equipment, Training and Enabling Skills

Equipment Required	Calculator School laboratory equipment will be needed for the experiments. If you do not have access to this please let us know so that we can mail appropriate equipment to you. It is preferable to use your own equipment so that you have activities you can complete with your classes.
Enabling Skills Training Required to Complete this Course	3 unit mathematics: need to be able to use trigonometry, logarithms, vectors and calculus

9. Course Evaluation and Development

Student feedback is gathered periodically by various means. Such feedback is considered carefully with a view to acting on it constructively wherever possible. This course outline conveys how feedback has helped to shape and develop this course.

Mechanisms of Review	Last Review Date	Comments or Changes Resulting from Reviews
Major Course Review		This course ran for the first time in 2018.
myExperience[3]		
Other	*2019* *2020*	Made entirely online, four experiments completed in two days at UNSW replaced with three experiments conducted at school. Lab exercises have been updated for 2020 based of 2019 feedback.

10. Administration Matters

Expectations of Students	Even though this course is completely online the assumption is that students will spend the same amount of time working on it as a face-to-face physics course. Students should spend approximately twelve hours a week working through the course materials, answering questions and completing assessments.		
Assignment Submissions	All submission times are Sydney times. There is a 25% penalty for each day the investigations are late. This is applied using the time Moodle shows the assignment was submitted (in Turnitin). Students should submit well in advance of the submission deadline as the Moodle can slow down due to heavy usage at the due time. **If a student experiences any difficulty submitting an assignment through Moodle they must email a copy of the assignment to e.angstmann@unsw.edu.au before assignment is due, with a report of what went wrong (so that we can fix it).** If there are special circumstances causing a student to miss a deadline they should apply for special consideration through myUNSW, a doctor's certificate or other suitable documentation will be needed. All assignments need to be typed.		
Occupational Health and Safety[4]	Is very important. You must complete and abide by a risk assessment for each of the investigations you conduct, including the one for your final report.		
Assessment Procedures **UNSW Assessment Policy**[5]	The UNSW special consideration information can be found here: https://student.unsw.edu.au/special-consideration		
Equity and Diversity	Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course Convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or http://www.studentequity.unsw.edu.au/). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.		
Student Complaint Procedure[6]	**School Contact**	**Faculty Contact**	**University Contact**
	A. Prof. Elizabeth Angstmann First year Physics Director e.angsmtann@unsw.edu.au Or Prof. Adam Micolich, Director of Teaching, Physics adam.micolich@unsw.edu.au	Deputy Dean Education A. Prof. Alison Beavis a.beavis@unsw.edu.au Or Dr Gavin Edwards Associate Dean (Undergraduate Programs) g.edwards@unsw.edu.au Tel: 9385 6125	Student Conduct and Appeals Officer (SCAO) within the Office of the Pro-Vice-Chancellor (Students) and Registrar. Telephone 02 9385 8515, email studentcomplaints@unsw.edu.au University Counselling and Psychological Services[7] Tel: 9385 5418

[4] UNSW OHS Home page
[5] UNSW Assessment Policy
[6] UNSW Student Complaint Procedure
[7] University Counselling and Psychological Services

11. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage.[8] *At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.*

Further information about academic integrity and plagiarism can be located at:

- *The Current Students site* student.unsw.edu.au/plagiarism*, and*
- *The ELISE training site* subjectguides.library.unsw.edu.au/elise

The Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: student.unsw.edu.au/conduct*.*

[8] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.