DEPARTMENT OF PHYSICS
UNIVERSITY OF CAPE TOWN

PHY3004W
Advanced Physics
2019

Course Information Sheet

PHY3004W is the final-year course for students majoring in Physics for the BSc degree. Each student registered for this course is required to have a laptop for use during class sessions as well as after hours. The minimum specifications of the laptop are available at www.phy.uct.ac.za. (A tablet or "netbook" will not be suitable).

***Course entry requirements*:** PHY2004W, and 40% in MAM2000W or (MAM2004H and MAM2047H).

***Convener*:** Dr. Steve Peterson, 5.14 RW James, steve.peterson@uct.ac.za

***Lectures*:** RW James LT2A, 4th period (11h00 – 11h45), Monday to Friday.

***Course website*:** The course content will be provided on Vula.

***Class tutor*:**

First semester:	EM:	Will Grunow
	AP:	TBA
Second semester:	TBA	

***Weekly problem sets*:** Each week a problem set will be issued. Solutions must be written completely and legibly to receive full marks. Students may work together on the problems, and discuss the results together, but the handed-in script must be each student's own work. The problem sets will be marked by the tutor and returned to the student using the PHYLAB3 pigeonholes.

***Tutorials*:** White board style tutorials will run most Tuesdays from 14h00 to 17h00 in PHYLAB2 (see the calendar). Attendance will be recorded and used for DP purposes. Solutions to tutorials will not be posted, so students are to ensure that they use the tutorial time effectively.

***Laboratory*:** Labs run most Mondays from 14h00 to 17h00 in PHYLAB3. See the 'Laboratory' folder on Vula for more information and the schedule.

***Project*:** As part of the integrated assessment requirement of the course, a project will involve independent reading, research, and measurement or computation. More details will be communicated shortly.

***Test and Exams*:** Students may bring a self-generated formula sheet (two A4 pages double-sided) to all tests and examinations. Additional formula and/or data sheets will be provided.

***Plagiarism*:** The real criterion is this: work that you hand-in for credit is work that you must yourself understand. If copying from others is detected, the work of both the copier and the copied will not be marked, and a mark of zero will be awarded to each, and university disciplinary procedures may be invoked. Submitting the solutions taken from the solutions posted on the website by the class tutor in previous years, also constitutes copying. A mark of zero may be awarded, or a nominal mark may be awarded at the discretion of the course convener.

NOTE: You will be required to complete the online Vula quiz stating that you agree with the department's Plagiarism Policy. Please read it on Vula under Resources/Administration.

***Assessment*:**

4 x class tests	15% together
24 x weekly problem sets:	5%
1 x project report and presentation:	10%
laboratory record:	20%
2 x June exam papers [2 hours each]	25% together
2 x November exam papers [2 hours each]	25% together

There is a subminimum of 40% required on the average of the four examinations (see Science Faculty Handbook).

***Checking Course Marks*:** Students may check their course marks using the Physics self-service WebApp: http://webapp-phy.uct.ac.za/webmarks/3004w

***Missed Activities*:** If you are ill and miss any grade-carrying activity, then a medical certificate from a registered medical practitioner (with the Medical Certificate Form found on Vula) needs to be presented to Jill Patel (Room 5.07 RW James) within 2 days of returning to classes. You are also required to email the course convener indicating the activities you have missed. Students missing a test due to illness will be asked by the course convener to write a make-up test within a few days. Plans will also be made to hand in missed homework, tutorials or other assignments. Exceptions are only granted in very rare circumstances. Exemptions from laboratory activities are handled by the laboratory convener for the course and not the overall course convener.

***Short Leave*:** If a student wishes to be granted an exemption or extension for a course requirement associated with a planned (future) short absence from the course, then there is a form to complete (available on the course Vula site). This form needs to be submitted to Jill Patel (Room 5.07 RW James) at least 3 working days prior to the period in question. Irreversible plans (such as flight bookings) must not be made before approval of leave is granted.

***Duly Performed (DP) requirement*:** In order to qualify for writing the final examination, the following DP requirements must be met by Monday, 7 October:

- minimum of 40% in class record;
- attendance at all tests;
- completion of all laboratory reports;
- completion of the project;
- completion of 75% of the tutorials and problem sets

***Lecture Outline*:** There are 7 lecture modules.

First Semester			
NP	Nuclear Physics Intro	5 lectures	Prof. Andy Buffler & Dr. Steve Peterson
EM	Electromagnetism	29 lectures	Dr. Tom Dietel
AP	Atomic Physics	26 lectures	A/Prof. Heribert Weigert
Second Semester			
TP	Thermal Physics	20 lectures	Prof. Andre Peshier
NP	Nuclear Physics	9 lectures	Dr. Steve Peterson
PP	Particle Physics	10 lectures	Dr. Sahal Yacoob
SS	Solid State Physics	19 lectures	Dr. Trisha Salagaram

Electromagnetism: Maxwell's equations in vacuum and in matter, conservation laws, momentum and angular momentum in EM fields, EM waves, absorption and dispersion, wave guides, gauge transformations, retarded potentials, electric and magnetic dipole radiation, power radiated by a point charge, special relativity, four-vectors, relativistic electrodynamics, EM field tensor.

- Griffiths, D.: Introduction to Electrodynamics (Pearson, 2014)
- Jackson, J.D.: Classical Electrodynamics (Wiley, 1998)

Atomic Physics: Atoms; x-rays; angular momentum in quantum mechanics; spherical harmonics; hydrogen atom; transitions and selection rules; spin, fine structure, Lamb shift, Zeeman effect, hyperfine structure; helium atom; multi-electron atoms; atomic structure and the periodic table.

- Griffiths, D.: Introduction to Quantum Mechanics (Pearson, 2005)
- Sakuri, J.J.: Modern Quantum Mechanics (Addison, 1994)
- Scheck, F.: Quantum Physics (Springer, 2007)

Thermal Physics: Temperature, heat and work, first law of thermodynamics, ensembles and entropy, second law of thermodynamics, Boltzmann distribution and Helmholtz free energy, thermal radiation, chemical potential and Gibbs distribution, Femi-Dirac statistics, electrons in metals, Bose-Einstein statistics, phonons, photons and the black-body distribution, the Bose-Einstein condensate, application to classical and quantum systems.

- Schroeder, D.: Introduction to Thermal Physics (Pearson, 2013)

Nuclear and Particle Physics: basic properties of nuclei, nuclear binding energy and the semi-empirical mass formula, nuclear shell model, radioactivity and the radioactive decay series; alpha, beta and gamma radioactivity; interaction of radiation with matter, radiation dosimetry; standard model of particle physics, Feynman diagrams, high energy particle physics experimentation.

- Martin, B.: Nuclear and Particle Physics (Wiley, 2006)
- Lilley, J.: Nuclear Physics (Wiley, 2001)
- Griffiths, D.: Introduction to Elementary Particles (Wiley, 2004)

Solid State Physics: Crystal structure; lattice vibrations; electron states in solids; nearly free electron model, energy band theory; semiconductor physics and devices.

- Hoffmann, P.: Solid State Physics - An Introduction (Wiley, 2007)