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7701 RONDEBOSCH

Dean's & Faculty Offices: Room 6.43, P D Hahn Building
28 Chemistry Road
Upper Campus

Office Hours: Mondays to Fridays: 08h30 - 16h30

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Dean's Office (021) 650 2711
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Admissions (021) 650 2128

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UCT's Home Page http://www.uct.ac.za
Science Home Page http://www.science.uct.ac.za
Dean's Office sci-science@uct.ac.za
Faculty Office iapo@uct.ac.za
International Academic Programmes
Office

The Admissions Office and Student Records Office are located in the Masingene Building, Middle Campus, and are open from 08h30 to 16h30. The Cashier's Office is located in Kramer Building, Middle Campus, and is open from 09h00 to 15h30.

This handbook is part of a series that consists of

Book 1: Undergraduate Prospectus
Book 2: Authorities and information of record
Book 3: General Rules and Policies
Book 4: Academic Calendar and Meetings
Book 5: Student Support and Services
Book 6-11: Handbooks of the Faculties of Commerce, Engineering & the Built Environment, Health Sciences, Humanities, Law, Science
Book 12: Student Fees
Book 13: Bursary and Loan Opportunities for Undergraduate Study
Book 14: Financial assistance for Postgraduate Study and Postdoctoral Research
DEPARTMENT OF PHYSICS

The Department is housed in the R W James Building, 9 University Avenue
Telephone (021) 650-3326 Fax (021) 650-3342 Website: www.phy.uct.ac.za

The Departmental abbreviation for Physics is PHY.

Professor and Head of Department:
A Buffler, MSc PhD HDE Cape Town

Professors:
M S Allie, MSc PhD Cape Town (CHED)
A Peshier, MA PhD Dresden

Senior Scholars:
J W A Cleymans, MSc D en Sc Louvain FRSSAf
C A Dominguez, MSc PhD Buenos Aires FRSSAf

Emeritus Professors:
D G Ashman, BSc Hons Cape Town DPhil Oxon
D T Britton, MSc PhD London
R D Viollier, Dipl Phys Dr phil nat Basel FRSSAf

Associate Professors:
M D Blumenthal, BSc Witwatersrand Dipl Phys Bonn PhD Cantab
W A Horowitz, MA MSc PhD Columbia
S W Peterson, MA PhD Wisconsin
H W G Weigert, Dipl Phys Dr rer nat habil Regensburg

Emeritus Associate Professors:
R W Fearick, BSc Hons PhD Witwatersrand
M Häring, Dipl Phys Regensburg Dr. Ing BW München
P E Spargo, BSc (Eng) MSc Witwatersrand Cert Ed Cantab FRSSAf
G N v d H Robertson, BSc Hons Cape Town DPhil Oxon

Adjunct Associate Professor:
S R Naidoo, PhD Witwatersrand

Honorary Professor:
F Azaiez, MSc Paris PhD Orsay

Senior Lecturers:
T Dietel, Dipl Phys Heidelberg Dr phil nat Frankfurt am Main
D L Taylor, BSc Hons HDE UKZN MSc PhD Witwatersrand (CHED)
S M Wheaton, MSc PhD Cape Town
S Yacoob, MSc Cape Town PhD Northwestern

Lecturers:
K Cole, MPhys Hons MSc Liverpool PhD ICL
D R Geduld, MSc Cape Town
J M Keaveney, PhD Dublin
T Leadbeater, MSc PhD Birmingham
T Salagaram, MSc PhD UKZN

Honorary Research Associates:
J A Ayala, PhD Minnesota
L A Hernandez, PhD Cape Town
M Loewe, PhD Hamburg
K Schilcher, PhD Vienna
M Spiesberger, PhD Mainz

Chief Scientific Officer:
N Razak, MSc PhD Cape Town
Scientific Officers:
K Maibane, MSc UWC
M R van Heerden, MSc(Eng) Cape Town

Research Officer:
N B Ndabeni, MSc PhD Stell

Junior Research Fellow (MeASURe):
T Hutton, EngD Birmingham

Principal Technical Officers:
J Dickson
G K Fowle
K J Ontong
C J J Sadler

Chief Technical Officer:
M Christians

Department Administrator:
N Lovric

Administrative Assistants:
B Matubatuba
J Patel

Laboratory Attendant:
R Hansen

Departmental Assistant:
N Mzamo

RESEARCH IN PHYSICS

The Department of Physics is accommodated in the R W James Building, which houses laboratories equipped for nuclear physics, solid state and nanophysics, ultracold physics (8 mK dilution refrigerator), and physics education research. Additional facilities available to the Department are provided by iThemba Laboratories for Accelerator-Based Sciences (200 MeV cyclotron and other particle accelerators).

Major areas of interest at present include:

1. Experimental nuclear physics at iThemba LABS (A Buffler, R W Fearick, T Leadbeater, N B Ndabeni and S W Peterson) comprising: (a) Gamma ray spectroscopy with the AFRODITE array; (b) Giant resonance reactions with the magnetic spectrometer; (c) Fast neutron physics; (d) Radiation detection and measurement.

2. Theoretical Physics (J W A Cleymans, C A Dominguez, W A Horowitz, A Peshier and H W G Weigert), comprising: (a) Research within the Centre for Theoretical and Mathematical Physics; (b) Structure of elementary particles; (c) Neutrino physics and astrophysics; (d) Quantum field theory, quantum electrodynamics and chromodynamics in free space, in the cavity and at extreme temperatures and pressures; (e) Renormalization group equations, both linear and nonlinear (Color Glass Condensate); (f) Nonlinear effects in QCD at high densities; (g) Phenomenology of heavy ion reactions; (h) Quark gluon plasma.

3. Experimental high energy physics (J W A Cleymans, T Dietel, S Yacoob and J M Keaveney), comprising:
   (a) Research within the UCT-CERN Research Centre; (b) Relativistic heavy ion collisions within the ALICE collaboration at CERN; (c) High energy proton-proton collisions within the ATLAS collaboration at CERN.

4. Nanophysics and solid state physics (M D Blumenthal and T Salagaram), comprising: (a) Research within the Nanoelectronics Research Laboratory; (b) Structural and electrical properties of nanomaterials; (c) Single electron transport and interactions; (d) Computational studies.

5. Applied Physics (M D Blumenthal, A Buffler, K E Cole, T Leadbeater, S W Peterson, T Salagaram, T Hutton, N B Ndabeni and S M Wheaton), comprising: (a) Research within the Metrological and Applied Sciences University Research Unit (MeASURe). (b) Positron Emission Particle Tracking at PEPT Cape Town, iThemba LABS and the Position Imaging Centre, University
of Birmingham, UK; (c) Radiation transport modelling in industrial and medical systems; (d) Applied nuclear physics and engineering; (e) Electrical and radiation measurement standards.

6. Tertiary physics education (M S Allie, A Buffler, T Salagaram, D L Taylor and S M Wheaton), comprising: (a) Curriculum design and evaluation; (b) Role of language; (c) Understanding of measurement and uncertainty; (d) Modelling and visualization; (e) Computational physics education.

**Undergraduate Courses**

Credit will not be given for both PHY1023H and PHY1031F. Credit can be given for both of PHY1023H and PHY1004W.

**First-Year Courses**

**PHY1004W**  **MATTER & INTERACTIONS**

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). The course convener will provide details of additional software (open source) required.

36 NQF credits at NQF level 5

**Convener:** Professor A Buffler

**Course entry requirements:** At least 60% for NSC Physical Science. MAM1000W (or equivalent) must have been passed or be taken concurrently. Students registered for this course will be assessed in week 5; if it is judged that they are not coping with the level and pace of the course, and would benefit from an opportunity to strengthen foundational concepts and learn new material at a slower pace, they will be required to transfer to PHY1031F or PHY1023H from week 7.

**Course outline:**

PHY1004W is an advanced calculus-based introductory course for Science students intending to continue with second-year Physics. It features the modelling of physical systems from fundamental principles, and computational problem solving using VPython. The course includes the following topics: Modern mechanics: Conservation laws, the momentum principle, atomic nature of matter, conservation of energy, energy in macroscopic systems, energy quantization, multi-particle systems, exploring the nucleus, angular momentum, entropy. Electric and magnetic interactions: Electric fields, electric potential, magnetic fields, electric circuits, capacitance, resistance, magnetic force, Gauss' Law, Ampere's Law, Faraday's Law, induction, electromagnetic radiation, waves and particles.

**Lecture times:** Monday - Friday, 3rd period

**DP requirements:** Minimum of 40% in class record, including 50% in laboratory assessment.

**Assessment:** Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour examination in June counts 25%; one 2-hour examination in November counts 25%.

**PHY1023H**  **PRINCIPLES OF PHYSICS**

Students passing PHY1023H may proceed into PHY1032F. Students who pass PHY1023H and then register for and pass PHY1004W will gain credit for both courses.

18 NQF credits at NQF level 5

**Convener:** Dr D L Taylor

**Course entry requirements:** At least 60% for NSC Physical Science. The permission of the Dean or Head of Department is required prior to registration for this course. Notes: 1) This course only begins in week 7 and is intended for students who have been advised to transfer to this course after initially registering for PHY1004W or PHY1031F (see entries for these courses). 2) The course places an emphasis on the strengthening of foundational concepts and skills, the carefully-paced introduction of new material, and the development of sound approaches to effective learning.
Course outline:
PHY1023H is an algebra-based introductory course for Science students. Some calculus may be used. The course includes the following topics: Tools and skills: Essential mathematical, diagrammatic and conceptual tools and skills for Physics, co-ordinate systems, vectors, rates of change, the fundamental forces, mathematical techniques and their relationship with physical phenomena. Mechanics: kinematics, forces, dynamics, momentum, impulse, work, energy, power, collisions, rotation, rotational dynamics, torque, angular momentum, static equilibrium, gravitation. Properties of matter: elasticity, hydrostatics, hydrodynamics. Vibrations and waves: simple harmonic motion, damped oscillations, forced oscillations, resonance, travelling waves, superposition, standing waves, sound waves, sound intensity and Doppler Effect.

Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record, including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in November counts 50%.

PHY1031F GENERAL PHYSICS A
18 NQF credits at NQF level 5
Convener: Dr S M Wheaton
Course entry requirements: At least 60% for NSC Physical Science. Note: Students registered for this course will be assessed in week 5; if it is judged that they are not coping with the level and pace of the course, and would benefit from an opportunity to strengthen foundational concepts and learn new material at a slower pace, they will be required to transfer to PHY1023H from week 7.
Course outline:
PHY1031F is an algebra-based introductory course for Science students who do not intend proceeding to second-year courses in Physics. Some calculus may be used. The course includes the following topics: Mechanics: vectors, kinematics, forces, dynamics, momentum, impulse, work, energy, power, collisions, rotational dynamics, torque, angular momentum, static equilibrium, gravitation. Properties of matter: elasticity, hydrostatics, hydrodynamics. Vibrations and waves: simple harmonic motion, damped oscillations, forced oscillations, resonance, travelling waves, superposition, standing waves, sound waves, sound intensity and Doppler Effect.
Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record; including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in June counts 50%.

PHY1032F GENERAL PHYSICS B
18 NQF credits at NQF level 5
Convener: Dr T Salagaram
Course entry requirements: PHY1031F or PHY1023H
Course outline:
PHY1032F is an algebra-based introductory course usually taken by Science students who have completed PHY1023H. Some calculus may be used. The course includes the following topics: Electricity and magnetism: electric charge, electric field, Gauss’ law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, magnetic field, Biot Savart law, Ampere’s law, electromagnetic induction, inductance, alternating currents. Thermal physics: temperature, heat, kinetic theory of gases, first and second laws of thermodynamics. Optics: Geometrical optics, polarization, electromagnetic waves, interference, diffraction. Modern physics: atomic structure, quantum physical phenomena, wave-particle duality, X-rays, elementary nuclear physics, radioactivity.
Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record, including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in June counts 50%.
**PHY1032S  GENERAL PHYSICS B**

18 NQF credits at NQF level 5  
**Convener:** Associate Professor H W G Weigert  
**Course entry requirements:** PHY1031F or PHY1023H  
**Course outline:**  
PHY1032F is an algebra-based introductory course usually taken by Science students who have completed PHY1023H. Some calculus may be used. The course includes the following topics: Electricity and magnetism: electric charge, electric field, Gauss’ law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, magnetic field, Biot Savart law, Ampere’s law, electromagnetic induction, inductance, alternating currents. Thermal physics: temperature, heat, kinetic theory of gases, first and second laws of thermodynamics. Optics: Geometrical optics, polarization, electromagnetic waves, interference, diffraction. Modern physics: atomic structure, quantum physical phenomena, wave-particle duality, X-rays, elementary nuclear physics, radioactivity.  
**Lecture times:** Monday - Friday, 3rd period  
**DP requirements:** Minimum of 40% for the class record, including 50% in laboratory assessment.  
**Assessment:** Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in November counts 50%.

**Second-Year Courses**

**PHY2004W  INTERMEDIATE PHYSICS**

*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). The course convenor will provide details of additional software (open source) required.*

48 NQF credits at NQF level 6  
**Convener:** Associate Professor M D Blumenthal  
**Course entry requirements:** PHY1004W, a full first-year course in Mathematics, and MAM2000W or (MAM2004H and MAM2047H) as co-requisite.  
**Course outline:**  
PHY2004W develops the foundations of a major in Physics and allows continuation to third-year Physics. The theory component features a set of intermediate topics, and the laboratory component develops both experimental and computational skills. The course includes the following topics: Mechanics: Review of Newton’s Laws, inertial and non-inertial frames, transformations, equations of motion for 1D systems, oscillations, resonance, non-linear systems, Euler’s equation, Lagrange’s equation, generalized co-ordinates and constrained systems, Hamiltonian formalism, phase space and Liouville’s theorem, effective potentials, planetary motion, systems of particles, angular momentum, collisions, rigid bodies, simple harmonic motion, resonance, coupled oscillators, wave equation, special relativity, relativistic mechanics.  
Electromagnetism: Vector calculus (div, grad, curl), electrostatics, special techniques for potentials, electric fields in matter, magnetostatics, magnetic fields in matter, current, Ohm’s law, circuits, electromagnetic induction, electrodynamics, Maxwell’s equations.  
Quantum Mechanics: The basic assumptions of quantum mechanics, solutions of Schrödinger's equation, properties of wave functions and operators, one-dimensional applications, angular momentum in quantum mechanics, three-dimensional applications, the hydrogen atom, approximate methods.  
Laboratory: Practical and computational tasks designed to develop advanced skills of experimentation and problem solving within the context of Mechanics, Electromagnetism and Quantum Mechanics.  
**Lecture times:** Monday - Friday, 4th period  
**DP requirements:** Minimum of 40% for the class record; completion of all laboratory reports and 75% of tutorial work and problem sets; attendance at all tests.
Assessment: Class record (tests, weekly problem sets and laboratory work) counts 50%; one 3-hour examination in June counts 25%; one 3-hour examination in November counts 25%. A subminimum of 40% is required in each of the two examinations.

Third-Year Courses

**PHY3004W  ADVANCED PHYSICS**
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). The course convenor will provide details of additional software (open source) required.

72 NQF credits at NQF level 7
Convener: Dr T W Leadbeater
Course entry requirements: PHY2004W, and 40% in MAM 2000W or (MAM2004H and MAM2047H).
Course outline: This course completes the major in Physics. The theory component aims to develop advanced skills in problem solving within physics, and includes the following topics:
- Electromagnetism: Maxwell's equations in vacuum and matter, momentum and angular momentum in electromagnetic fields, electromagnetic waves, wave guides, gauge transformations, retarded potentials, electric and magnetic dipole radiation, special relativity, relativistic kinematics and electrodynamics, electromagnetic field tensor.
- Thermodynamics and Statistical Physics: Temperature, heat and work, laws of thermodynamics, ensembles and entropy, Boltzmann distribution and Helmholtz free energy, thermal radiation, chemical potential and Gibbs distribution, Fermi-Dirac statistics, electrons in metals, Bose-Einstein statistics, phonons, photons and the black-body distribution, the Bose-Einstein condensate, applications to classical and quantum systems.
- Applications of Quantum Mechanics: Atomic Physics (atomic structure and spectra, selection rules, spin, fine structure, Zeeman effect, time dependent and independent perturbation theory); Nuclear and Particle Physics (properties of nuclei, nuclear forces, structure, reactions and models, nuclear models, interactions of elementary particles, quarks and leptons, symmetries and the gauge forces); and Solid State Physics (crystal structure, lattice vibrations, electron states in solids, energy band theory, semiconductor physics and devices).

The laboratory component includes practical and computational tasks to develop advanced skills of experimentation and scientific report writing.
Lecture times: Monday - Friday, 4th period
DP requirements: Minimum of 40% for the class record; attendance at all tests; completion of all laboratory reports; completion of the project and completion of 75% of tutorials and problem sets.
Assessment: Class record (tests, weekly problem sets, laboratory work and project) counts 50%; two 2-hour examinations in June count 25%; two 2-hour examinations in November count 25%. A subminimum of 40% exists in the weighted average of the four examinations.

Postgraduate Courses

**PHY4000W  PHYSICS HONOURS**
Since the code PHY4000W will not carry a NQF credit value, students will be concurrently registered for PHY4006W (coursework component of 120 NQF credits) and PHY4007W (research project of 40 NQF credits).
160 NQF credits at NQF level 8 (the combined credit value of both components)
Convener: Dr J M Keaveney
Course entry requirements: The entrance requirement is a BSc degree with a major in Physics. Acceptance will be at the discretion of the Head of Department who will consult the Honours course convenor. Criteria for acceptance include a pass of 60% in PHY3004W, or equivalent; and a pass of
60% in MAM2000W or MAM2046W, or equivalent; and in cases where the Head of Department deems it necessary, favourable referee reports. Enrolment is limited to 15 students. Preference may be given to UCT graduates who meet the course entry requirements.

Course outline:
The Honours course in Physics consists of several modules. Each student needs to design a module package which sums up to at least 12 units, and not more than 14 units. The Research Project (3 units) is compulsory. The compulsory modules (1 unit each) are: Electromagnetism 1, Quantum Mechanics 1 and Statistical Physics. At least five further modules (1 unit each) must be chosen from: Electromagnetism 2, Quantum Mechanics 2, Classical Mechanics, Computational Physics, Particle Physics, Nuclear Physics, Relativistic Quantum Mechanics, Quantum Field Theory, and Solid State Physics. Students are strongly encouraged to include both Electromagnetism 2 and Quantum Mechanics 2 in their module choice. The course starts with a compulsory non-credit bearing module dealing with mathematical tools and skills, and aspects of physics education. Furthermore, the course can be complemented by physics-related modules offered by the Departments of Astronomy, and Mathematics and Applied Mathematics, for example. The choice of modules and research project must be approved by the Head of Physics in consultation with the PHY4000W convener. Details appear on the Physics website: www.phy.uct.ac.za. The Department of Physics is presently reviewing the curriculum of PHY4000W.

DP requirements: 30% for class tests and problem sets, and suitable progress in the Research Project.

Assessment: The pass mark is 50% and is based on an aggregation of the results of all modules, and is further subject to the subminimum criteria of obtaining a minimum mark of 50% in the Research Project, passing two thirds of all modules, and achieving a mark of at least 35% in all but one of the compulsory modules. The Research Project will count 25% of the final mark. These component parts of the course will be combined in a final overall mark which will be reflected against the course code PHY4000W, with PA (pass) entered against the coursework and project codes; each of these components must be passed separately for the award of the degree.

PHY5000W  PHYSICS DISSERTATION
180 NQF credits at NQF level 9

Course outline:
This course consists of an investigation of an approved topic chosen for intensive study by the candidate (student), culminating in the submission of a dissertation. The dissertation shall demonstrate the successful completion of a programme of training in research methods, a thorough understanding of the scientific principles underlying the research and an appropriate acquaintance with the relevant literature. It must be clearly presented and conform to the standards of the department and faculty. The dissertation will usually consist of a report detailing the conduct, and analysis of the results of, research performed under the close guidance of a suitably qualified supervisor/s. The dissertation should be well-conceived and acknowledge earlier research in the field. It should demonstrate the ability to undertake a substantial and informed piece of research, and to collect, organise and analyse material. General rules for this degree may be found in the front of the handbook.

PHY5001W  THEORETICAL PHYSICS DISSERTATION
180 NQF credits at NQF level 9

Course outline:
This course consists of an investigation of an approved topic chosen for intensive study by the candidate (student), culminating in the submission of a dissertation. The dissertation shall demonstrate the successful completion of a programme of training in research methods, a thorough understanding of the scientific principles underlying the research and an appropriate acquaintance with the relevant literature. It must be clearly presented and conform to the standards of the department and faculty. The dissertation will usually consist of a report detailing the conduct, and analysis of the results of, research performed under the close guidance of a suitably qualified supervisor/s. The dissertation should be well-conceived and acknowledge earlier research in the
field. It should demonstrate the ability to undertake a substantial and informed piece of research, and to collect, organise and analyse material. General rules for this degree may be found in the front of the handbook.

PHY5003W  ASTROPHYSICS & SPACE SCIENCE MINOR DISSERTATION
(National Astrophysics & Space Science Programme (NASSP); for further details see entry under Department of Astronomy)
90 NQF credits at NQF level 9
Course entry requirements: AST5003F
DP requirements: None.
Assessment: Students will work on an approved research topic on which a minor dissertation must be presented for formal examination.

PHY5006W  TERTIARY PHYSICS EDUCATION DISSERTATION
180 NQF credits at NQF level 9
Course outline:
This course consists of an investigation of an approved topic chosen for intensive study by the candidate (student), culminating in the submission of a dissertation. The dissertation shall demonstrate the successful completion of a programme of training in research methods, a thorough understanding of the scientific principles underlying the research and an appropriate acquaintance with the relevant literature. It must be clearly presented and conform to the standards of the department and faculty. The dissertation will usually consist of a report detailing the conduct, and analysis of the results of, research performed under the close guidance of a suitably qualified supervisor/s. The dissertation should be well-conceived and acknowledge earlier research in the field. It should demonstrate the ability to undertake a substantial and informed piece of research, and to collect, organise and analyse material. General rules for this degree may be found in the front of the handbook.

PHY5007Z  DATA SCIENCE FOR PARTICLE PHYSICS
12 NQF credits at NQF level 9
Convener: Dr T Dietel
Course entry requirements: Core modules of the Masters course in Data Science.
Course outline:
This course introduces students to the important computational aspects of high-energy nuclear and particle physics research. Using examples from current research at the European Organization for Nuclear Research (CERN), the students are introduced to: the basic principles of high-energy physics, the Grid computing model employed by the Worldwide LHC Computing Grid (WLCG), the simulation of interactions between subatomic particles and their detection, the ROOT data analysis tool used by all the large high-energy physics collaborations, the signal extraction and significance estimation techniques employed by the most recent particle discoveries including concepts like nuisance parameters and the look-elsewhere effect.
DP requirements: 50% average for the two projects.
Assessment: Two projects: 25% each. Practical 'take-home' Computing examination: 50%. A sub-minimum of 50% for each of the project and examination components will be required.

PHY5008W  DATA SCIENCE MINOR DISSERTATION
90 NQF credits at NQF level 9
Convener: Dr S Er
Course entry requirements: Successful completion of the coursework component of the Masters course in Data Science.
Course outline:
The research component of the degree is based on a 90 credit dissertation. The topic of the research will be based on an analysis of large data sets from Physics.
PHY6000W  PHYSICS THESIS
360 NQF credits at NQF level 10

Course outline:
The PhD is a research degree on an advanced topic under supervision which can be taken in any of the departments in the Faculty. Examination is by thesis alone. A candidate shall undertake doctoral research and advanced study under the guidance of a supervisor/s appointed by Senate. The thesis must constitute a substantial contribution to knowledge in the chosen subject, must show evidence of original investigation and give a full statement of the literature on the subject. The PhD degree demands that the candidate is able to conduct independent research on his/her own initiative. Through the thesis the candidate must be able to demonstrate that he/she is at the academic forefront in the topic selected, that the work is original and that it advances our knowledge in the relevant field. Candidates are referred to the rules for this degree as set out in Book 3, General Rules and Policies.

PHY6001W  TERTIARY PHYSICS EDUCATION THESIS
360 NQF credits at NQF level 10

Course outline:
The PhD is a research degree on an advanced topic under supervision which can be taken in any of the departments in the Faculty. Examination is by thesis alone. A candidate shall undertake doctoral research and advanced study under the guidance of a supervisor/s appointed by Senate. The thesis must constitute a substantial contribution to knowledge in the chosen subject, must show evidence of original investigation and give a full statement of the literature on the subject. The PhD degree demands that the candidate is able to conduct independent research on his/her own initiative. Through the thesis the candidate must be able to demonstrate that he/she is at the academic forefront in the topic selected, that the work is original and that it advances our knowledge in the relevant field. Candidates are referred to the rules for this degree as set out in Book 3, General Rules and Policies.
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Book 14: Financial assistance for Postgraduate Study and Postdoctoral Research
Assessment: One paper written in June or November no longer than 2.5 hours: 60%, class record 40%.

MAM2085S  VECTOR CALCULUS FOR ASPECT
16 NQF credits at NQF level 6
Convener: Dr P Padayachee
Course entry requirements: END1020 and END1021, or MAM1023 and MAM1024
Course outline:
This course aims to develop an understanding of vector calculus. Topics include: differentiation of vector valued functions, space curves and surfaces. Partial derivatives, chain rule, maxima and minima, Lagrange multipliers. Gradient, divergence and curl. Taylor's theorem for one and several variables, Jacobians, Newton's method for several variables. Multiple integrals and change of variable. Surface integrals. Line integrals, work done by a force, potentials. Green's theorem, divergence theorem, and Stokes' theorem.
Lecture times: Monday-Friday 1st period, 1 afternoon tutorial, optional additional mini-tutorials in 2nd or 3rd period
DP requirements: 35% class record; attendance of tutorials
Assessment: One paper written in June or November no longer than 2.5 hours: 60%, class record 40%.

PHYSICS
Professor and Head of Department:
A Buffler, MSc PhD HDE Cape Town

Refer also to the Science Faculty Handbook.

PHY1012F  PHYSICS A FOR ENGINEERS
18 NQF credits at NQF level 5; First-year, first semester course.
Convener: D R Geduld
Co-requisites: MAM1020F (or equivalent)
Course outline:
The course aims to provide students with a strong foundation in mechanics, properties of matter and thermodynamics. The aims are to encourage conceptual understanding, the development of certain mathematical and graphical skills as well as problem solving. Mechanics forms the basis of all the engineering disciplines. It is therefore crucial that students have a good grasp of the concepts and proficiency in the skills. Problem solving abilities develop through the course as a preparation for further development in later engineering courses. Topics include: vectors, kinematics, dynamics, work, energy, power, conservative and non-conservative forces, friction, impulse, momentum, collisions, rotation, rotational dynamics, torque, rotational inertia, rotational energy, angular momentum, elasticity, elastic moduli, hydrostatics, hydrodynamics, temperature, heat, kinetic theory of gases, thermodynamics and entropy.
DP requirements: An average of at least 40% for class record, including 50% for laboratories.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour examination counts 50%. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supp tutoring and revision programme.
PHY1012S  PHYSICS A FOR ENGINEERS

It is assumed that students in PHY1012S have first attempted PHY1012F.
18 NQF credits at NQF level 5; First-year, second semester course.

Convener: Associate Professor W A Horowitz

Co-requisites: MAM1020F (or equivalent)

Course outline:
The course aims to provide students with a strong foundation in mechanics, properties of matter and thermodynamics. The aims are to encourage conceptual understanding, the development of certain mathematical and graphical skills as well as problem solving. Mechanics forms the basis of all the engineering disciplines. It is therefore crucial that students have a good grasp of the concepts and proficiency in the skills. Problem solving abilities develop through the course as a preparation for further development in later engineering courses. Topics include: vectors, kinematics, dynamics, work, energy, power, conservative and non-conservative forces, friction, impulse, momentum, collisions, rotation, rotational dynamics, torque, rotational inertia, rotational energy, angular momentum, elasticity, elastic moduli, hydrostatics, hydrodynamics, temperature, heat, kinetic theory of gases, thermodynamics and entropy.

DP requirements: An average of at least 40% for class record, including 50% for laboratories.

Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour examination counts 50%. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supp tutoring and revision programme.

PHY1013F  PHYSICS B FOR ENGINEERS

18 NQF credits at NQF level 5; First-year, first semester course.

Convener: D R Geduld

Course entry requirements: PHY1012F/S or PHY1014F/S

Co-requisites: MAM1020F (or equivalent)

Course outline:
The course is the second part of the first year engineering Physics sequence. It aims to provide a foundation in the concepts and mathematics of physical phenomena within the context of vibrations and waves, and electromagnetism, and features the topics of electric charge, electric field, Gauss' Law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, the magnetic field, Biot-Savart Law, Ampere's Law, electromagnetic induction, inductance, simple harmonic motion, damped oscillations, resonance, travelling waves, phase velocity, superposition, standing waves, sound waves, sound intensity, Doppler effect, interference and diffraction.

DP requirements: An average of at least 40% for class record, including 50% for laboratories.

Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour examination counts 50%. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supp tutoring and revision programme.

PHY1013S  PHYSICS B FOR ENGINEERS

18 NQF credits at NQF level 5; First-year, second semester course.

Convener: D R Geduld

Course entry requirements: PHY1012F/S or PHY1014F/S

Co-requisites: MAM1020F (or equivalent)

Course outline:
The course is the second part of the first year engineering Physics sequence. It aims to provide a foundation in the concepts and mathematics of physical phenomena within the context of vibrations and waves, and electromagnetism, and features the topics of electric charge, electric field, Gauss' Law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks,
the magnetic field, Biot-Savart Law, Ampere's Law, electromagnetic induction, inductance, simple harmonic motion, damped oscillations, resonance, travelling waves, phase velocity, superposition, standing waves, sound waves, sound intensity, Doppler effect, interference and diffraction.

**DP requirements:** An average of at least 40% for class record, including 50% for laboratories.

**Assessment:** Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour examination counts 50%. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supplemental tutoring and revision programme.

**PHY1014F  PHYSICS A FOR ASPECT**
18 NQF credits at NQF level 5
Convener: P le Roux
Co-requisites: MAM1020F/S or MAM1023F/S, or equivalent

Course outline:
The course aims to provide students with a strong foundation in mechanics, properties of matter and thermodynamics. The aims are to encourage conceptual understanding, the development of certain mathematical and graphical skills as well as problem solving. Mechanics forms the basis of all the engineering disciplines. It is therefore crucial that students have a good grasp of the concepts and proficiency in the skills. Problem solving abilities develop through the course as a preparation for further development in later engineering courses. Topics include: vectors, kinematics, dynamics, work, energy, power, conservative and non-conservative forces, friction, impulse, momentum, collisions, rotation, rotational dynamics, torque, rotational inertia, rotational energy, angular momentum, elasticity, elastic moduli, hydrostatics, hydrodynamics, temperature, heat, kinetic theory of gases, thermodynamics and entropy.

**DP requirements:** An average of at least 40% for the class record.

**Assessment:** Class record (tests, tutorials, workshops and laboratory record) counts 50%; one 2-hour examination counts 50%. A subminimum of 40% is required for the theory examination paper. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supplemental tutoring and revision programme.

**PHY1014S  PHYSICS A FOR ASPECT**
18 NQF credits at NQF level 5
Convener: P le Roux
Co-requisites: MAM1020F/S or MAM1023F/S, or equivalent

Course outline:
The course aims to provide students with a strong foundation in mechanics, properties of matter and thermodynamics. The aims are to encourage conceptual understanding, the development of certain mathematical and graphical skills as well as problem solving. Mechanics forms the basis of all the engineering disciplines. It is therefore crucial that students have a good grasp of the concepts and proficiency in the skills. Problem solving abilities develop through the course as a preparation for further development in later engineering courses. Topics include: vectors, kinematics, dynamics, work, energy, power, conservative and non-conservative forces, friction, impulse, momentum, collisions, rotation, rotational dynamics, torque, rotational inertia, rotational energy, angular momentum, elasticity, elastic moduli, hydrostatics, hydrodynamics, temperature, heat, kinetic theory of gases, thermodynamics and entropy.

**DP requirements:** An average of at least 40% for the class record.

**Assessment:** Class record (tests, tutorials, workshops and laboratory record) counts 50%; one 2-hour examination counts 50%. A subminimum of 40% is required for the theory examination paper. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44%
PHY1015F  PHYSICS B FOR ASPECT  
18 NQF credits at NQF level 5  
Convener: P le Roux  
Course entry requirements: PHY1014F/S or PHY1012F/S.  
Co-requisites: MAM1020F/S or MAM1023F/S, or equivalent  
Course outline:  
The course is the second part of the first year engineering Physics sequence. It aims to provide a foundation in the concepts and mathematics of physical phenomena within the context of vibrations and waves, and electromagnetism, and features the topics of electric charge, electric field, Gauss' Law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, the magnetic field, Biot-Savart Law, Ampere's Law, electromagnetic induction, inductance, simple harmonic motion, damped oscillations, resonance, travelling waves, phase velocity, superposition, standing waves, sound waves, sound intensity, Dopper effect, interference and diffraction.  
DP requirements: An average of at least 40% for the class record.  
Assessment: Class record (tests, tutorials, workshop and laboratory record) counts 50%; one 2-hour examination counts 50%. A subminimum of 40% is required for the theory examination paper. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supp tutoring and revision programme.

PHY1015S  PHYSICS B FOR ASPECT  
18 NQF credits at NQF level 5  
Convener: P le Roux  
Course entry requirements: PHY1014F/S or PHY1012F/S.  
Co-requisites: MAM1020F/S or MAM1023F/S, or equivalent  
Course outline:  
The course is the second part of the first year engineering Physics sequence. It aims to provide a foundation in the concepts and mathematics of physical phenomena within the context of vibrations and waves, and electromagnetism, and features the topics of electric charge, electric field, Gauss' Law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, the magnetic field, Biot-Savart Law, Ampere's Law, electromagnetic induction, inductance, simple harmonic motion, damped oscillations, resonance, travelling waves, phase velocity, superposition, standing waves, sound waves, sound intensity, Dopper effect, interference and diffraction.  
DP requirements: An average of at least 40% for the class record.  
Assessment: Class record (tests, tutorials, workshop and laboratory record) counts 50%; one 2-hour examination counts 50%. A subminimum of 40% is required for the theory examination paper. Although a supplementary examination is usually granted for a final grade in the range 45-49%, a supplementary examination may also be granted for certain key courses in the range 40-44% under conditions agreed to by the Deans of EBE and Science, normally involving a mandatory pre-supp tutoring and revision programme.

PHY1031F  GENERAL PHYSICS A  
18 NQF credits at NQF level 5  
Convener: Dr S M Wheaton  
Course entry requirements: At least 60% for NSC Physical Science. Note: Students registered for this course will be assessed in week 5; if it is judged that they are not coping with the level and pace of the course, and would benefit from an opportunity to strengthen foundational concepts and learn new material at a slower pace, they will be required to transfer to PHY1023H from week 7.
Course outline:
PHY1031F is an algebra-based introductory course for Science students who do not intend proceeding to second-year courses in Physics. Some calculus may be used. The course includes the following topics: Mechanics: vectors, kinematics, forces, dynamics, momentum, impulse, work, energy, power, collisions, rotation, rotational dynamics, torque, angular momentum, static equilibrium, gravitation. Properties of matter: elasticity, hydrostatics, hydrodynamics. Vibrations and waves: simple harmonic motion, damped oscillations, forced oscillations, resonance, travelling waves, superposition, standing waves, sound waves, sound intensity and Doppler Effect.

Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record; including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in June counts 50%.

PHY1032F  GENERAL PHYSICS B
18 NQF credits at NQF level 5
Convener: Dr T Salagaram
Course entry requirements: PHY1031F or PHY1023H

Course outline:
PHY1032F is an algebra-based introductory course usually taken by Science students who have completed PHY1023H. Some calculus may be used. The course includes the following topics: Electricity and magnetism: electric charge, electric field, Gauss’ law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, magnetic field, Biot Savart law, Ampere’s law, electromagnetic induction, inductance, alternating currents. Thermal physics: temperature, heat, kinetic theory of gases, first and second laws of thermodynamics. Optics: Geometrical optics, polarization, electromagnetic waves, interference, diffraction. Modern physics: atomic structure, quantum physical phenomena, wave-particle duality, X-rays, elementary nuclear physics, radioactivity.

Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record, including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in June counts 50%.

PHY1032S  GENERAL PHYSICS B
18 NQF credits at NQF level 5
Convener: Associate Professor H W G Weigert
Course entry requirements: PHY1031F or PHY1023H

Course outline:
PHY1032F is an algebra-based introductory course usually taken by Science students who have completed PHY1023H. Some calculus may be used. The course includes the following topics: Electricity and magnetism: electric charge, electric field, Gauss’ law, electric potential, capacitance, current, current density, emf, resistance, resistivity, networks, magnetic field, Biot Savart law, Ampere’s law, electromagnetic induction, inductance, alternating currents. Thermal physics: temperature, heat, kinetic theory of gases, first and second laws of thermodynamics. Optics: Geometrical optics, polarization, electromagnetic waves, interference, diffraction. Modern physics: atomic structure, quantum physical phenomena, wave-particle duality, X-rays, elementary nuclear physics, radioactivity.

Lecture times: Monday - Friday, 3rd period
DP requirements: Minimum of 40% for the class record, including 50% in laboratory assessment.
Assessment: Class record (weekly problem sets, class tests and laboratory record) counts 50%; one 2-hour written examination in November counts 50%.
PHY2010S  ELECTROMAGNETISM FOR ENGINEERS
16 NQF credits at NQF level 6
Convener: Dr T Salagaram
Course entry requirements: PHY1012F/S and PHY1013F/S; or PHY1014F/S and PHY1015F/S. MAM2083F/S.
Co-requisites: MAM2084F/S.
Course outline:
This course aims to develop an understanding of electromagnetism in an engineering context. Topics include: Semiconductors, energy bands in solids, charge carriers in semiconductors, diodes and transistors, Coulomb's Law, Gauss' Law. The vector differential operator; div, grad curl. Poisson and Laplace's equations, the magnetic field, Biot-Savart Law, Ampere's Law, electric and magnetic fields in materials, and propagation in optical fibres.
DP requirements: Minimum of 40% for the class record; completion of all laboratory reports and 75% of tutorial work and problem sets; attendance at all tests.
Assessment: Class record (tests, weekly problem sets and laboratory work) counts 50%; 2-hour examination in November counts 50%. There is a subminimum of 40% required for the final examination.

STATISTICAL SCIENCES
Associate Professor and Head of Department:
F Little, MSc PhD Cape Town

For further information refer to Handbook of the Faculty of Science or Faculty of Commerce.

STA1000F  INTRODUCTORY STATISTICS
(No first year students) STA1000F and STA1000S are identical courses offered in first and second semesters. Owing to the mathematics prerequisites, first-year students can only register for STA1000S in the second semester and STA1000F on completion of the mathematics prerequisite. One lecture per week, one workshop per week and one tutorial per week. A student cannot obtain credits for more than one of STA1000F/S/P/L, STA1007S, STA1006S, STA1008F/S.
18 NQF credits at NQF level 5
Convener: S Britz
Course entry requirements: A pass in any of MAM1004F/S or MAM1005H or MAM1000W or MAM1006H or MAM1020F/S or MAM1010F/S.
Course outline:
This is an introductory statistics course aimed at exposing students to principles and tools to support appropriate quantitative analysis. The aim is to produce students with a functional sense of statistics. We introduce students to statistical modelling and also cover exploratory data analysis. Appropriate tools for display, analysis and interpretation of data are discussed. This course is offered predominantly, but not exclusively, to Commerce students. The aim is to give a foundation to students who will encounter and apply statistics in their other courses and professions. Topics covered include: Exploratory data analysis and summary statistics; probability theory; random variables; probability mass and density functions; binomial, Poisson, exponential, normal and uniform distributions; sampling distributions; confidence intervals; introduction to hypothesis testing (including various tests on means); determining sample sizes; simple linear regression and measures of correlation. Students are assessed on their knowledge of the topics covered and their ability to perform simple and appropriate statistical analyses using spreadsheet functions.
DP requirements: Satisfactory attendance of lectures, tutorials, practicals and tests and completion of assignments and/or exercises as set out in course outline. Class record of at least 35%.
Assessment: Class record 40% and a 2-hour exam counting 60%. Weights will be adjusted in the case of missed assessments, as detailed in the course outline.
UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
(UNDERGRADUATE)

2021

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The Registrar's and General Enquiries offices are located in the Bremner Building and remain open during the lunch hour. The Admissions Office and Student Records Office are located in the Masingene Building, Middle Campus, and are open from 08h30 to 16h30. The Cashier's Office is located in Kramer Building, Middle Campus, and is open from 09h00 to 15h30.

This handbook is part of a series that consists of
Book 1: Undergraduate Prospectus
Book 2: Authorities and information of record
Book 3: General Rules and Policies
Book 4: Academic Calendar and Meetings
Book 5: Student Support and Services
Book 6-11: Handbooks of the Faculties of Commerce, Engineering & the Built Environment, Health Sciences, Humanities, Law, Science
Book 12: Student Fees
Book 13: Bursary and Loan Opportunities for Undergraduate Study
Book 14: Financial assistance for Postgraduate Study and Postdoctoral Research
Instead, foundations and concepts pertaining to the core material in the CEM1011F syllabus are discussed in depth. Additional and alternative approaches are used to help students understand this core material. The CEM1111S course comprises three lectures, two tutorials and one practical session per week in the second semester. The lectures and tutorials are one hour each and the practical is three hours. Students have daily contact with the chemistry lecturer and/or tutor.

**DP requirements:** Although there is no final examination for CEM1111S, to qualify for the CEM1011X final examination in June the following year, students are required to meet the DP requirements for both CEM1111S and CEM1011X, which entail: attendance and completion of practicals, tests and tutorial exercises.

**Assessment:** The CEM1111S class record counts 31%. The CEM1111S class record and the CEM1011X class record count 45%. The CEM1011X examination counts 55%. A subminimum of 45% is required in the final examination.

**CEM1011X  CHEMISTRY FOR MEDICAL STUDENTS**

*(Faculty of Science)* This course will not be offered in 2021.

18 NQF credits at NQF level 5

**Convener:** Dr S Wilson

**Course entry requirements:** CEM1111S

**Course outline:**

CEM1011X is a foundational chemistry course and, together with CEM1111S, covers the same material as that in the CEM1011F syllabus. Students in the Intervention Programme Part 2 are required to take this course. Although CEM1111S and CEM1011X together are equivalent to CEM1011F, the lecture material is not simply repeated. Instead, foundations and concepts pertaining to the core material in CEM1011F are discussed in depth. Additional and alternative approaches are used to help students understand the core material. The course comprises three lectures and one two-hour tutorial session per week in the first quarter and one two-hour tutorial session in the second quarter of the first semester.

**DP requirements:** Attendance and completion of tests and tutorials exercises.

**Assessment:** The CEM1011X class record (comprising tests and tutorials) counts 14%. The CEM1011X class record and the CEM1111S class record count 45%. The CEM1011X examination counts 55%. A subminimum of 45% is required in the final examination.

**PHY1025F  PHYSICS 1025**

18 NQF credits at NQF level 5

**Convener:** Associate Professor S W Peterson

**Course entry requirements:** None

**Course outline:**

The course aims to provide a foundation in physics for later courses in the biological and physical sciences in the medical curriculum. Topics covered include mathematical skills for physics; Newton's laws of translational motion, force, friction, work and energy; bodies in static equilibrium; density and pressure in fluids; fluid flow, viscosity, temperature, gas laws, heat and heat transfer; first law of thermodynamics, human metabolism and first law; wave motion, transverse and longitudinal waves, interference of waves; sound, ear's response to sound, Doppler effect, ultrasound and medical imaging; electric charge and field, electric potential and potential difference, electric current, resistivity and simple circuits; light, reflection and refraction, thin lenses and the human eye.

**DP requirements:** Attendance of all scheduled tutorials and practical sessions; completion of all set written course activities (i.e. tutorial assignments, practical reports and course tests); and a minimum class record of 35%.

**Assessment:** Coursework counts 40% and comprises three class tests (10% each) and a laboratory record (10%); and the final examination counts 60%.