

13005-154(16) Introductory Physics for Biological Sciences B (3l, 3p)

2018

Course summary:

Selected topics, relevant to the biological sciences, from introductory electricity, magnetism, thermodynamics, gas laws, atomic physics, radioactivity, oscillations and waves.

Method of assessment: Flexible assessment

Prerequisite module: Physics (Bio) 134

Language policy:

Afrikaans or English in separate class groups (Parallel medium):

A class is divided into separate Afrikaans and English groups. Students provide their preferred language of teaching at registration. Additional learning opportunities involving students from both language groups will be used to promote integration.

Module relevance in programme:

The Physics (Bio) 154 module along with the Physics (Bio) 134 module forms part of a one year introductory Physics course aimed at students following programmes mainly in the Biological Sciences, but also in Earth Science and Geo informatics.

The topics covered in this module, including waves, sound, temperature, gas laws, heat, electricity, magnetism, radioactivity, measurement and uncertainty, have been chosen to provide students with an understanding of basic physics principles, and skills in problem solving, scientific reasoning, measurement and data evaluation.

The physics principles taught will contribute to students' understanding of the physical world and many phenomena they will learn about in their programme. Some of these principles also underpin many of the analytical methods used by students in these programmes and in their future careers, for example DNA fingerprinting used in forensics and chemical analysis of materials using mass spectrometry and neutron activation.

Outcomes of course:

The student will be:

- able to correctly use the terminology associated with the subject.
- equipped with problem-solving skills that can be applied within the subject.
- able to integrate concepts thereby making the topic relevant and applicable.
- given the opportunity to develop his/her writing, language and communication skills.
- able to perform plausible experiments.
- able to apply the scientific method to obtain data, which can be analyzed mathematically.

Lecturers:

Prof BIS van der Ventel (Afr)

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Email address: bventel@sun.ac.za

Office: Room 1019 in the Merensky Physics Building.

Prof RT Newman (Eng)
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Email address: rnewman@sun.ac.za
Office: Room 1017 in the Merensky Physics Building

Mentor:

The Department of Physics has appointed a staff member as mentor for each year of its physics programme to be available to students for consultation. Students should feel free to discuss general issues related to the physics programme or specific modules in the programme with the relevant mentor, in addition to usual consultations with their individual lecturers of modules.

The appointed mentor for this module is Dr JJ van Zyl (Email address: jjvz@sun.ac.za).

Course content:

1. Vibrations and Waves.

- Simple Harmonic Motion (SHM)
- Energy in the Simple Harmonic Oscillator
- The Period and Nature of SHM
- The Simple Pendulum
- Damped Harmonic Motion
- Forced Vibrations; Resonance
- Wave motion - general definitions
- Types of waves: transverse and longitudinal
- Energy transported by waves
- Reflection and transmission of waves
- Interference; Principle of Superposition
- Standing waves;
- Resonance

2. Sound.

- Characteristics of sound
- Intensity of sound: decibels
- Sources of sound: vibrating strings and air columns
- Interference of sound waves; beats
- Doppler effect
- Applications of sound (e.g. echolocation_in_animals)

3. Temperature and kinetic theory.

- Atomic theory of matter
- Temperature and thermometers
- Thermal expansion
- The gas laws and absolute temperature
- The ideal gas law
- Problem solving with the ideal gas law
- Ideal gas law in terms of molecules: Avogadro's number
- Kinetic theory and the molecular interpretation of temperature
- Temperature and reaction rates
- Diffusion

4. Heat.

- Heat as energy transfer
- Internal energy
- Specific heat
- Calorimetry - solving problems
- Latent heat
- Heat transfer: conduction
- Heat transfer: convection
- Heat transfer: radiation
- Applications (evaporation, condensation, greenhouse gasses and climate)

5. Electric charges and Coulomb's law

- Electric charge and its conservation, insulators and conductors, induced charge
- Coulomb's law, vectors, examples of calculations
- Electric field, electrostatics, field lines, electric fields and conductors

6. Electric potential, electric energy and capacitance

- Electric potential, difference, electric potential and field, electron volt, electric potential due to point charges
- Capacitance, dielectrics, storage of electric energy

7. Electric currents

- Electric current, Ohm's law, resistivity,
- Electric Power
- Microscopic view of electric current
- EMF and terminal voltage
- Resistors in series and parallel
- Kirchhoff's rules
- Capacitors in series and parallel
- Resistor and capacitor in series
- Applications (to biology – neurons, diffusion and the membrane potential)

8. Magnetism and electromagnetic induction

- Magnets, magnetic fields, electric currents produce magnetic fields
- Force on an electric current in a magnetic field, between two parallel wires
- Definition of the ampère and the coulomb
- Induced EMF, Faraday's law
- Changing magnetic flux produces an electric field

Practical and Tutorials:

Practical and tutorial schedules will be available on SUNLearn (<http://learn.sun.ac.za>) at the start of the semester.

Study material:

Handbook: **Giambattista, Physics, 3rd edition PLUS the McGraw-Hill Connect and Learnsmart digital products.**

Note that the purchasing of access to the Connect/Learnsmart digital products are strongly encouraged as (i) the lecturer may assign homework through it, and (ii) the software provides a valuable learning tool to help master the necessary skills and concepts required in Physics.

(The Connect/Learnsmart code will be shrink-wrapped with the printed book for access to the Connect and Learnsmart products, and available from bookstores. For those students who choose not to purchase the printed book, they will still need to purchase the Connect code from the bookstores.)

Learning opportunities:

- Lectures
- Tutorials
- Practicals
- Connect and Learnsmart software that accompany the prescribed textbook are available on the internet. The software will provide regular self-assessment opportunities to help students to continually assess their understanding of the subject.

Lecture Hall, Room number, Level:

Lecture halls allocated are available on MyMaties

All practicals and tutorials will take place in the Physics Merensky Building.

The practical and tutorial schedule and venues will be handed out at the beginning of the second semester, and will be made available on the module pages on SUNLearn.

Assessment:

Methods of Assessment

- Class tests
- Tutorial tests
- Practical assessments (short reports, tests)

Venue and time of assessment opportunities

Available on MyMaties

Calculation of class mark

No class mark. An adequate final mark must be accumulated throughout the semester.

Calculation of final mark for the module:

Class tests: 50%

Tutorial tests: 15%

Practical assessments: 35%

Admission to examination:

This is a continuous assessment module where no exam is written.