13005 – 134 (16) Introductory Physics for Biological Sciences A (3l, 3p)

2021

Course summary:

Selected topics, relevant to the biological sciences, from introductory mechanics, hydro-statics and optics.

Method of assessment: Flexible assessment

Co-requisite module: Mathematics (Bio) 124 or Mathematics 114

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

Suitable topics, including measurement and uncertainty, introductory mechanics, work and energy, hydrostatics and geometric optics, have been chosen to provide students with the tools and the understanding of basic physics and its principles, as well as scientific reasoning and data evaluation skills.

These physics principles contribute to the skills foundation of the larger Biological Science programmes and underpin many biophysical methods used in applications such as forensic science, imaging and sensing, and treatment modalities.

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 not only within the subject, but in the broader sciences.
- able to integrate concepts thereby making the topic relevant and applicable.
- given the opportunity to develop his/her scientific writing, language and communication skills.
- able to perform plausible experiments.
- able to apply the scientific method to obtain data, which can be analysed mathematically.

Lecturers:

Dr JJ van Zyl (Eng)
Telephone number: (021) 808-3384
Email address: jjvz@sun.ac.za
Office: Room 1016 in the Merensky Building.

Prof SM Wyngaardt (Afr)
Telephone number: (021) 808-3379 / 91
E-mail address: shaunmw@sun.ac.za
Office: Room 1018 in the Merensky 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 mentor for the first year programme is **Dr G Bosman** gwb@sun.ac.za (preferred method of communication)

Course content:

1. Introduction and definitions. (3 h)
This chapter introduces students to the basic nature of Physics, its relation to other fields, models, theories, and laws. Fundamental scientific concepts are refreshed, such as measurement and uncertainty, significant figures and units. Special mention is made of size and shape, the relationships among length, area and volume, and its application to biological systems in terms of isometry and allometry.

2. Dynamics. (6 h)
The focus of this chapter is on the effects of forces acting on objects. The main principles of Newton's three laws are covered, and the concepts of vectors and different forces such as weight, thrust, lift and drag are introduced. Specific biological applications of Newton dynamics, such as locomotion, skeletal forces of tension and compression, are discussed.

3. Circular motion and Rotational Equilibrium. (6 h)
This chapter brings together the concepts of rotation and uniform circular motion to describe static equilibrium for e.g. balance and upright locomotion. We introduce the ideas of torque, shear, bending and biting in e.g. skeletal systems, and consider Newton's universal law of gravity as an example of circular motion.

4. Work and energy. (6 h)
This important chapter deals with the fundamental principle of the conservation of energy. We introduce key concepts such as work, kinetic and potential energy, dissipative forces and power. This chapter forms an important foundation for the Physics (Bio) 154 course which deals with heat exchange and radiation.

5. Linear momentum. (3 h)
Following on from the previous section on energy conservation, this chapter applies the conservation of momentum, and concepts such as impulse, to one-dimensional elastic and inelastic collisions.

6. Fluids. (6 h)
This chapter introduces the foundational concepts used in hydrostatics and hydrodynamics, namely pressure, density, buoyancy (Archimedes' principle), the continuity equation and Bernoulli's principle. These key concepts are used in pressure measurement and to explain everyday phenomena such as floating, swimming, flying. This section lays the foundation also for follow-up studies that will deal with e.g. osmoregulation.

7. Geometric optics. (9 h)
This chapter covers the broad subject of geometric optics including ray-tracing, reflection and refraction, image formation through spherical lenses and plane and spherical mirrors, magnification, Snell's law and total internal reflection. These principles are further applied to compound optical instruments, corrective lenses for the eye, sight, accommodation, stereoscopic vision and colour perception. It is also foundational

to topics covered in the next semester Physics (Bio) 154 course, namely acoustics, wave production, transmission, reception and echolocation in animals.

Practical (Tutorials):

The practical part of the course consists of three experiments. Self-study is an important part of the practical. Material regarding the practicals is available electronically, which gives students the opportunity to familiarize themselves with the apparatus beforehand. Practical and tutorial schedules will be handed out in class and will be available on SUNLearn at the start of the semester.

Study material:

Prescribed textbook: ***Giambattista, Physics, 5th 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:

1. Regular tutorials
2. A selection of practical laboratory experiments related to the subjects covered in class.
3. 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 asses their understanding of the subject.

Lecture Hall Room number Level

This module will be offered using augmented Emergency Remote Teaching, Learning and Assessment (ERTLA). This means that a significant component of teaching and learning will continue remotely (online).

- All lecture material will be offered online via SUNLearn.
- All lectures will be offered using online mode, i.e. there are no scheduled f2f (face-to-face) lectures. The interactions are facilitated via digital technology by utilising asynchronous (non-real-time) modalities, e.g. upload of video lectures and problem discussions.
- Tutorials will be offered in an augmented mode with asynchronous provision of material and f2f learning opportunities (with limited number of students in venue) used for question and answer sessions. The tutorial schedule and venues for the f2f groups will be made available on the module page on SUNLearn.
- Practical work will be offered in a virtual practical environment (i.e. no f2f practicals).

Assessment:

Methods of Assessments
Class tests
Tutorial tests
Practical reports and practical tests

Venue and time of assessment opportunities
Available on MyMaties.

Calculation of class mark:

No class mark. However, an adequate **final mark** must be accumulated throughout the semester - see below.

Calculation of final mark for the module:
This is a **flexible assessment** module in which a final mark of at least 50% is needed to pass the module. The final mark can be accumulated through the following opportunities:

- Class tests : 60%
- Tutorial tests : 25%
- Practicals : 15%

Admission to examination:
This is a continuous assessment module where no exam is written.