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

2019

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 Sciences 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 Sciences 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 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 analysed mathematically.

Lecturers:

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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. (7 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, Rotation and Equilibrium. (3 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. (4 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. (2 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 and optical instruments. (6 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:

New prescribed textbook from 2016: ***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:

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

Lecture halls available on MyMaties.

All practicals and tutorials are in the **Merensky Building** for Physics. The practical and Tutorial schedule and venues will be handed out at the beginning of the year, and made available on the module page on SUNLearn.

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. An adequate final mark must be accumulated throughout the semester.

Calculation of final mark for the module:
Class tests: 60%
Tutorial tests: 25%
Practicals: 15%

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