PHYS 160 Physics for the Life Sciences 2015

Offered:	Semester 1 & Semester 2
Credit:	15 points
Pre-/Co-requisites:	None

Description

A course in basic physics for students who wish to advance their studies in the Life Sciences, including Medicine. The major areas of physics are covered with emphasis on the application to the understanding of biological systems. Numerical competence and the ability to perform elementary algebraic operations is assumed. The course has a laboratory component, but also makes use of in-class demonstrations and experiments distributed through the lectures.

Aims

This course will provide students with the knowledge of Physics essential for an understanding of processes in, and affecting, biological systems, from macromolecules to ecosystems and from molecular energy transfer to biomechanics.

Skills and knowledge to be gained

Students who pass this course should be able to:

- have a sound knowledge of basic physics in areas of particular relevance to Life Sciences, including Mechanics, Wave motion and Optics, Thermal physics, Fluids, and Electricity
- be familiar with the definition and units of all relevant physical quantities
- demonstrate an understanding of the important principles of physics in these areas, including applications to biological systems
- be able to formulate solutions to quantitative problems involving these principles
- be able to use mathematical skills in algebra, geometry and trigonometry in the solution of such problems
- have acquired skills in experimental physics, including facility with the use of apparatus, analysis of results, and estimation of experimental error.

Syllabus

Classical Mechanics

- Basics: quantities, units, conversion, measurement, orders of magnitude, frame of reference.
- Rectilinear motion: Galileo, Newton's 1st law, displacement, velocity, acceleration, motion under gravity.
- Vectors: vector addition, vector resolution, relative velocity
- Two-dimensional motion: kinematics, projectile motion, circular motion Newton's 2nd Law: force, springs, weight, universal gravitation
- Newton's 3rd Law: impulse, momentum, conservation of momentum, collisions Work and

energy: kinetic energy, the Work-Energy Theorem, potential energy, conservation of mechanical energy, power, dynamic friction

- Static equilibrium: free-body force diagrams , static friction, force balance, torque, torque balance, centre of mass, lifting a weight with upper arm, lower back and posture
- Scaling: areas, volumes, isomorphic objects, metabolic rate, running, jumping Fluids: quantities, units, static fluids, continuity, Bernoulli's equation, viscosity, Poiseulle's law, turbulence, Reynolds number
- Biomechanics: Mechanics of soft tissue, constitutive properties, equilibrium. Case Studies: aneurysms, cartilage, bone

Thermal Physics

- Temperature: Celsius, Kelvin and Fahrenheit Scales
- Thermal Expansion: Linear and Volumetric, Expansion of Holes
- Ideal Gases: Pressure, Mole, Molar Mass, Avogadro's Number, Partial Pressures Kinetic Theory: Ideal gas equation, particle kinetic energy and velocity, microscopic interpretation
- Heat: Joule’s experiment, specific heat, energy conservation, latent heat Vapour Pressure: Humidity, dew point, boiling point
- Heat Transfer: conduction, convection, radiation Diffusion: Fick's Law
- Thermodynamics: Internal Energy, First Law
- Work: PV Diagrams , Isobaric, Isochoric, Isothermal, Adiabatic Processes Second Law: Reversible and Irreversible Processes, Carnot Cycle, Entropy

Oscillations & waves

- Basics: wave motion, physical and mathematical definitions, interference, standing waves
- Acoustics: origin of sound, decibel measure, attenuation, hearing, loudness Optics: light waves, electromagnetic spectrum, polarization.
- Geometric optics: rays and wavefronts, images, mirrors and lenses. Vision: defects, correction.
- Photons: photon energy and variation within em spectrum, x-rays (production, interactions, applications)
- Imaging: ultrasonics, attenuation, impedance, transducers, Doppler effect, magnetic resonance imaging, precession, T1 and T2. Nuclear physics in medicine

Electricity

- Charge conservation, Coulomb's law, electric fields, field line representation, electrical shielding
- Potential difference, CRT, equipotential surfaces, Millikan oil drop experiment Capacitance, dielectrics, electric field energy storage, applications of capacitors EMF, batteries, current, resistivity, Ohm's law
- Power, AC, DC, RMS and peak voltage, temperature dependence of resistance, internal resistance
- Resistors in series and parallel, voltmeters and ammeters RC circuits, time constants.
- Bioelectricity and the propagation of electrical activation

Learning activities and teaching methods

Description	Study time
Lectures 48 X 1 hour	48 hours
Assignments 4 X 6 hours	24 hours
Laboratory work 5 X 3 hours	15 hours
Tutorial 4 X 2 hours	08 hours
Lecture problems 48 X 20 mins	16 hours
Private study (1.5 hours/lecture)	72 hours (recommended)

Inclusive learning
Students are urged to discuss privately any impairment-related requirements face-to-face and/or in written form with the course convenor/lecturer and/or tutor.

Assessment

Form	Weight	Time	When
Assignments	10% (4 × 2.5%)	26 hours	weeks 3, 5, 8, 11
Laboratory work	10% (5 × 2%)	15 hours	
Tutorials	5% (4 X 1.25%)	08 hours	
Tests	15% (2 X 7.5%)	02 hours	weeks 6, 11
Exam	60%	03 hours	exam period

Academic Integrity
The University of Auckland will not tolerate cheating, or assisting others to cheat, and views cheating in coursework as a serious academic offence. The work that a student submits for grading must be the student's own work, reflecting his or her learning. Where work from other sources is used, it must be properly acknowledged and referenced. This requirement also applies to sources on the world-wide web. A student's assessed work may be reviewed against electronic source material using computerised detection mechanisms. Upon reasonable request, students may be required to provide an electronic version of their work for computerised review. Please visit the below link for further information:
https://www.auckland.ac.nz/en/about/learning-and-teaching/policies-guidelines-and-procedures/academic-integrity-info-for-students.html

Resources

Physics Coursebook (available from University Book shop) Prescribed Text (Physics by Cutnell and Johnson. 9th edition Wiley)

WileyPlus website for their assignments (https://www.wileyplus.com/WileyCDA/)

Feedback

Marked script and model solutions to assignments; marked exam script (if requested)
Model solutions to tests and practice tests. Assignment feedback via Wileyplus.

Enrolment

Typical enrolment	Semester 1: 130
	Semester 2: 600