

PHSI 191 BIOLOGICAL PHYSICS (2024)

Course Structure

The course covers the foundations of physics for the health sciences, including maths for physics, mechanics, properties of fluids and solids, thermodynamics, optics, electrostatics, and radiation and health.

PHSI191 is a text-book-based course, and the lectures and assignments are closely integrated with the text *Introduction to Biological Physics for the Health and Life Sciences (2nd ed)*, Franklin et al (Wiley, 2019). Self-directed learning is an important aspect of this course, and students are expected to prepare for lectures by reading specified sections from the text.

Teaching Hours: There are a total of 51 hours of formal teaching split between lectures (36 hours) and laboratories (15 hours).

Lectures: There are three 1-hour lectures each week, and the course runs for the entire semester. Each physics topic in the curriculum consists of four to six lectures, and four lectures of maths are included at the start of the course.

Laboratories: Five 3-hour laboratory sessions the last hour of which is a dedicated problem-solving tutorial session. Five online Lab Assessment Tests (LATs) are associated with the laboratory material.

Assessment:

Laboratories	Terms requirement
Lab Assessment Tests	10%
Progress Test	20%
Final exam	70%

The final exam is a three-hour, 55-question, multi-choice exam. The PHSI191 Progress Test is an optional one-hour, 20-question multi-choice exam. Plussage applies to the PHSI191 Progress Test mark.

Curriculum

Maths for Physics - 4 Lectures Review of algebra

Exponents and logarithms

Trigonometry

Systems of units and unit conversion

Vectors

Mechanics of Movement - 6 Lectures + 2 Laboratories

Kinematics, forces, statics, dynamics

Work and energy, types of energy, energy conservation

Linear momentum and momentum conservation

Torque and levers

Simple Harmonic Motion, circular and wave motion

Solids and Fluids - 6 Lectures + 1 Laboratory

Stress, strain, elasticity

Young's modulus, shear modulus, bulk modulus

Pressure, volume, density

Surface tension, capillarity

Buoyancy and Archimedes' principle

Dynamics of non-viscous fluids - Continuity equation, Bernoulli's equation

Viscosity, laminar flow, turbulence, Reynolds' number

Dynamics of viscous fluids – Poiseuille's Law

Transport Phenomena – Diffusion, osmosis

Thermodynamics - 5 Lectures + ½ Laboratory (shared with Electricity)

Temperature, heat, thermal expansion

Ideal gas law (including partial pressures, Charles's, Dalton's and Boyle's Laws)

Specific heat, latent heat, phase changes

Water vapour in the air - Psychrometric chart, humidity, dry-bulb and wet-bulb temperature, dew point

Heat transfer - conduction, convection and radiation

First law of thermodynamics, simple processes, efficiency

Electricity - 5 Lectures + ½ Laboratory (shared with Thermodynamics)

Forces between charges, Coulomb's law

Electric fields, energy of charges, electric potential

Conductors, insulators, capacitors

Current, Ohm's law, simple DC circuits

Series and parallel resistors, RC circuits

Optics - 5 Lectures + ½ Laboratory (shared with Radiation)

Electromagnetic spectrum - reflection, refraction

Geometric optics, image formation

Wave optics, interference, diffraction, resolution limit

The eye and vision correction

Radiation - 5 Lectures + ½ Laboratory (shared with Optics)

Atoms, nuclei, nuclear decay, half life

Radiation: nature, types and measurement

Natural and artificial radiation

Biological effects of radiation

Radiation dose, absorbed and effective dose