

# PHSI 191 BIOLOGICAL PHYSICS (2021)

## 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 topic in the curriculum consists of four to six lectures. Some weeks include an Integrated Context Lecture delivered by a staff from numerous departments with an interest in the health sciences.

**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