1E4 PHYSICS [5 credits]

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Module organisation
The module runs for the second half (12 weeks) of the academic year and comprises of three lectures, one tutorial every week and one laboratory session every second week (total of 59 hours contact time).

Module description, aims and contribution to programme
- To introduce the student to the basic physical laws describing thermodynamic processes, heat and heat-transfer, oscillations and waves (including light and sound), electrostatics and magnetostatics
- To demonstrate the application of these laws and enable the student to apply them to basic, technologically relevant examples
- To introduce the student to measurement principles and their application to investigate physical phenomena
- To establish good laboratory practice and precise written reporting procedures

Learning outcomes
Upon completion of this module, students will be able to:
1. Demonstrate a detailed knowledge of thermal physics, oscillators, laws of geometric optics, waves and static electricity and magnetism;
2. Derive the relevant expressions from basic physical principles and laws for solving problems in geometric optics, oscillations, waves, thermal physics and static electricity and magnetism;
3. Discuss how the laws of physics have been exploited and applied in the development and design of simple engines and in engineering systems;
4. Collate, analyse and formulate an experimental report with detailed error analysis and conclusions;
5. Gain experience of both individual and team working;
6. Carry out basic experimental procedures on aspects of physical systems and to appreciate the need for safety procedures in the laboratory.
Module content

**Thermal Physics**
- Temperature (including kinetic gas theory), temperature scales, thermometers, thermal expansion, laws of thermodynamics, ideal and real gases, isochoric and isobaric heat capacity, thermodynamic potentials, thermodynamic cycles (including clockwise and anti-clockwise Carnot cycle); heat transfer, conduction, convection, radiation.

**Geometric Optics**
- Mirrors, lenses and prisms, reflection, refraction, polarisation, interference/diffraction, image formation, simple optical systems.

**Oscillations and Waves**
- Oscillator equation of motion, simple harmonic oscillator, damping, properties of waves, wave-equation, travelling and stationary waves, superposition-principle, Huygens principle, diffraction, interference, and polarisation, electromagnetic and sound waves.

**Electricity and Magnetism**
- Introduction to electrostatics, magnetostatics and electromagnetism: electric charge, Coulomb's law, concepts of electrical field and potential, energy, Biot-Savart Law, Ampere’s Law, magnetic fields, Lorenz Force, Electromagnetic induction and Faraday's Law, summary of Maxwell equations.

Teaching strategies
The module is taught using a combination of lectures, laboratories and tutorials. Most module materials (notes, tutorials) are provided in electronic form. Students work in tutorial and laboratory groups thereby encouraging teamwork and co-operation whereas the research reports and homework are individual.

Associated laboratory/project programme
- P1: Pendulum, determination of acceleration due to gravity, g
- P2: Energy storage and transfer: elastic, kinetic and gravitational energy
- P3: Electrical resistance
- P4: Leslie’s cube
- P5: The resonance tube

Assessment
Continuous assessment contributes 40% towards the final grade with the end-of-year final written two-hour examination contributing 60%.

Required textbook
*University Physics*, Young and Freedman, 12th edition