Aims

The goal of the course is to explain the basic principles of Newtonian mechanics and to show how this theory describes a range of physical phenomena.

Syllabus

**One-dimensional dynamics**: Newton’s second law in one dimension: free fall in constant gravitational field, simple harmonic motion, conservation of energy (5 lectures)

**Oscillations**: Revision of second order differential equations with constant coefficients: method of undetermined coefficients for inhomogeneous equations, application to equation of oscillating spring with damping and driving term, resonance (6 lectures)

**Three-dimensional kinematics and Newtonian mechanics**: Motion of a particle in three dimensions, relative motion, Newton’s first and second law of motion, circular motion, projectile motion (8 lectures)

**Conservation laws**: Linear momentum and energy, Newton’s third law and momentum conservation, collisions (5 lectures)

**Planetary motion**: Motion under a central force, conservation of angular momentum and energy, Kepler’s laws (9 lectures)

Teaching and Assessment

**Contact Hours**: 3 lectures and 1 tutorial per week

**Assessment**: 30% by class tests or other continuous assessment
70% by end of module 2-hour exam

**Resit Type**: exam
By the end of the course, students should be able to:

- Understand fundamental concepts of kinematics such as velocity, acceleration and kinetic energy
- Understand Newton's laws
- Sketch simple trajectories
- Derive and solve the equation of motion for a projectile near the earth's surface
- Derive and solve the equation of motion of an object oscillating on a spring, including damping and periodic driving force.
- Understand the terms damping constant, characteristic frequency, transient and steady solution, resonance.
- Understand elastic and inelastic collisions
- Derive and apply conservation laws for energy and angular momentum
- Understand the principles of planetary orbits