

# MATH009 Newtonian Mechanics

<i>Year:</i>	2024–2025
<i>Code:</i>	MATH0009
<i>Level:</i>	4 (UG)
<i>Normal student group(s):</i>	UG: Year 1 Mathematics degrees
<i>Value:</i>	15 credits (= 7.5 ECTS credits)
<i>Term:</i>	2
<i>Assessment:</i>	The final weighted mark for the module is given by: 85% examination, 15% coursework. In order to pass the module you must have at least 40% in both the examination and the final weighted mark.
<i>Normal Pre-requisites:</i>	MATH0008, MATH0010
<i>Lecturer:</i>	Dr Rosemary Harris

## *Course Description and Objectives*

This course follows the first term applied mathematics course and gives a comprehensive introduction to Newtonian mechanics. The essential concepts of force, torque, momentum, angular momentum and energy are introduced. This is followed by a thorough coverage of the Newtonian dynamics of point particles, including the classic problem of a central force with the inverse square law. Vector methods, including vector differential equations, are used extensively.

## *Recommended Texts*

Suggested textbooks are: (i) P. Smith and R. C. Smith, *Mechanics* (2nd ed.), Wiley; (ii) C. D. Collinson, *Introductory Mechanics*, Arnold; (iii) M. Lunn, *A first course in Mechanics*, OUP; (iv) C. D. Collinson and T. Roper, *Particle Mechanics*, Arnold.

## *Detailed Syllabus*

- Ingredients of mechanics: Force as a vector, moments, couples. Velocity, momentum, angular momentum, acceleration. Newton's Laws. Conservative and non-conservative forces. Energy; energy conservation; conservation of angular momentum.
- Particle motion with one degree of freedom.
- Vector differential equations. Projectile examples; examples in three dimensions.
- Plane polar coordinates. Acceleration in polars. Motion under a central force, the  $\mathbf{u}$ -equation. Properties of conics; Kepler's laws of planetary motion. Stability of motion.
- Examples from cylindrical geometry.
- Systems with transfer of mass.