MATH009 (Newtonian Mechanics)

Year:	2019–2020
Code:	MATH0009
Old code	MATH1302
Level:	4 (UG)
Normal student group(s):	UG: Year 1 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Structure:	3 hour lectures, 1 hour problem class per week. Small group tutorials. Weekly assessed coursework.
Assessment:	The final weighted mark for the module is given by: 90% examination, 10% coursework. In order to pass the module you must have at least 40% in both the examination and the final weighted mark.
Normal Pre-requisites:	MATH0008 (previously MATH1301), MATH0010 (previously MATH1401)
Lecturer:	Prof E Burman
Problem class teacher:	Mr M Nechita

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 $\boldsymbol{u}$-equation. Properties of conics; Kepler's laws of planetary motion. Stability of motion.
- Examples from cylindrical geometry.
- Systems with transfer of mass.