MATH0115 Solid Mechanics

Year:	2024–2025
Code:	MATH0115
Level:	7 (UG)
Normal student group(s):	UG Year 3 or Year 4 Mathematics degrees
Value:	15 credits (= 7.5 ECTS credits)
Term:	2
Assessment:	90% examination, 10% coursework
Normal Pre-requisites:	MATH0015 and MATH0056
Lecturer:	Dr Shane Cooper

Course Description and Objectives

The modules aims to provide an introduction to the mathematical modelling of elastic materials. By the end, students should be able to derive the governing partial differential equations of the theory of linear elasticity and use them to solve simple problems.

Recommended Texts

1. Gurtin. The Linear Theory of Elasticity
2. S.P. Timoshenko and J.N. Goodier. Theory of Elasticity
3. N.Bakhvalov, Panasenko, G. Homogenisation: Averaging Processes in Periodic Media
4. J.Pujol. Elastic Wave Propagation and Generation in Seismolog

Detailed Syllabus

- Analysis of strain: Kinematics of deformation, finite strain, infinitesimal strain, compatibility, homogeneous displacement fields, pure strains, principle axes and invariants of strain
- Analysis of stress: Traction and Cauchy-Euler stress principle, pure stresses, principle directions and invariants of the stress tensor, static force and moment equilibrium equations for a continuum.
- Constitutive laws: Generalised Hooke's law, material symmetry, linear isotropic media, properties of materials (Young's modulus, Poisson's ratio, Bulk Modulus).
- Some problems of elastostatics: Partial differential equations of linear elasticity, boundary conditions, uniqueness of solutions, solutions to simple problems.
- Wave propagation in isotropic elastic media: Plane waves in homogeneous media, shear and compression waves in isotropic media, surface (Love and Rayleigh) waves.
- Composite media and Homogenisation: equations of composite media, derivation of ideal contact interface conditions. introduction to homogenisation theory and effective material properties.