Course ID 009279

Elasticity

MATH 35021

Credit rating 10

ECTS credits 5

Unit coordinator: Andrew Hazel

Semester 1

School of Mathematics

Undergraduate

Level 3

FHEQ level ' Last part of a Bachelors'

Marketing course unit overview

This course unit gives an introduction to the linearised theory of elasticity. A typical problem of the subject is as follows: Suppose an elastic body (e.g. an underground oil pipe) is subjected to some loading on its outer surface. What is the stress distribution which is generated throughout the body? Does this stress distribution have unexpectedly large values which might lead to failure? The subject is developed, and particular problems solved, from a mathematical standpoint.

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Aims

The course unit introduces students to the mathematical theory of linear elasticity. The general theory is developed and then applied to a number of practical problems in solid mechanics. Analytical techniques will be introduced to solve the resulting differential equations.

Learning outcomes

On successful completion of this course unit students will be able to

- calculate stresses, strains and tractions, and formulate boundary value problems;
- understand constitutive relations for elastic solids and compatibility constraints;
- solve various two-dimensional problems (plane strain) using the Airy stress function.

Syllabus

- Analysis of strain. The infinitesimal strain tensor; maximum normal strain. Equations of compatibility of strain.
- Analysis of stress. The traction vector and the stress tensor; maximum normal stress. Stress equations of motion and their linearisation.

- Stress-strain relations. Elastic and linearly elastic materials; isotropic materials. Equations of compatibility of stress for an isotropic materials in equilibrium (Beltrami-Michell equations). Navier's equation of motion for the displacement vector. Formulation of boundary value problems of linear elastostatics.
- One-dimensional problems. A selection of soluble problems (which are effectively one-dimensional) in Cartesian, cylindrical polar or spherical polar coordinates. St. Venant's principle.
- Plane strain problems. Theory of plane strain, Airy stress function. A selection of soluble two-dimensional problems using plane-strain theory.

Assessment methods

Other	20%
Written exam	80%

Coursework: weighting 20%End of semester examination: two hours weighting 80%

Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

Requisites

NONE

Available as free choice? N

Recommended reading

The course does not follow one particular book. A good book, covering most of the course, is

- P.L. Gould, Introduction to Linear Elasticity, 2nd Edition, Springer, 1994.

This book, and many others on the theory of elasticity can be found at 531.38 in the John Rylands University Library.

Scheduled activity hours

Lectures	22
Tutorials	11

Independent study hours 67 hours

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