UNIVERSITY of BRADFORD

Module Descriptor

| Module Details | |
|---|---|
| Module Title | Advanced Solid Mechanics |
| Module Code | MAE7013-B |
| Academic Year | 2023/4 |
| Credits | 20 |
| School | Department of Mechanical and Energy Systems Engineering |
| FHEQ Level | FHEQ Level 7 |

| Contact Hours | |
|---|---|
| Type | Hours |
| Directed Study | 160 |
| Lectures | 20 |
| Seminars | 20 |

| Availability | |
|---|---|
| Occurrence | Location / Period |
| BDA | University of Bradford / Semester 1 |

## Module Aims

To extend knowledge of Solid Mechanics in the context of modern mathematical analysis. To develop understanding of stresses and strains while emphasising their parallels. To introduce large deformations and more general material behaviour. To demonstrate the methods for implementing advanced theory numerically within finite element analyses. To give examples of applications of these numerical techniques.

## Outline Syllabus

Stress analysis: 3D equilibrium equations, the stress tensor, transformations and principal directions. Strain analysis: large deformations, deformation gradient tensors, rigid body rotations and principal directions. Analogies between stress and strain analysis. Constitutive relationships: linear, nonlinear, strain energy functions, elastic-plastic behaviour and flow rules. Applications of the finite element technique. Case studies.

| Learning Outcomes | |
|---|---|
| Outcome Number | Description |
| 01 | Analyse stress and strain at arbitrarily large deformations as tensor quantities. |
| 02 | Apply analytically a set of material models in current use. |
| 03 | Use a commercial FEM package to create models of stressed bodies. |
| 04 | Use a commercial FEM package to implement large deformation, nonlinear analyses using material models in current use. |

## Learning, Teaching and Assessment Strategy

Analytical material: A combination of online lectures (SOL lectures) and problems classes (workshops and OL seminars blended 50/50). In the latter, students attempt problems and are given individual guidance.

Numerical material: Introduced by online tutorials (OL seminars), followed by hands-on use of FEM package (tutorials and OL tutorials blended 50/50). Students receive assistance and feedback during class.

The analytical material is assessed via the online examination. The numerical FEM work is assessed via thecomputer-based class test. Formative assessment is via in-class guidance.

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This module satisfies the below Learning Outcomes as specified by the Accreditation of Higher Education Programmes: Fourth Edition (AHEP4) as published by the Engineering Council in-line with the UK Standard for Professional Engineering Competence (UK-SPEC). These outcomes specify five key areas of learning which partially (C) or fully (M) meet the academic requirement for CEng registration: Science and Mathematics (1), Engineering Analysis (2-4), Design and Innovation (5-6), The Engineer and Society (7-11), and Engineering Practice (12-18). Further details of these learning outcomes can be found at https://www.engc.org.uk/ahep/

M1, M2, M3, M4, M5, M12, M13,

## Mode of Assessment

| Type | Method | Description | Weighting |
|---|---|---|---|
| Summative | Examination - Closed Book | Examination - answer 4 questions from 6 (2 Hrs) | 50% |
| Summative | Coursework - Written | Individual assignment - Design problem with ABAQUS 2000 words | 50% |

## Reading List

To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html

*Please note:*
*This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.*

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