UNIVERSITY of BRADFORD

Module Descriptor

| Module Details | |
|---|---|
| Module Title | Solid Mechanics and Vibration Analysis |
| Module Code | MAE5013-B |
| Academic Year | 2024/5 |
| Credits | 20 |
| School | School of Engineering |
| FHEQ Level | FHEQ Level 5 |

| Contact Hours | |
|---|---|
| Type | Hours |
| Lectures | 30 |
| Tutorials | 15 |
| Laboratories | 3 |
| Directed Study | 152 |

| Availability | |
|---|---|
| Occurrence | Location / Period |
| BDA | University of Bradford / Academic Year |

## Module Aims

(1) To evaluate the concepts of general three-dimensional stress and strain state and to relate these concepts to the behaviour of actual materials and structural elements.
(2) To study and understand a set of basic problems in solid mechanics.
(3) To understand the concepts of dynamic mechanical systems and associated soluble problems.

## Outline Syllabus

On Statics:
Fundamental assumptions of solid mechanics. Stress state; principal stresses, maximum shear stress, two-dimensional stress states, plane stress and plane strain. Mohr's circle of stress. Torsion -the torsion equation. Work of external loads. Total potential energy. Strain energy methods. Unit load method for calculating deflections. Thick cylinder. Elasticity and plasticity. Yield criteria and their application. Buckling instabilities -the Euler criterion. Brittle and ductile behaviour. Fundamentals of fracture mechanics -stress intensity, strain energy release rate, plastic zone size.
On Dynamics:
(1) Planar kinematics of rigid bodies: translation; rotation about a fixed point; time derivatives of vectors, general motion; relative motion; instantaneous centre, gears motion, sliding motion;
(2) Kinetics of rigid bodies: moments of inertia; equations of motion; general plane motion; work & energy; impulse and momentum.
(3) Three dimensional analysis of rigid body motion: rotation; general motion; relative motion; angular momentum; gyroscopic motion.
(4) Machines dynamics analysis using ADAMS tools: dynamic simulation techniques; linkage design, joints and motion constraints, design and analysis of machines and systems dynamics.
On Vibration:
(1) Free Vibration of Single Degree of freedom system.

## Learning Outcomes

| Outcome Number | Description |
|---|---|
| 01 | Understanding of the principles of equilibrium solid mechanics |
| 02 | Application of the principles to a set of known problems, and critically evaluate their practical application. |
| 03 | Critically evaluate the principles of dynamic analysis and vibration analysis. |
| 04 | Use Adams software to model and analyse the dynamic performance of machines. |

## Learning, Teaching and Assessment Strategy

The following strategies are used in teaching this module
(1) SOL Lectures. Class-based interactive lectures are used to demonstrate the principles of stress analysis and dynamic analysis. Power-points and videos will be used in lectures to make them easy to understand. Our research results will be combined to teach to inspire students in research.
(2) Seminars and OL Seminars (50/50). Interactive problems classes. Three methods are used in tutorial sessions. First, we will answer student questions; secondly, students will be divided into small groups to answer some examples; third, some examples will be demonstrated to support the understanding of knowledge. Sometimes, we encourage students to demonstrate part of the examples to improve their presentation skills.
(3) Laboratories for Statics.
(4) OL Lab sessions for dynamics. Adams software will be taught and used for students to create some complex dynamic system. A research-based strategy will be applied.

Students need to do some research and complete their designs, then use Adams software is used to solve their problems.
The assessment of these modules will include
(1) Summativeassessments to test the understanding of knowledge of machines. There is one summative assessment in each semester. Formative feedback will be given after exams.
(2) Reports of course work. Students are divided into groups to design a machine and develop their models by using Adams software. Students will make an informal presentation and some feedback will be given.

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, C1, M2, C2, M12, C12, M16, C16,

## Mode of Assessment

| Type | Method | Description | Weighting |
|---|---|---|---|
| Summative | Examination - Closed Book | Students required to answer 4 questions from 6 (Statics) (2 Hours) | 50% |
| Summative | Coursework - Written | Report based on ADAMS simulation | 20% |
| Summative | Examination - Closed Book | Students required to answer 3 questions from 5 (Dynamics and Vibration) (2 Hours) | 30% |

## 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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