# SOLID MECHANICS 1 - 2024/5

## Module code: ENG1066

## Module Overview

This module consists of two components: stress analysis and dynamics. In this module, students will extend their understanding of stress analysis from uni-axial to multi-axial conditions. In dynamics, students will be introduced in to concepts of linear momentum and the mathematical modelling of one- and two-degree of freedom mechanical systems.

### Module provider

Mechanical Engineering Sciences

### Module Leader

BIRCH David (Mech Eng Sci)

### Number of Credits: 15

### ECTS Credits: 7.5

### Framework: FHEQ Level 4

### Module cap (Maximum number of students): N/A

## Overall student workload

Independent Learning Hours: 62

Lecture Hours: 33

Tutorial Hours: 11

Guided Learning: 11

Captured Content: 33

## Module Availability

Semester 2

## Prerequisites / Co-requisites

N/A

## Module content

Indicative content includes:

### Stress analysis

Multiaxial behaviour: stress transformation of two-dimensional stress states; principal stresses; strain and strain gauges; strain transformation and principal strains; multi-axial stress-strain relationship; Poisson's ratio and generalized Hooke's law, and the relationship between shear modulus, Young's modulus and Poisson ratio; introduction to failure criteria according to Rankine, Tresca and von Mises.

Stress analysis in mechanical design: uniform torsion, non-uniform torsion and statically indeterminate problems featuring torsion; transmission of power by circular shafts; combined bending and torsion of shafts.

### Dynamics

Principles of displacement, velocity and acceleration; coordinate systems, vectors and vector notation; relative motion; free-body diagrams; conservation of linear momentum, collisions, internal and external forces, impulse and constrained motion; angular momentum of particles; conservation of momentum of rigid bodies, external moments, moments of inertia and constrained motion.

## Assessment pattern

| Assessment type | Unit of assessment | Weighting |
|---|---|---|
| Coursework | Coursework Portfolio | 25 |
| Examination | Final Examination (2 Hours) | 75 |

## Alternative Assessment

None

## Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate that they have developed a good understanding of the fundamental principles and physics underlying the behaviour of objects with applied loads, as well as their motion in response to those loads. The summative coursework portfolio allows students to demonstrate the development of their practical problem-solving skills in both dynamics and stress-analysis. Thus, the summative assessment for this module consists of:

- Coursework portfolio [Learning outcomes 1, 2, 3, 4, 5]
- Examination [Learning outcomes 1, 2, 3, 4, 5]

Formative assessment and feedback

- Formative verbal feedback is given in all tutorials and on preparatory activities for the coursework portfolio

## Module aims

- Provide students with a basic introduction to the elastic response of solids to externally applied loads, including multi-axial stresses and strains, the stress-strain relationship and failure criteria;
- Provide students with the fundamental analytical skills to mathematically model the motion of systems of particles and rigid bodies with and without mass and/or external forces.

## Learning outcomes

| | | Attributes Developed |
|---|---|---|
| 001 | On successful completion of this module, students will be able to: Design simple components under multi-axial stress states by using a combination of stress analysis and the appropriate failure criteria; | KC |
| 002 | Idealise simple engineering structures; | K |
| 003 | Discuss the principle of conservation of momentum and its relevance to physical phenomena and engineering practice; | K |
| 004 | Solve for the motion of one- and two-degree-of-freedom rigid-body systems with external applied forces; | KC |
| 005 | Analyse simple dynamic systems. | KC |

### Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

## Methods of Teaching / Learning

The learning and teaching strategy is designed to introduce students to fundamental concepts in statics, stress analysis, dynamics and their applications through the development of the theoretical framework and its application to practical problem-solving.

The learning and teaching methods include lectures in which students will be introduced to fundamental concepts and demonstrations of the application of these concepts to solving complex problems, and tutorials in which students are guided through the problem-solving process and given the opportunity to apply their learning individually and in small groups with staff guidance.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

## Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENG1066

## Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in (i) employability, (ii) digital capabilities, (iii) global and cultural capabilities, (iv) sustainability and (v) resilience. This module is designed to allow students to develop knowledge, skills and capabilities in the following areas:

Employability: Basic stress analysis and mechanical modeling are critical skills used by professional engineers; students will be developing key transferrable analytical skills which are directly transferrable to the engineering workplace.

Sustainability: Through the examples and case studies selected as demonstrations in this module, the importance of sustainabile engineering will be reinforced;

## Programmes this module appears in

| Programme | Semester | Classification | Qualifying conditions |
|---|---|---|---|
| Aerospace Engineering BEng (Hons) | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |
| Aerospace Engineering MEng | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |
| Biomedical Engineering BEng (Hons) | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |
| Biomedical Engineering MEng | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |
| Mechanical Engineering BEng (Hons) | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |
| Mechanical Engineering MEng | 2 | Compulsory | A weighted aggregate mark of 40% is required to pass the module |