Module Specification

Solid Mechanics, Materials and Manufacturing

Version: 2022-23, v4.0, 20 Jul 2022

Contents

Part 1: Information

Module title: Solid Mechanics, Materials and Manufacturing

Module code: UFMFLS-30-1

Level: Level 4

For implementation from: 2022-23

UWE credit rating: 30

ECTS credit rating: 15

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Delivery locations: City of Bristol College, Frenchay Campus, University Centre Somerset, University Centre Weston

Field: Engineering, Design and Mathematics

Module type: Standard

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This introductory module considers a wide range of engineering analysis of static solid structures and their manufacture, setting examples in an industrial context where possible, otherwise using key learning examples.

The module explores how engineering principles are related to properties of

materials, product design and environmental sustainability. Mathematics and numerical modelling are presented in an engineering context in order to strengthen the students' confidence to address future design engineering challenges.

Reflective practice is encouraged throughout the module where students are working in groups to allow them to share and discuss any aspects or challenges that the module may bring to light. The module takes the students through a journey of examples and applications based around a single platform example, where learning is reinforced with numerical modelling, laboratory based activities and interactive quizzes, allowing the students to practise their maths and challenge their understanding.

Features: Not applicable

Educational aims: The module covers a range of theory and techniques that are central to sound core engineering. This includes the study of statics both in theory and practice, associated analytical methods, materials science and manufacturing techniques.

The module explains key engineering principles integrating them with mathematical techniques, numerical modelling and design methodologies, to give the students a basic toolkit to allow them to further investigate and tackle real engineering problems.

Outline syllabus: Statics:
* Introduction to statics; static equilibrium equations, reactions at supports, distributed and concentrated loading:
* Pin-jointed framework; compression and tension. Method of Joints; Method of sections. Frames and machines.
* Properties of materials, stress, strain, Young's Modulus.
* Shear Force & Bending Moment Theory. Bending moment and shear diagrams, integration theory.
* Stresses in beams & Second Moment of Area, Parallel axis theorem.
* Combined bending and end load; Bi –axial bending. Thermal Strain & Intro to 2D & 3D theory.
* Torsion, derivation of the engineering torsion formula.

Materials:

* Classification of Materials; Metals, Polymers, Composites and Ceramics. Atomic structure and bonding.
*Environmental impact of materials and manufacturing processes.
* Material property and sustainability selection, using Ashby charts.
* Mechanical properties of materials and their measurement; e.g. tensile, bending, hardness, impact.
* Metals: Crystal structures and crystal defects; strengthening processes: alloying, work hardening, grain refinement and heat treatment; simple phase transformations and microstructures; basic heat treatment.
* Polymers: structure, properties and manufacturing of polymers.
* Composites: structure, properties and manufacturing of composites.
* Primary and secondary bonding and the structure of materials.

Manufacturing:

* Classification of Manufacturing: Job, Batch and Continuous manufacture. Economies of scale. Breakeven Analysis.
* Primary Processes: Rolling, casting, extrusion and forging of metals.
* Presswork and Associated Processes: Sheet metal blanking, piercing, shearing and forming. Press tools, drawing and extrusion.
* Material Removal Processes: Conventional metal cutting processes. Turning, milling and grinding. CNC machining. Calculation of power required to cut and Taylor's tool life equation.
* Introduction to assembly and joining techniques: Welding, adhesives and fasteners.

Part 3: Teaching and learning methods

Teaching and learning methods: The module delivery is designed to bring together engineering theory and concepts, analysis and practical experience together so that students consolidate theoretical knowledge through practice and observation.

The module combines lectures, lectorials, class-based interactive workshops, technical workshops and introduces students to the experience of working on real engineering challenges.

The module devotes time to the use of numerical modelling tools as well as laboratories in order to demonstrate the importance of both approaches to solving problems and allowing the students to develop skills to work in a safe and professional manner with their peers.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Accurately identify and explain the relationship between material properties and their structure at the atomic/molecular level (SM1b)

MO2 Evaluate materials and manufacturing processes to meet requirements with relationship to manufacturing volume, mechanical properties, economic, ethical and environmental cost, dimensional accuracy and automation (EL4, P2, P3)

MO3 Analyse engineering problems by applying analytical skills and models using fundamental and well-understood static principles. (SM1b, EA1b)

MO4 Analyse test results in comparison to theory and ideal manufacturing methods using static analysis to demonstrate an understanding of material and manufacturing uncertainty. (EA2, G1, G4)

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Total = 300

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/modules/ufmfls-30-1.html

Part 4: Assessment

Assessment strategy: The module brings together three areas of engineering knowledge and practice that are essential elements in the education of a graduate engineer; namely solid mechanics, materials and manufacturing. The assessment is designed to ensure that students have secure knowledge in the underpinning engineering analysis before attempting assessment tasks that integrate these areas of knowledge.

Component A
Students build confidence with applying the fundamental engineering principles of solid mechanics and structural analysis (statics) through an end of the first semester e-assessment taken under a fixed time-window (standard time 2 hours with reasonable adjustments consideration). Students will have the opportunity to take short practice tests throughout the semester. (35%)

Component B
Statics, materials and manufacturing principles will be brought together through a group work project on an engineering challenge assessed during the second Project Week held in Semester 2. This is a coordinated assessment shared with Engineering Practice 1 and Dynamics Modelling and Simulation. The activity is designed to allow students to demonstrate learning outcomes relevant to this module with the production of a Poster demonstrating their current understanding of all learning outcomes. Tutors formally assess the poster, as part of this activity students perform peer-to-peer formative assessment via a presentation activity. (25%)

Students will develop a range of technical laboratory skills and be assessed on their competence through a portfolio of laboratory exercises. (Pass/Fail)

At the end of the module there will be assessment in the form of a technical group presentation and individual assessment (in terms of Q/A after the presentations or fixed individual written questions) to assess students' understanding and knowledge

of the fundamentals of materials and manufacturing and to explain lab based experimental results that they obtained during the second semester and their approach to finding some solutions for real-world materials and manufacturing problems. (40%)

The resit assessment strategy is the same as the first sit.

Assessment components:

Examination (Online) - Component A (First Sit)
Description: Statics e-assessment (end of TB1) : 4 hours
Weighting: 35 %
Final assessment: No
Group work: No
Learning outcomes tested: MO3, MO4

Laboratory Report - Component B (First Sit)
Description: Portfolio of laboratory exercises.
Weighting:
Final assessment: No
Group work: No
Learning outcomes tested: MO4

Presentation - Component B (First Sit)
Description: Group Presentation (group live presentation or group recorded presentation or group PowerPoint slides plus individual written assessment)
Weighting: 40 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO1, MO2

Poster - Component B (First Sit)

Description: Group poster questions for assessment of statics, materials and manufacturing (typically during project week 2) (15 mins formative presentation assessment)
Weighting: 25 %
Final assessment: No
Group work: Yes
Learning outcomes tested: MO1, MO2, MO3, MO4

Examination (Online) - Component A (Resit)
Description: Statics e-assessment: 4 hours
Weighting: 35 %
Final assessment: No
Group work: No
Learning outcomes tested: MO3, MO4

Laboratory Report - Component B (Resit)
Description: Portfolio of laboratory exercises.
Weighting: 0 %
Final assessment: No
Group work: No
Learning outcomes tested: MO4

Presentation - Component B (Resit)
Description: Group Presentation (group live presentation or group recorded presentation or group PowerPoint slides plus individual written assessment)
Weighting: 40 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO1, MO2

Poster - Component B (Resit)
Description: Group poster questions for assessment of statics, materials and manufacturing (typically during project week 2) (15 mins formative presentation assessment)

Weighting: 25 %

Final assessment: No

Group work: Yes

Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Aerospace Engineering with Pilot Studies [Frenchay] BEng (Hons) 2022-23

Mechanical Engineering [Frenchay] BEng (Hons) 2022-23

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2022-23

Aerospace Engineering [Frenchay] MEng 2022-23

Automotive Engineering [Frenchay] BEng (Hons) 2022-23

Automotive Engineering [Frenchay] MEng 2022-23

Mechanical Engineering [Frenchay] MEng 2022-23

Aerospace Engineering {Apprenticeship-UCW} [UCW] BEng (Hons) 2022-23

Aerospace Engineering [Frenchay] BEng (Hons) 2022-23

Mechanical Engineering [Sep][FT][Frenchay][3yrs] BEng (Hons) 2022-23

Mechanical Engineering [Sep][SW][Frenchay][4yrs] BEng (Hons) 2022-23

Mechanical Engineering {Apprenticeship-UCW} [Sep][FT][UCW][3yrs] FdSc 2022-23

Aerospace Engineering [Sep][FT][Frenchay][3yrs] BEng (Hons) 2022-23

Aerospace Engineering [Sep][SW][Frenchay][4yrs] BEng (Hons) 2022-23

Aerospace Engineering [Sep][FT][Frenchay][4yrs] MEng 2022-23

Aerospace Engineering [Sep][SW][Frenchay][5yrs] MEng 2022-23

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][5yrs] MEng 2022-23

Aerospace Engineering with Pilot Studies [Sep][FT][Frenchay][4yrs] MEng 2022-23

Aerospace Engineering with Pilot Studies [Sep][FT][Frenchay][3yrs] BEng (Hons) 2022-23

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][4yrs] BEng (Hons) 2022-23

Automotive Engineering [Sep][SW][Frenchay][4yrs] BEng (Hons) 2022-23

Automotive Engineering [Sep][FT][Frenchay][3yrs] BEng (Hons) 2022-23

Automotive Engineering [Sep][SW][Frenchay][5yrs] MEng 2022-23

Automotive Engineering [Sep][FT][Frenchay][4yrs] MEng 2022-23

Mechanical Engineering [Sep][SW][Frenchay][5yrs] MEng 2022-23

Mechanical Engineering [Sep][FT][Frenchay][4yrs] MEng 2022-23

Aerospace Engineering {Apprenticeship-UWE} [Sep][FT][UCW][4yrs] BEng (Hons) 2022-23

Aerospace Engineering {Apprenticeship-UCW} [Sep][FT][UCW][4yrs] BEng (Hons) 2022-23

Aerospace Engineering {Apprenticeship-UCW} [Sep][FT][UCW][5yrs] BEng (Hons) 2022-23

Mechanical Engineering with Manufacturing {Apprenticeship-UWE} [Sep][FT][UCW][4yrs] BEng (Hons) 2022-23

Mechanical Engineering with Manufacturing {Apprenticeship-UWE} [Sep][FT][COBC][4yrs] BEng (Hons) 2022-23

Mechanical Engineering {Apprenticeship-UCS} [Sep][FT][UCS][3yrs] FdSc 2022-23

Mechanical Engineering {Apprenticeship-GlosColl} [Sep][FT][GlosColl][3yrs] FdSc 2022-23

Mechatronics {Apprenticeship-UCW} [Sep][FT][UCW][3yrs] FdSc 2022-23

Aerospace Engineering {Apprenticeship-UCW} [UCW] BEng (Hons) 2022-23

Mechanical Engineering {Apprenticeship-UCW} [UCW] FdSc 2022-23

Mechanical Engineering {Apprenticeship-GlosColl} [GlosColl] FdSc 2022-23

Mechanical Engineering {Apprenticeship-UCS} [UCS] FdSc 2022-23

Mechanical Engineering with Manufacturing {Apprenticeship-UWE} [UCW] BEng (Hons) 2022-23

Mechanical Engineering with Manufacturing {Apprenticeship-UWE} [COBC] BEng (Hons) 2022-23

Aerospace Engineering {Apprenticeship-UWE} [UCW] BEng (Hons) 2022-23

Mechatronics {Apprenticeship-UCW} [UCW] FdSc 2022-23

Mechanical Engineering {Foundation}[Sep][SW][Frenchay][5yrs] BEng (Hons) 2021-22

Aerospace Engineering {Foundation} [Sep][FT][Frenchay][4yrs] BEng (Hons) 2021-22

Mechanical Engineering {Foundation}[Sep][FT][Frenchay][4yrs] BEng (Hons) 2021-22

Mechanical Engineering [Sep][PT][Frenchay][6yrs] BEng (Hons) 2021-22

Aerospace Engineering {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2021-22

Aerospace Engineering with Pilot Studies {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2021-22

Aerospace Engineering with Pilot Studies {Foundation} [Sep][FT][Frenchay][4yrs] BEng (Hons) 2021-22

Automotive Engineering {Foundation}[Sep][FT][Frenchay][4yrs] BEng (Hons) 2021-22

Automotive Engineering {Foundation}[Sep][SW][Frenchay][5yrs] BEng (Hons) 2021-22

Mechanical Engineering [Sep][PT][Frenchay][7yrs] MEng 2021-22