ES195-15 Materials for Engineering

24/25

Department
School of Engineering
Level
Undergraduate Level 1
Module leader
Ishwar Kapoor
Credit value
15
Module duration
10 weeks
Assessment
30% coursework, 70% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The focus of this module is on enabling students to undertake a systematic materials selection process, taking account of the required performance, constraints, objectives, cost and environmental implications for engineering components. Selecting the wrong material can be as bad as any other poor decision when designing engineering products or systems. Poor materials choices can lead to non-competitive or environmentally damaging products and, in the worst cases, catastrophic failures.
Materials selection involves: the translation of functional requirements into materials performance objectives; the screening of materials that do not meet these objectives; the development of performance indices to rank candidate materials; and refining down to a single optimal material taking cost and environmental factors into account.

Module web page

Module aims

The aim of this module is to equip students with the knowledge and technical skills required to undertake a systematic materials selection process (primarily for structural, mechanical problems), with the aid of traditional engineering data sheets and computer-aided engineering (CAE) tools. Students' appreciation of engineering data will be supported by laboratory activities from which they will learn and experience how fundamental measurements of mechanical properties of

materials are carried out.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.
Introduction to engineering materials and materials selection.
Case studies that introduce students to materials selection (translation, screening, ranking, refining) based on fundamental mechanical properties (such as stiffness, strength and toughness), cost and sustainability factors.
Strengthening mechanisms of common engineering materials (such as bonding, grain size strengthening, solid solution strengthening, precipitation strengthening and work hardening).
Basic failure mechanisms of structural engineering materials (such as plasticity, fracture and fatigue), supported by laboratories in which these mechanisms and related properties will be measured for different engineering materials.

Learning outcomes

By the end of the module, students should be able to:

- Qualitatively describe the main stages of a systematic materials selection process, how it links with the Engineering Design Process, and the importance of lifecycle of a product and global context of optimising materials selection for a variety of engineering applications with consideration of economic and environmental drivers C7(D) M7(D).
- Describe the characteristic properties of different major families of engineering materials such as metals, ceramics, polymers and hybrids, with reference to fundamental differences in their underlying microstructure C13 M13.
- With the aid of a CAE tool (such as Edupack) and technical literatures (such as engineering data sheet book), combine fundamental theory and performance requirements, along with cost and simple measures of environmental impact (such as embodied energy) to carry out a materials selection process for a broadly-defined engineering application C4(D) M4(D).
- Describe the strengthening mechanisms found in structural engineering materials and identify how these are connected to their mechanical properties (such as stiffness, strength and toughness) C13 M13.
- Describe typical failure mechanisms of structural engineering materials and be able to perform calculations to predict failure mechanisms for broadly-defined engineering applications C13 M13.
- Demonstrate a knowledge of how fundamental mechanical properties of engineering materials are measured and appreciate the link between experimental data and engineering design data found in data sheets and CAE tools C4 (D) M4 (D) C13 M13.

Indicative reading list

- Ashby for Materials Selection
- Swift and Booker for Process Selection

- Callister for Materials Science
- Anderson for Fracture Mechanics

View reading list on Talis Aspire

Subject specific skills

Plan and conduct a materials selection process using a CAE tool.
Knowledge and understanding of the underpinning science of materials behaviour and the link between structure and properties and failure.
Ability to apply relevant laboratory skills to safely evaluate materials properties via destructive means, understand the value of the data being generated, and analyse that data to extract materials property values.
Communicate effectively with technical and non-technical audiences – creating a simple technical summary of a materials selection process.

Transferable skills

Numeracy: apply mathematical and computational methods to communicate parameters, model and optimise solutions within the context of a materials selection activity.
Apply laboratory skills, data gathering & evaluation, and the effective use of materials testing facilities.
Communicate (written and oral; to technical and non-technical audiences) and work with others.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Seminars	10 sessions of 1 hour (7%)
Practical classes	1 session of 2 hours (1%)
Private study	118 hours (79%)
Total	150 hours

Private study description

Private study can be used to self refer lecture notes; watch pre-recorded CAE tools videos and lecture notes, drop-in computer labs etc.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group DB

	Weighting	Study time
In module coursework	30%	

Coursework exercise in which students will individually complete a materials selection process with the use of a computer-aided engineering (CAE) tool and provide a materials recommendation based on performance and other factors.
Students will be provided with a template to answer the questions and expected total word count limit is 1200 words.

Online Examination	70%	

Online Examination 2 hours long covering fundamental understanding of materials selection processes, materials properties and underlying structure, and suitable engineering applications for different materials.

~Platforms - QMP

- Online examination: No Answerbook required
- Students may use a calculator
- Engineering Data Book 8th Edition

Feedback on assessment

For in module coursework:
Text feedback on report content
Breakdown of marks via a rubric
For in-class test:
Formative feedback from computer- and in-class based tests

Past exam papers for ES195

Availability

Courses

This module is Core for:

- Year 1 of UESA-H335 BEng Automotive Engineering
- Year 1 of UESA-H161 BEng Biomedical Systems Engineering
- Year 1 of UESA-H216 BEng Civil Engineering
- Year 1 of UESA-H63W BEng Electronic Engineering
- Year 1 of UESA-H113 BEng Engineering
- Year 1 of UESA-HN15 BEng Engineering Business Management
- Year 1 of UESA-HH75 BEng Manufacturing and Mechanical Engineering
- Year 1 of UESA-H315 BEng Mechanical Engineering
- Year 1 of UESA-HH35 BEng Systems Engineering
- Year 1 of UESA-HN11 BSc Engineering and Business Studies
- Year 1 of UESA-H336 MEng Automotive Engineering
- Year 1 of UESA-H163 MEng Biomedical Systems Engineering
- Year 1 of UESA-H217 MEng Civil Engineering
- Year 1 of UESA-H63X MEng Electronic Engineering
- Year 1 of UESA-H114 MEng Engineering
- Year 1 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 1 of UESA-H316 MEng Mechanical Engineering
- UESA-HH31 MEng Systems Engineering
    - Year 1 of HH31 Systems Engineering
    - Year 1 of HH35 Systems Engineering
- Year 1 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 1 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng