ES195-15 Materials for Engineering

23/24

Department
School of Engineering
Level
Undergraduate Level 1
Module leader
Ishwar Kapoor
Credit value
15
Module duration
15 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, manufacturing processes, 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 manufacturing, 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, 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 and electrical 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.

- Introduction to engineering materials and materials selection.
- A series of case studies that introduce students to the basics of materials selection (translation, screening, ranking) based on fundamental mechanical and electrical properties (such as stiffness, strength, resistivity, permeability, permittivity, etc.) supported by laboratories in which these properties will be measured for a range of engineering materials.
- More advanced case studies that incorporate cost, manufacturing and sustainability factors to refine materials selection processes down to a single optimal material.

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 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; link these to fundamental differences in their underlying microstructure; and give examples of engineering applications in which they are used C13(D) M13(D).
- Develop and demonstrate a practical knowledge and ability to measure fundamental mechanical and electrical properties of engineering materials, and appreciate the link between experimental data and engineering design data found in data sheets and CAE tools C13 (D) M13(D).
- With the aid of a common CAE tool (such as Edupack), combine fundamental theory and performance requirements to carry out the initial stages (translation, screening and ranking) of a materials selection process and produce a shortlist of candidate materials for a given engineering application C4 (D) M4(D).
- With the aid of a common CAE tool (such as Edupack), develop and apply knowledge of manufacturing processes, cost, and simple measures of environmental impact (such as embodied energy) to refine a materials selection process down to a single optimal material for a given engineering application C4 (D) M4(D).

Indicative reading list

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

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.
- 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 -Interpreting phase diagrams, isothermal transformation diagrams, stress-strain curves.

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.
- Plan self-learning and improve performance, as the foundation for lifelong learning/CPD.
- Exercise initiative and personal responsibility, including time management.
- Overcome difficulties by employing skills, knowledge and understanding in a flexible manner.
- Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Seminars	9 sessions of 1 hour (6%)
Practical classes	2 sessions of 2 hours (3%)
Other activity	2 hours (1%)
Private study	115 hours (77%)
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.

Other activity description

Revision class in advance of QMP.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group DA

	Weighting	Study time	Eligible for self-certification
Assessment component			
In module coursework	30%		Yes (extension)
One submission through term on engineering materials selection			
Reassessment component is the same			
Assessment component			
Online Examination	70%		No
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

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

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

	Weighting	Study time	Eligible for self-certification

Reassessment component is the same

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
- UESA-H316 MEng Mechanical Engineering
    - Year 1 of H315 Mechanical Engineering BEng
    - Year 1 of H316 Mechanical Engineering MEng
- 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