ES195-15 Materials for Engineering

22/23

Department
School of Engineering
Level
Undergraduate Level 1
Module leader
Muhammad Khan
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module is about equipping students with the basic skills and knowledge needed to conduct a substantiated selection process for the materials and manufacturing processes that are needed to make a component. Selecting the wrong material or manufacturing process can be as bad as any other poor decision when designing engineering systems - at best this will result in a non-competetive product and at worst can lead to environmental issue or the catasptrophic failure of the component.
To a first approximation materials are chosen empirically by looking what materials are common for the application being considered. A better selection then is to consider what properties are required an match these to materials/material types.
Deeper understanding then derives from understanding how these properties are moderated. The first level of this is by understanding what microstructures a material is capable of, which can have a huge impact on the performance and lifespan of the material. The second is the influence of treatment processes on these structures. At the base level sits the immutable limitations to material behaviour which are derived from the atoms and interatomic bonds present in the material.

Module web page

Module aims

The module will begin by describing the fundamental way by which material selection integrates into the rest of the engineering design process. As the term progresses the student's skill in materials selection will be strenghtened with the help of CAE tools and the knowledge of materials science is extended so that they can make a more sophiosticated case for selecting one material over another for a particular application. This extension of knowledge is also a progressive dive down to the atomic level of the underlying science so that the improvement in materials selection skills is complemented by an increase in knowledge and understanding of materials.

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.

The syllabus is made of six main sections: Selection, Applications, Properties, Microstructures, Processing, Chemistry. There is a general progression from Selection to Chemistry during the module, so that the module starts at the simple end of the selection process, i.e., common sense and stereotypical material use, and then explores the layers of understanding between this simple approach and the constitutent atoms and bonds that make up a material. The objective is to equip the student with the "starter pack" of skills and knowledge required to look at materials and process selection as a functional task. This functional task starts with a set of requirements on the component which can be expressed as a set of materials property-based performance indices which can be used to highlight without prejudice what materials are capable of meeting those requirements. With this broader outlook on materials and their related manufacturing processes an engineer can better explore the balances between pragmatism and innovation, and between financial profit and environmental impact.

Learning outcomes

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

- Select an appropriate engineering material and manufacturing process for a given design.
- Link the performance of engineered products to the complex interactions between material, manufacturing process and design.
- Explain how the structure of engineering materials affect the properties through the structure property relationship.
- Describe how structures of materials can be manipulated to enhance the properties of materials.
- Distinguish the main classes of engineering materials and the underlying materials science that determines their properties and their applications.
- Evaluate the life cycle environmental impacts related to the material and process design choices.

Indicative reading list

Callister for Materials Science
Groover for Manufacturing Processes
Ashby for Materials Selection
Swift and Booker for Process Selection

Trolier-McKinstry and Nwenham for Structure-Property Relationships

View reading list on Talis Aspire

Subject specific skills

1. Plan and conduct a materials selection process using a CAE tool
2. Knowledge and understanding of the underpinning science of materials behaviour and the link between structure and properties.
3. Knowledge and understanding of manufacturing processes and their relationships with the various classes of materials.
4. Ability to apply relevant practical and laboratory skills to safely evaluate materials properties via destructive and non-destructive means, understand the value of the data being generated, and analyse that data to extract materials property values.
5. Knowledge and understanding of the balance between material performance, cost and environmental impact.

Transferable skills

1. Numeracy: apply mathematical and computational methods to communicate parameters, model and optimise solutions within the context of a materials selection activity.
2. Apply laboratory skills, data gathering & evaluation, and the effective use of materials testing facilities
3. Communicate (written and oral; to technical and non-technical audiences) and work with others
4. Plan self-learning and improve performance, as the foundation for lifelong learning/CPD
5. Exercise initiative and personal responsibility, including time management
6. Awareness of the blended cost of manufacturing with materials in the creation of economic and social value
7. Overcome difficulties by employing skills, knowledge and understanding in a flexible manner
8. Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.

Study

Teaching split

Provider	Weighting
WMG	80%
School of Engineering	20%

Study time

Type	Required
Lectures	80 sessions of 15 minutes (13%)
Seminars	16 sessions of 1 hour (11%)
Tutorials	6 sessions of 1 hour (4%)
Practical classes	2 sessions of 2 hours (3%)
Private study	104 hours (69%)
Total	150 hours

Private study description

Time is allotted against each subsection to explore each subject area.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time
Selection Report	100%	

A report that contains two selection processes, that will be developed by the students during the module.

Feedback on assessment

Text feedback on report content
Breakdown of marks via a rubric

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