ES195-15 Materials for Engineering

21/22

Department
School of Engineering
Level
Undergraduate Level 1
Module leader
Glenn Miles
Credit value
15
Module duration
10 weeks
Assessment
50% coursework, 50% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

It is estimated that 70% of innovation arising from engineering research and development is based on advancements in materials science and the associated manufacturing techniques. Engineers are required to make appropriate selection of materials and manufacturing processes taking due account of performance, cost and sustainability to maintain the competitiveness of a product in light of technological advancements and developments in economical, social and environmental requirements.

Module web page

Module aims

This module will introduce the field of materials science, a degree subject in itself, by starting at the atomic level, progressively building up an understanding of how different classes of materials owe their differing properties to the diversity of structures formed when their constituent atoms come together.
Understanding these structures and why they affect material properties leads to an understanding of why materials are chosen for the design demands on a component and also the development of families of manufacturing processes.
The module concludes by learning a systematic approach to the selection of materials and the associated manufacturing processes on the basis of design requirements and the influence of

social and environmental considerations.
The principal aims then are to enable students to integrate materials selection into their Computer Aided Engineering (CAE) capabilities and be able to substantiate that selection by understanding the science that underpins the behaviour 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 Module will cover the 4 main classes of Materials.

- Steels and other Ferrous alloys
- Non Ferrous alloys
- Polymeric Materials
- Composites, Ceramics and Glasses

Each of these classes will be characterised by the explaining the following aspects of Materials Science

- Atomic and molecular structure, microstructure, macrostructure
- Appropriate mechanical, physical, chemical, environmental, electrical, electronic, and manufacturing properties
- Transformations in materials structures
- Structure-property relationships
- Manufacturing Processes and Constraints
- In service considerations, degradation and failure
- Environmental and sustainability considerations.
- Selection of appropriate materials
- Selection of appropriate manufacturing processes (shaping, joining and surface treatment).

Learning outcomes

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

- Distinguish the main classes of engineering materials and the underlying materials science that determines their properties and their applications.
- 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
- Link the performance of engineered products to the complex interactions between material, manufacturing process and design
- Select an appropriate engineering material and manufacturing process for a given design
- Evaluate the life cycle environmental impacts related to material and process choice

Indicative reading list

Materials science and engineering Book by William D. Callister; David G. Rethwisch

The Science and Engineering of Materials. Donald R. Askeland, Wendelin J. Wright. Seventh edition, SI. Boston, MA : Cangage Learning, [2016]

Materials Selection in Mechanical Design / Michael F. Ashby. Butterworth-Heinemann 2011. 4th ed.

Engineering Materials 1 [electronic resource] : an Introduction to Properties, Applications, and Design. Michael F. Ashby, David R.H. Jones. Butterworth-Heinemann 2012. 4th edition

Engineering Materials 1 : An Introduction to Properties, Applications and Design by Michael F. Ashby and David R.H. Jones. Butterworth-Heinemann 2011. 4th ed.

Introduction to Materials Science for Engineers. James F. Shackelford. Pearson Prentice Hall 2009 7th ed.

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

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Practical classes	3 sessions of 2 hours (4%)
Online learning (scheduled sessions)	4 sessions of 1 hour (3%)
Private study	120 hours (80%)
Total	150 hours

Private study description

120 hours guided independent learning

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group C

	Weighting	Study time
Lab assessments 3 lab assessments	50%	
Online Examination Written Examinaton 1 hour long covering the entire syllabus ~Platforms - QMP	50%	

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

Feedback on assessment

Formative feedback from computer- and in-class based tests. N.B. These labs are regarded as a combined component worth 50% of the module mark.

Cohort level feedback on exams

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
- Year 1 of UESA-HH31 MEng Systems Engineering
- Year 1 of UESA-H605 Undergraduate Electrical and Electronic Engineering
- Year 1 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng