ENGINEERING MATERIALS - 2024/5

Module code: ENG3164

Module Overview

A lecture and tutorial based module, which will build on an earlier module to provide a deeper understanding and broader appreciation of materials for engineering applications, with an emphasis on deployment in challenging environments requiring a combination of properties. The first part of the module will (i) examine the processing-microstructure-properties that underpin materials selection, performance and deployment, (ii) examine basic methods of materials selection.

The second part of the module examines specific engineering materials: technical ceramics, polymers, elastomers, steels, aluminium alloys, titanium alloys and nickel-based alloys. Throughout the second part of the module specific applications are explored. These include aerospace, automotive, gas turbine and biomedical applications. A two-hour case study provides a concluding showcase of the role of engineering materials and the application of the major materials classes. This case study is currently undersea oil extraction.

Module provider

Mechanical Engineering Sciences

Module Leader

WHITING Mark (Mech Eng Sci)

Number of Credits: 15

ECTS Credits: 7.5

Framework: FHEQ Level 6

Module cap (Maximum number of students): N/A

Overall student workload

Independent Learning Hours: 75

Lecture Hours: 30

Tutorial Hours: 10

Guided Learning: 5

Captured Content: 30

Module Availability

Semester 1

Prerequisites / Co-requisites

N/A

Module content

- The classification of engineering Materials classification: ceramics, metals, polymers, elastomers, hybrids, natural materials, etc. The role of crystal structure and atomic/molecular bonding in determining the physical properties of Engineering Materials. The role of microstructure in determining the engineering properties of Engineering Materials. An introduction to processing–microstructure–property relationships.

- An overview of materials selection. The importance of resource management (materials and energy) and the need to design for end of life: re-use and recycling.

- Engineering ceramics: properties, processing and applications.

- Engineering polymers (including composites): properties, processing and applications.

- Heat treatment, nucleation and growth, phase diagrams, time-temperature-transformation diagrams, continuous cooling transformation diagrams.

- Engineering steels: properties, processing, microstructure and applications.

- Titanium alloys: properties, processing, microstructure and applications. Nickel alloys: properties, processing, microstructure and applications.

- Bone as an example of hierarchically structured material. Biomaterials – requirements, range of materials used: bio-inert, bioactive and resorbable. Overview of applications, including Case Study – total hip replacement – stem, including coating, femoral head and cup.

- Industrial case study

Assessment pattern

Assessment type	Unit of assessment	Weighting
Coursework	COURSEWORK	100

Alternative Assessment

N/A

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate all for LOs. Each student is allocated a different engineering material which together with the module content, research, and dialogue within the module, enables the core principles to explored and applied.

Thus, the summative assessment for this module consists of a single coursework assignment [testing learning outcomes 1, 2, 3 and 4].

Formative assessment and feedback is provided in the form of verbal feedback given in tutorials and during discussion elements in lectures.

Module aims

- To build on the overview of materials provided at Year 1 and to provide a critical insight into processing-microstructure-property relationships for all major classes of materials.
- To explain and critically evaluate the rationale underpinning the selection and performance of materials for use in a range of environments, which necessitates a number of requirements to be met simultaneously.

Learning outcomes

Ref			Attributes Developed
001	Apply engineering and science principles to understand the interplay between processing, microstructure and properties across a range of materials.	KC	C1, C/M12
002	Select and apply appropriate specific materials in a range of engineering applications.	KCP	C/M13
003	Select and apply appropriate processes so that a material meets a number of complex requirements.	KCT	C/M13
004	Provide a critical comparison of the suitability of a number of materials for an existing or proposed application, taking into account the environmental and societal impacts of the solutions.	KCT	C7

Attributes Developed

C - Cognitive/analytical

K - Subject knowledge

T - Transferable skills

P - Professional/Practical skills

Methods of Teaching / Learning

The learning and teaching strategy is designed to:

(i) Consolidate an understanding of the relationships between microstructure, processing and properties, (ii) evaluate the specific advantages and disadvantages of the major materials classes as engineering materials, and (iii) explore materials selection as an engineering problem. These three areas are achieved principally through lectures and tutorial classes. During the first 6 weeks, this is evaluated by a summative assignment.

The learning and teaching methods include lectures, tutorials, captured content, guided learning (module blog) and independent learning.

Indicated Lecture Hours (which may also include seminars, tutorials, workshops and other contact time) are approximate and may include in-class tests where one or more of these are an assessment on the module. In-class tests are scheduled/organised separately to taught content and will be published on to student personal timetables, where they apply to taken modules, as soon as they are finalised by central administration. This will usually be after the initial publication of the teaching timetable for the relevant semester.

Reading list

https://readinglists.surrey.ac.uk
Upon accessing the reading list, please search for the module using the module code: ENG3164

Other information

The School of Mechanical Engineering Sciences is committed to developing graduates with strengths in Employability, Digital Capabilities, Global and Cultural Capabilities, Sustainability, and Resourcefulness and Resilience. This module is designed to allow students to develop knowledge, skills, and capabilities in the following areas:

Digital capabilities: The students will use MS Word in preparing their assessment. The assessment also makes use of data requiring the use of MS Excel. The classroom elements will include some discussion about the use, strengths, and pitfalls of AI to generate narrative material and answer advanced technical questions.

Employability: The assessment is designed to enhance life-long learning research skills and making a narrative argument. Both skills are essential professional engineering careers.

Sustainability: The exploration of materials in this module makes frequent reference to the limitations posed on engineering materials posed by scarce resources as well as the impact of materials manufacture on the environment. Some attention is paid to ageing processes that limit material's lifetime. Life cycle analysis, whilst not examined in detail, is explored for each material class in terms of reuse, recycling, and end of life issues.

Resourcefulness and resilience: Students will discuss research methods for addressing their bespoke assessment. This will include evaluating a range of sources including textbooks, journals, blogs, AI chat bots, news articles and documentary archives.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Aerospace Engineering BEng (Hons)	1	Optional	A weighted aggregate mark of 40% is required to pass the module
Aerospace Engineering MEng	1	Optional	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering BEng (Hons)	1	Optional	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering MEng	1	Optional	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering BEng (Hons)	1	Optional	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering MEng	1	Optional	A weighted aggregate mark of 40% is required to pass the module