MATERIALS SELECTION IN MECHANICAL DESIGN - 2024/5

Module code: ENG3206

Module Overview

A lecture and tutorial based module, which builds on ENG1063 (Materials and Statics), and is complementary to ENG3164 (Engineering Materials). It provides a deeper and broader appreciation of methods for selecting materials as part of mechanical design. Material property charts are used throughout as a means to rapid appropriation of solutions from a wide range of engineering materials. The module includes the selection of materials processes in addition to selection of materials. Approaches that enable multiple constraints and conflicting objectives to be handled are explored. Materials selection and component shape is addressed as a pointer to more sophisticated contemporary approaches such as topological optimisation.

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: 50

Lecture Hours: 32

Tutorial Hours: 11

Guided Learning: 25

Captured Content: 32

Module Availability

Semester 2

Prerequisites / Co-requisites

None

Module content

An introduction to the design process using constraints and objectives.

Engineering materials and their properties as design allowables.

Material property variability.

An introduction to material property charts. including creating charts.

The scope of materials selection and case studies.

Primary shaping processes

Machining, joining, and finishing processes. Processes and their effect on properties, and process-property trajectories.

Industrial approaches to materials selection.

Introduction to process selection. Process limitations and quality. The economics of scaling processes.

Handling multiple constraints and conflicting objectives: theory and case studies.

Materials selection and shape.

Eco-selection of materials in mechanical design.

Assessment pattern

Assessment type	Unit of assessment	Weighting
Coursework	MATERIALS SELECTION DESIGN PROBLEM	40
Examination Online	2 hour EXAM	60

Alternative Assessment

N/A

Assessment Strategy

The assessment strategy is designed to provide students with the opportunity to demonstrate: (i) they understand how to use diverse engineering materials property data to select appropriate materials for structural applications in a variety of engineering contexts, (ii) they can use engineering materials property data to justify the selection of materials, processes and component geometry against various design goals. Thus, the summative assessment for this module consists of: 1. Assignment [learning outcomes 1 and 2], and 2. Examination [learning outcomes 1, 2, 3 and 4].

Formative assessment is provided in the form of tutorial questions and case studies and formative verbal feedback is given in tutorials. Written feedback is given on the coursework assignment. Feedback is also available on the discussion forum on the SurreyLearn module.

Module aims

- To understand how to use diverse engineering materials property data to select, with critical insight, appropriate materials for structural applications in a variety of engineering contexts.
- To use engineering materials property data to justify, with critical insight, the selection of materials, processes and component geometry against various design goals.

Learning outcomes

Ref		Attributes Developed	
001	Use materials property charts, to apply engineering and science principles, to make initial judgements about the selection of materials for diverse engineering design contexts.	KCT	C/M13
002	Apply engineering and science principles to understand a broad range of processes for materials manufacture and their implications for materials and process selection.	KCT	C/M13
003	Apply engineering and science principles to analyse the mechanics of a materials design problem so as to select materials and geometry to minimise weight, minimise environmental impact, etc.	KCT	C1
004	Establish when a composite material might provide a better design solution than a monolithic engineering material.	KCT	C2

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 enable students to: (i) use and create materials property charts to make initial judgments about the selection of materials for diverse engineering design contexts, (ii) understand a broad range of processes for materials manufacture and their implications for materials and process selection, (iii) analyse the mechanics of a materials design problem so as to select materials and geometry to minimise weight, minimise environmental impact, etc. The learning and teaching methods include: lectures, tutorials, guided learning and independent learning informed by the assessments.

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: ENG3206

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 underpinning principle for the module are property data charts which are generated by software made available to the students. 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. Among the properties explored in this module are eco properties such as embodied energy. 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 chatbots, news articles and documentary archives.

Programmes this module appears in

Programme	Semester	Classification	Qualifying conditions
Aerospace Engineering BEng (Hons)	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Aerospace Engineering MEng	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering BEng (Hons)	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Automotive Engineering MEng	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Biomedical Engineering BEng (Hons)	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Biomedical Engineering MEng	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering BEng (Hons)	2	Optional	A weighted aggregate mark of 40% is required to pass the module
Mechanical Engineering MEng	2	Optional	A weighted aggregate mark of 40% is required to pass the module

Please note that the information detailed within this record is accurate at the time of publishing and may be subject to change. This record contains information for the most up to date version of the programme / module for the 2024/5 academic year.