MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME403 (ME406 sem1/ ME418 sem2) Engineering Materials Selection

Module Registrar: Prof B Wynne bradley.wynne@strath.ac.uk	**Taught To (Course): Cohorts for whom class is compulsory**		
Other Lecturers Involved:	**Credit Weighting: 10**	**Semester: 1 and 2**	
Assumed Prerequisites: ME212 Materials Engineering and Design	**Compulsory**	**Academic Level: 4**	**Suitable for Exchange: Y**

Alternative codes and credit values for those taking only one semester:
Semester 1: ME406 Engineering Materials Selection [5 Credits / ECTS 2.5]
Semester 2: ME418 Engineering Materials Selection [5 Credits / ECTS 2.5]

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
22							6	72	100

Educational Aim

This module presents the key underlying science, engineering, and mathematical tools to predict material performance in-service to enable engineers to have an objective set of tools to make rational decisions on materials selection. The module covers materials ranging from light alloys (i.e., aluminium alloys and titanium alloys) to steels (carbon, stainless, and advanced high strength steels). The course centres on the physical metallurgy of such engineering alloys to demonstrate the effect of alloying and its implications for the processing, microstructure and performance of structural pipeline steels, large scale forgings and aerospace components in both airframe and aero-engine applications. Some parallels will also be drawn with the automotive industry, when discussing both steels and light alloys.

Learning Outcomes

On completion of the module the student is expected to be able to:

LO1 Understand the key aspects of a material's chemistry and microstructure that determine its mechanical properties.

LO2 Know how to apply mathematical tools that predict performance in-service of a material to guide materials selection for the design process.

LO3 Appreciate the importance of understanding how microstructure evolves during materials processing, product manufacture, and during service in order to have a holistic approach to materials selection in design.

LO4 Develop a deeper understanding of the science of the key engineering materials in order to be able to apply evolving cutting-edge developments into new designs.

Syllabus

The module will teach the following:

1. Underlying principles of crystal structure, microstructure, defects on mechanical properties
2. The effects of point 1 on strength and toughness of materials/mathematical tools to describe the behaviour.
3. The effects of point 1 on fatigue of materials/mathematical tools to describe the behaviour.
4. The effects of point 1 on creep of materials/mathematical tools to describe the behaviour.
5. The effect of alloying elements and processing on microstructure of aluminium alloys to optimise mechanical properties – application of points 1-5.
6. Overview of physical metallurgy of steels, including stainless steels.
7. Overview of physical metallurgy of titanium.
8. Overview of residual stress formation and its mitigation.
9. Overview of Non-Destructive Evaluation

Assessment of Learning Outcomes

Criteria

LO1: Understand the key aspects of a material's chemistry and microstructure that determine its mechanical properties.
C1: Able to appreciate the effects of microstructure on length scales from atomic defects to macroscopic segregation on mechanical properties
C2: Be able to describe, in a general way, how microstructure influences mechanical properties, particularly, strength, toughness, fatigue and creep.
C3: Students know how to troubleshoot problems in the use of metals and alloys.

LO2: Know how to apply mathematical tools that predict performance in-service of a material to guide materials-selection for the design process.
C1: Be able to identify the key materials selection criteria based on the design/performance in-service requirements of the product
C2: Be able to clearly articulate a materials selection solution in mathematical terms that can fit with a design team

LO3: Appreciate the importance of understanding how microstructure evolves during materials processing, product manufacture, and during service in order to have a holistic approach to materials selection in design.
C1: Be able to know how to approach the design of a heat treatment for an alloy for a particular application.
C2: Appreciate how to design an alloy to maximise processing and performance in-service outcomes.

LO4: Develop a deeper understanding of the science of the key engineering materials in order to be able to apply evolving cutting-edge developments into new designs.
C1: Be able to make a rationale decision on material selections based on the key attributes of the materials available.
C2: Appreciate the relative engineering constraints of modern-day materials, including cost and environmental considerations.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

Weekly Engagement Sessions
Assistance and feedback will be provided at weekly engagement sessions by highlighting the key elements of the week's online content and through verbal discussion with individuals or groups. There will be a large number of online questions for each week which will have immediate feedback online but discussion about these will also be undertaken in the weekly session.

Revision
Additional tutorial sessions will be provided during revision period to give students feedback on their revision progress.

Online Quizzes
Model answers will be provided shortly after complete cohort completion of the quiz.

Course exam
Formal, summative can be provided on request by the return of examination marks to students after assessment (note: - exam scripts will not be returned to students and no individual or collective discussion of exam performance will be facilitated).

ME403: Assessment: 2 hour exam at end of Semester 2 (80%), Online quiz (untimed quiz) at end of Semester 1 (10%), Online quiz (untimed quiz) at 2/3 through Semester 2 (10%).

ME406: Assessment: 1 hour exam at end of Semester 1 (80%), Online quiz (untimed quiz) at end of Semester 1 (20%).

ME418: Assessment: 1 hour exam at end of Semester 2 (80%), Online quiz (untimed quiz) at 2/3 through Semester 2 (20%).

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

ME403

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Apr/May	2 hrs	80%						
1 (Quiz)	s1 wk11	3 hrs	10%						
1 (Quiz)	s2 wk8	3 hrs	10%						
*L01,L02,L03,L04 (s1:L01,L02 / s2: L03,L04)				*		*		*	

ME406

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Dec	1 hr	80%						
1 (Quiz)	s1 wk11	3 hrs	20%						
*L01,L02				*		*		*	

ME418

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Apr/May	1 hrs	80%						
1 (Quiz)	s2 wk8	3 hrs	20%						
*L03,L04				*		*		*	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submission deadlines (*academic weeks*):

Resit Assessment Procedures:
2hr examination in July/August diet

PLEASE NOTE:
Students must gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-assessed during the August diet. This re-assessment will consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference**

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** Callister, W.D., Materials Science and Engineering: An Introduction, John Wiley & Sons, Incorporated, 2007
* Polmear, Meatllurgy of Light Alloys, Butterworth-Heinemann, 2017
Honeycombe and Bhadeshia, Steels: Microstructure and Properties, Butterworth-Heinemann, 2017

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

Date	Time	Room No
		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr G Houston-Scott

Date of Last Modifications: 10/08/2024

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME403 / 406 / 418**	**Module Title:**	**Engineering Materials Selection**

Brief Description of Assessment:

ME403 Assessment: 2hr exam at end of sem2 (80%), Online quiz at end of sem1 (10%), Online quiz at 2/3 through sem2 (10%)
ME406 Assessment: 1hr exam at end of sem1 (80%), Online quiz at end of sem1 (20%) – as per Semester One row below.
ME418 Assessment: 1hr exam at end of sem2 (80%), Online quiz at 2/3 through sem2 (20%) – as per Semester Two row below.

All quizzes mentioned above are untimed quizzes via Myplace and are shown as 'online test' below.

Assessment Timing

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Online Test	Exam (ME406 only)

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Online Test	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam