

Module Title:	Materials and Manufacturing	Level:	4	Credit Value:	20
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Module code:	ENG490	Is this a new module?	YES	Code of module being replaced:	ENG419
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Cost Centre:	GAME	JACS3 code:	H700
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Trimester(s) in which to be offered:	1, 2	With effect from:	September 18
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School:	Faculty of Arts, Science and Technology	Module Leader:	N Luhyna
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Scheduled learning and teaching hours	60 hrs
Guided independent study	140 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered	Core	Option
BEng (Hons) Aeronautical and Mechanical Engineering	✓	<input type="checkbox"/>
BEng (Hons) Mechanical Manufacturing	✓	<input type="checkbox"/>
BEng (Hons) Automotive Engineering	✓	<input type="checkbox"/>
BEng (Hons) Aerospace & Modern Optics	✓	<input type="checkbox"/>
BEng (Hons) Applied Product Design	✓	<input type="checkbox"/>
BEng (Hons) Drone Technology & Operations	✓	<input type="checkbox"/>

Pre-requisites
None

Office use only

Initial approval February 17

APSC approval of modification Sept 18

5/8/20 Approval of temporary assessment changes or 20-21

22/9/21 Temporary assessment change extended for 21-22

Have any derogations received Academic Board approval?

Version 3

Yes ✓ No

Module Aims

Understanding of different type of materials and how we manufacture with them is key to engineering design. This module introduces materials selection by underpinning the key properties of a range of materials from naturally occurring traditional materials, like such as wood and stone, to modern metallic alloys and ceramics. Once the basic mechanical and electrical properties have been understood, manufacturing and fabrication methods will be introduced. Different manufacturing processes will be discussed with reference to how it changes the mechanical and electrical properties of the base material. Environmental and sustainability concerns will be discussed and analysed alongside failure types and challenges in using some materials.

Intended Learning Outcomes

Key skills for employability

- KS1 Written, oral and media communication skills
- KS2 Leadership, team working and networking skills
- KS3 Opportunity, creativity and problem solving skills
- KS4 Information technology skills and digital literacy
- KS5 Information management skills
- KS6 Research skills
- KS7 Intercultural and sustainability skills
- KS8 Career management skills
- KS9 Learning to learn (managing personal and professional development, self-management)
- KS10 Numeracy

At the end of this module, students will be able to

Key Skills

At the end of this module, students will be able to		Key Skills	
1	Understand electrical and mechanical properties of different materials	KS3	KS6
2	Select materials for a particular engineering purpose	KS3	KS10
		KS4	
3	Provide a fundamental understanding of the manufacturing processes for particular materials and embed quality control processes within the manufacturing design	KS1	KS6
		KS3	
4	Identify environmental challenges in the manufacture and use of materials for particular applications.	KS3	KS6
5	Choose, when given a product specification, a suitable manufacturing process to meet in terms of quantity, precision, cost, recycling and application environment.	KS6	KS10
		KS7	

Transferable/key skills and other attributes

1. Self-evaluation;
2. Problem solving;
3. Material Selection
4. Sustainability and recycling
5. Understand mechanical and electrical properties

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Assessment:

Assessment One, In Class Test – A 2 hour closed book exam that will test the students understanding of mechanical and electrical properties of materials. In addition there will be questions of the manufacturing processes available for particular materials and how they should be selected.

Assessment Two: An in depth report into the materials and manufacturing selection process for a particular product specification.

Post Covid-19 Temporary modification valid for 20/21 and 21/22:

Assessment One: A 2000 word written assignment that covers the students understanding of mechanical and electrical properties of materials. In addition there will be questions of the manufacturing processes available for particular materials and how they should be selected

Assessment Two: As above

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1-4	In-class test	50	2 hours	
2	5	Report	50		2000
<u>Post Covid-19 Temporary modification valid for 20/21 and 21/22:</u>					
1	1-4	Written assignment	50%		2000
2	5	Report	50		2000

Learning and Teaching Strategies:

Lectures, guest speakers, tutorial classes, lab sessions (at the Composites Centre, Broughton) and case studies.

Syllabus outline:

Types of materials, Natural, metallic, Non Metallic, Alloys, Composites

Type of Loadings Tensile, compressive, shear torsion, bending,

Definitions of mechanical properties, Hookes Law, Youngs Modulus, Flexural Modules, Tensile strength (ultimate and Yield) Ductility, Hardness, Conductivity (thermal and electrical), Diffusivity, Coefficient of Thermal Expansion. Type of stresses, Direct, Principal, Hoop,

The basics of failure types- Factors of safety, Fatigue, crack propagation, creep

Material Processing – Grain direction, heat treatments, cold working, quenching and annealing, galvanising.

Manufacturing types – Additive/Subtractive, conventional/nonconventional

Metal processing and changes in properties as a result – Rolling, extrusion, pultrusion, castings (different types), diecasting, deforming,

Plastics – the distinction between Thermoplastic and Thermosets, moulding types, blown film, compression etc. 3D printing materials and their advantages and disadvantages

Glasses and Ceramics – Float galss process, optical quality glass processing, slumping, coatings,

Basics machining theory - Milling, Speeds, feed, cutting, tapping and deburring

Production and product related costs – Raw material, purchased items, labour costs, consumable and overheads, make or buy analysis. Manufacturing quality control.

Bibliography:

Essential reading

Gere, J., (2013) *Mechanics of Materials* 8th Ed, Cengage

Ashby, M. F., (2014) *Materials and design: the art and science of material selection in product design*, Butterworth-Heinemann

Callister, W., (2011) *Materials Science and Engineering*. 8th ed. Hoboken, N.J.: Wiley

Other indicative reading

Bolton, W., (2015) *Materials for engineers and technicians*, Routledge, Taylor and Francis

Ashby M. F., (2013) *Materials and the environment eco-informed material choice*,
Butterworth-Heinemann

Moore, Ron, (2007), *Selecting the Right Manufacturing Improvement Tools: What Tool?
When?*, Butterworth-Heinemann