

Module Code:	ENG742
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Module Title:	Advanced and Composite Materials
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Level:	7	Credit Value:	20
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Cost Centre(s):	GSAC	JACS3 code:	J500
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School:	Applied Science, Computing & Engineering	Module Leader:	Nataliia Luhyna
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Scheduled learning and teaching hours	40 hrs
Guided independent study	160 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered (not including exit awards)	Core	Option
MSc Engineering (Aeronautical)		✓
MSc Engineering (Mechanical Manufacture)		✓
MSc Engineering (Automotive)		✓
MSc Engineering (Composite Materials)	✓	
MSc Engineering (Renewable & Sustainable Energy)		✓

Pre-requisites
N/A

Office use only

Initial approval: 19/06/2018

With effect from: 01/09/2018

Date and details of revision:

Version no:3

Version no:

Module Aims

To develop a modern framework for the evaluation and selection of Modern Materials. It will also enable the student to understand that advanced properties of advanced & composite materials is at the heart of the new technological drive for the 21st century

- To provide a modern overview on new developments of conventional, advanced & composite materials.
- To predict mechanical and physical properties of composites.
- To develop further knowledge of the limitations of the conventional, advanced and composite materials used in industry.
- To assess the use of smart materials and the application of polymers to advanced structures.
- To be able to select and validate appropriate methods or techniques for manufacture of composite 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	Demonstrate detailed knowledge and application of the principles, theory, and limitations of various conventional, advanced & composite materials.	KS1	KS3
		KS4	KS6
		KS7	KS10
2	Interrelate design considerations with both manufacturing processes and ultimate performance.	KS1	KS3
		KS4	KS6
		KS10	
3	Critically review detailed theoretical analysis of modern engineering materials.	KS1	KS3
		KS4	KS6
		KS9	KS10
4	Critically assess the significance of aspects of composite development in a wider materials context.	KS1	KS3
		KS4	KS6
		KS9	KS10
5	Apply methods for determining mechanical properties of modern engineering materials.	KS1	KS4
		KS6	KS10

Transferable skills and other attributes

1. Communication
2. ICT Technologies
3. Time management and organisation
4. Interpersonal skills
5. Problem solving
6. Information handling including numeracy

Derogations

Credits shall be awarded by an assessment board for those Level 7 modules in which an overall mark of at least 50% has been achieved with a minimum mark of 40% in each assessment element.

Assessment:

Indicative Assessment Tasks:

Assessment One: An individually prepared critique of the use of advanced & composite materials in complex structure situations.

Assessment Two: A written examination which assesses the capability of knowledge and application of the principles, concepts and limitations of various advanced & composite materials.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	2, 3	Coursework	50	N/A	2000
2	1, 4, 5	Examination	50	2 hours	

Learning and Teaching Strategies:

The module will be delivered through detailed presentations combined with interactive sessions to enhance students' learning. The learning experience will be further supported by tutorials and self-study work.

Syllabus outline:

The following will be delivered (under condition of meeting all learning outcomes), depending on availability and relevance to the particular cohort:

- Present materials used in industrial design and future trends. Types, classification, definitions and scope of materials.
- Structure/property relationships with respect to strength, modulus, fatigue, toughness, thermal expansion, thermal conductivity, etc. (including metallographic investigations)
- Analysis and testing of materials, Instrumentation (e.g. NDT, SEM, C-Scan).
- Fundamentals of composite materials.
- Polymer Matrix Composites: Fibres, matrices and interfacial/interphasial effects.

- Mechanics of reinforcement for long and short fibre systems.
- Metal Matrix Composites (MMC): Sources and properties of metal whiskers. Uses of metal matrix composites. Fabrication techniques - solid state, liquid state, in situ fabrication. Mechanical and chemical bonding. Discontinuous reinforcement in MMC. Strength, stiffness, transverse, compressive, electrical and thermal properties
- Ceramic Matrix Composites: Fabrication, properties, interface problems, toughness. High temperature, corrosive, biomedical, friction related applications.
- New developments in composite materials and potential applications, including the practical applications in the area of renewable energy.

Indicative Bibliography:

Essential reading

Vasiliev, V. (2013) Advanced Mechanics of Composite Materials and Structural Elements. 3rd Edn. John Wiley and Sons.

Other indicative reading

Askeland, D. (2013) Essentials of Materials Science and Engineering. SI Edition. Cengage Learning Ed.

Harper, C.A. (2002) Handbook of Plastics, Elastomers and Composites. 4th Edn. McGraw Hill.

Mitton, G. (2002) Theory of Composites. Cambridge University Press.

Smith, P. (1969) Plastics as Metal Replacements. Scientific Pubns.

Sholte, J. (2005) Nanotechnology Industry Trends and Applications. Wiley.

Callister, W. (2002) Materials Science and Engineering. John Wiley and Sons.

Swanson, S.P. (1997) Introduction to Design and Analysis with Advanced Composite materials. Prentice Hall.

Journal of Materials: Design and Applications IMechE

Journal of Advanced Materials. Wiley