MODULE TITLE	**Advanced Materials Engineering**	**CREDIT VALUE**	**15**
MODULE CODE	**ECMM127**	**MODULE CONVENER**	**Prof Yanqiu Zhu (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS	**12 weeks**	**0**	**0**

Number of Students Taking Module (anticipated)	**0**

DESCRIPTION - summary of the module content

Materials engineers are often at the cutting edge. Their understanding of the properties and behaviours of different substances is crucial in the development of technologies - and advances in materials can drive the creation of new products and even new industries. This module will expose you to current developments in biomaterials, materials for energy, and nano-composites.

AIMS - intentions of the module

The purpose of this module is to develop the understanding of materials that you gained in previous modules. It is designed to engage you in the research that is on-going in these areas in an industrial, academic and international context.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

This is a constituent module of one or more degree programmes which are accredited by a professional engineering institution under licence from the Engineering Council. The learning outcomes for this module have been mapped to the output standards required for an accredited programme, as listed in the current version of the Engineering Council's 'Accreditation of Higher Education Programmes' document (AHEP-V3).

This module contributes to learning outcomes: **SM1m, SM1fl, SM4m, SM2fl, EA5m, EA2fl, D1m, D2m, D7m, D2fl, D8m, D3fl, ET2m, ET2fl, ET4m, ET4fl, EP2m, EP1fl, EP9m, EP2fl, G1m, G1fl, G2m, G2fl.**

A full list of the referenced outcomes is provided online: http://intranet.exeter.ac.uk/emps/subjects/engineering/accreditation/

The AHEP document can be viewed in full on the Engineering Council's website, at http://www.engc.org.uk/

On successful completion of this module, **you should be able to**:

Module Specific Skills and Knowledge: SM1m, SM1fl, SM4m, SM2fl, ET2m, ET2fl, ET4m, ET4fl, EP2m, EP1fl, EP9m, EP2fl

1 understand the state of the art in biomaterials, materials for energy and nano-composites;

2 select appropriate materials for tissue replacement applications;

3 recognise the medical/biological requirements for tissue replacement materials;

4 choose and/or process appropriate materials for energy production/storage, eg fuel cells;

5 grasp the synthesis, properties and processing of nanomaterials and nano-composites;
6 understand key properties and engineering potentials of carbon nanotubes and graphene

7 pick out and/or design nano-composite materials and processing routes for industrial applications;
8 understand the ethical and societal impacts that nanocomposites can have on our society.

Discipline Specific Skills and Knowledge: D1m, D2m, D7m, D2fl, D8m, D3fl, EA5m, EA2fl, EP2m, EP1fl, EP9m, EP2fl

9 comprehend one or these rapidly advancing technological fields;

10 appreciate materials science within sectors of the modern technological world.

Personal and Key Transferable/ Employment Skills and Knowledge: G1m, G1fl, G2m, G2fl

11 exhibit advanced information gathering skills;
12 present detailed and balanced views towards new technological field via formal reports
13 demonstrate the ability to synthesise information across disciplines and source types.

SYLLABUS PLAN - summary of the structure and academic content of the module

- introduction to nanomaterials and nano-composites;
- carbon nanotubes and graphene: synthesis, properties and engineering applications
- nano-composites processing;
- polymer matrix nano-composites; manufacture, properties, applications;
- metal matrix nano-composites; manufacture, properties, applications;
- ceramic matrix nano-composites; manufacture, properties, applications;
- future directions for nano-composites;
- introduction to biological and synthetic biomaterials, anatomy/physiology, biomechanics and tissue engineering synthetic and biological materials, mechanical and biological properties;
- tissue engineering;
- medical imaging;
- introduction to materials for energy, background and context lecture;
- elements of electrochemistry;
- materials for solid oxide fuel cells;
- materials for polymer electrolyte fuel cells;
- modelling workshop (computer based: use of visualisation and energy optimisation software);
- materials for lithium ion batteries;
- materials for solar cell panels;
- materials for catalytic conversion.

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	22.00	Guided Independent Study	128.00	Placement / Study Abroad	

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled learning and teaching activities	22	Lectures
Guided independent study	128	Guided independent study

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Questions asked of students in lectures			Feedback provided on the spot

SUMMATIVE ASSESSMENT (% of credit)

Coursework	30	Written Exams	70	Practical Exams	

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Written exam – closed book	70	3 hours - January Exam	All	Exam mark
Nanocomposite Coursework	20	5 pages	All	Written
Bioengineering Materials Coursework	10	5 pages	All	Written

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-reassessment
All above	Written exam (100%)	All	August Ref/Def period

RE-ASSESSMENT NOTES

If a module is normally assessed entirely by coursework, all referred/deferred assessments will normally be by assignment.

If a module is normally assessed by examination or examination plus coursework, referred and deferred assessment will normally be by examination. For referrals, only the examination will count, a mark of 50% being awarded if the examination is passed. For deferrals, candidates will be awarded the higher of the deferred examination mark or the deferred examination mark combined with the original coursework mark.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

ELE – http://vle.exeter.ac.uk

Reading list for this module:

Enderle, Blanchard and Bronzino. Introduction to Biomedical Engineering. 2nd Edition. Enderle, Blanchard and Bronzino 2005. ISBN: 978-0122386626
Lanza, Langer and Vacanti. Principles of Tissue Engineering. 3rd Edition. Academic Press 2007. ISBN: 978-0123706157
Ajayan, M Pulickel, Schadler and Braun. Nanocomposite Science and Technology. Wiley 2003. ISBN: 978-3527303595
Twardowski, Thomas. Introduction to Nanocomposite Materials. DEStech Publications 2007. ISBN: 978-1932078541
OHayre, R.; Cha, S.K.; Colella, W. and Prinz, F.B. Fuel Cell Fundamentals. John Wiley & Sons 2006. ISBN: 978-0471741480
Atkins, P. and De Paula, J. Atkins' Physical Chemistry. Oxford University Press 2009. ISBN: 978-0198700722

Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Extended	Enderle, Blanchard and Bronzino	Introduction to Biomedical Engineering	2nd	Enderle, Blanchard and Bronzino	2005	978-0122386626	[Library]
Extended	Lanza, Langer and Vacanti	Principles of Tissue Engineering	3rd	Academic Press	2007	978-0123706157	[Library]
Extended	Ajayan, M Pulickel, Schadler and Braun	Nanocomposite Science and Technology		Wiley	2003	978-3527303595	[Library]
Extended	Twardowski, Thomas	Introduction to Nanocomposite Materials		DEStech Publications	2007	978-1932078541	[Library]
Extended	OHayre, R.; Cha, S.K.; Colella, W. and Prinz, F.B.	Fuel Cell Fundamentals		John Wiley & Sons	2006	978-0471741480	[Library]
Extended	Atkins, P. and De Paula, J.	Atkins' Physical Chemistry		Oxford University Press	2009	978-0198700722	[Library]

CREDIT VALUE	15	ECTS VALUE	7.5
PRE-REQUISITE MODULES	None		
CO-REQUISITE MODULES	None		
NQF LEVEL (FHEQ)	M (NQF level 7)	AVAILABLE AS DISTANCE LEARNING	No
ORIGIN DATE	Tuesday 10 July 2018	LAST REVISION DATE	Tuesday 06 October 2020
KEY WORDS SEARCH	Bioengineering materials; biomaterials; nanomaterials; energy materials.		