UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Fundamentals of Materials
Module Code	MAE3003-B
Academic Year	2023/4
Credits	20
School	Department of Mechanical and Energy Systems Engineering
FHEQ Level	RQF Level 3

Contact Hours	
Type	Hours
Lectures	36
Tutorials	18
Laboratories	16
Directed Study	130

Availability	
Occurrence	Location / Period
BDA	University of Bradford / Academic Year

Module Aims

1. Material is necessary for every engineering system; as such, engineers must develop knowledge and understanding of the influence of material structure (from atomic through to microstructural) on materials' chemical and physical properties. Materials science combines tools from chemistry, biology,technology, and mathematics to develop a solution critical to societal needs and covers all natural and synthetic materials.

2. The module provides the theoretical knowledge of microstructures and materials properties for various materials, including metals and alloys; ceramics and glasses; polymers; electronic, magnetic, and optical materials; and composites. As well as metallurgical theories and concepts enable the understanding of the relationship between treatment and material properties for application in all branches of engineering.

3. In this module, students are supported to develop the analytical and practical skills necessary to understand and apply scientific engineering principles to create new sustainable products with the potential of reducing environmental impact and significantly improving our quality of life.

Outline Syllabus

The following topics will be covered in this module

Semester 1 - Physics of Materials

* States of matter,
* Gas Laws
* Avogadro constant, atom and electronic structure,
* Primary and secondary bonding,
* Polymorphism & carbon hybridisation, hard sphere modelling &
* Crystal lattices & defects,
* Mechanical properties,
* Mechanisms for enhancing properties,

Semester 1: Chemistryof materials

* Thermal properties.
* Enthalpy: heats of formation & combustion,
* Hess's Law, catalysts and activation energy, equilibrium, constant (Kc),
* Le Chateliers Principle,
* Organic reaction mechanisms, simple reactions of alcohols, carboxylic acids & amines.

Learning Outcomes

Outcome Number	Description
01	1.1 Confidently explain and discuss the nature of different properties of materials in relation to their structure. 1.2 Demonstrate a basic understanding of the chemical nature of materials and reaction kinetics.
02	2.1 Apply principles of theory to recommend suitable materials, based on their structure and properties, for engineering problems. 2.2 Perform elementary calculations using material properties 2.3 Apply the principles of chemical reactions to solve problems set in an engineering context.
03	3.1 Manage and interpret data. 3.2 Present technical data and analysis in formal reports. 3.3 Solve problems systematically using the scientific principles and theory. 3.4 Communicate technical information in a concise, confident, manner. 3.5 Work as part of a team.

Learning, Teaching and Assessment Strategy

* Per the overall educational philosophy of the Engineering Foundation Year, the delivery and assessment of the module recognise that the student cohort is diverse, including students with minimal knowledge of the physics and chemistry behind modern materials science. The teaching style is designed to gradually introduce students to the relevant principles using summative feedback as needed via worked through problem-solving in class and laboratory "hands-on" sessions to support students better. The formative assessment is likewise based on the use of several methods.

* The lectures will use a combination of handouts, demonstrations, class discussion, cooperative learning research and presentations to deliver the theories and concepts of material science. Students are required to spend time during those classes applying the theories to examples that are then discussed and explained by tutors. Ahead of each tutorial, students are assigned tutorial sheets with problems that will be addressed in subsequent tutorial sessions. Students can complete part or all of the problem sheets before class, depending on their understanding and confidence. After the class, they will have additional time to complete any outstanding questions. Tutors have opportunities to repeat explanations or increase the challenge depending on individual student needs. Students are taught how to answer exam-type questions during tutorial sessions.

* During semester one, students participate in hands-on laboratory experiments in small groups which creates an inclusive space for student to express ideas. The laboratory sessions expose students to methods of testing and ways of assessing materials' properties. Students are instructed on how to work in groups and write the report. The Lecturer then reviews preliminary reports through the Canvas submission box and provides formative feedback before the final report is submitted for marking.

* During the second semester, library staff teach students how to conduct research and prepare a report while avoiding plagiarism. The Lecturer also teaches the students how to deliver an effective presentation in order to develop their ?personal transferable skills?.

Mode of Assessment

Type	Method	Description	Weighting
Summative	Coursework	Laboratory report based upon the software package and observation of testing methods. 1500 words length.	20%
Summative	Examination - Closed Book	Closed book test	30%
Summative	Dissertation or Project Report	Individual report-based coursework and group presentation. 2000 words and a group presentation of 10 minutes.	50%
Formative		Method - Short classroom-based self-assessment worked examples. Description - Students will be able to work through examples in class and to self-assess their performance as the answer is revealed to all students by the Lecturer. Length/Duration - As needed by the lecture	N/A

Reading List

To access the reading list for this module, please visit https://bradford.rl.talis.com/index.html

Please note:
This module descriptor has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but minor changes may occur given the interval between publishing and commencement of teaching. Upon commencement of the module, students will receive a handbook with further detail about the module and any changes will be discussed and/or communicated at this point.

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