Module Descriptor

Module Details	
Module Title:	Materials in Electronics
Module Code:	CFS7024-B
Academic Year:	2019-20
Credit Rating:	20
School:	School of Chemistry and Biosciences
Subject Area:	Chemistry
FHEQ Level:	FHEQ Level 7 (Masters)
Pre-requisites:	
Co-requisites:	

Contact Hours

Type	Hours
Lectures	28
Seminar	6
Directed Study	166

Availability

Occurrence	Location / Period
BDA	University of Bradford / Semester 2 (Feb - May)

Module Aims

This module will introduce you to the electronic nature of materials. No previous knowledge of the electronic nature of materials is assumed but a good background in core inorganic and physical chemistry, especially that of bonding is essential. The purpose of the module is to provide students with a good background and appreciation of how the theories of chemical bonding within solids can be used to understand their inherent electronic structure. The content of this module is designed to impart a greater understanding and appreciation for how the properties of the many materials in the world around us can be accounted for.

Outline Syllabus

1. The chemical bond revisited.

2. Metallic bonding
3. Alloys and non-crystalline metals
4. Bands in ionic and covalent solids
5. Semiconductors
6. Optical transitions in the solid state
7. The electronic nature of the solid/liquid junction
8. Charge transfer at the solid/liquid junction
9. The electrochemical nature of interfaces
10. Use of electromagnetic radiation to probe the nature of interfaces

Learning Outcomes

1	Analyse the differences in the underlying electronic composition of the main classes of materials.
10	Deduce the effectiveness of various instrumentation and their associated techniques in the elucidation of many of the processes occurring at interfaces and the interpretation of the data so obtained.
11	Converse using the language of material science and be able to communicate with chemists, physicists and engineers in the area using the appropriate concepts.
12	Be competent at self-study and be able to quickly assimilate information.
13	Be able to think across your own discipline and explore other fields.
2	Appraise the main factors that contribute to the nature of the chemical bond.
3	Discuss the models employed to describe the underlying electronic nature of metals especially with respect to their charge transport.
4	Apply the knowledge introduced for metals so as to extend the models to describe the electronic nature of metals to account for the nature of other metallic materials e.g. alloys.
5	Highlight the important aspects of band theory that are employed to explain many of the properties observed by materials in the solid state.
6	Prioritise and discuss the properties of these materials with respect to their use in a variety of relevant device architectures.
7	Explain the role that the solid/liquid interface plays in the attenuation of charge transfer.
8	Explain the role of semiconducting materials play in charge transfer and evaluate the role that that mechanism of charge transport through the extended solid plays in their efficiency.
9	Elaborate on the nature of the solid/liquid interface and the role that it plays in optoelectronic applications.

Learning, Teaching and Assessment Strategy

Lectures will deliver core content; providing you with the opportunity to acquire the information to enhance your knowledge and understanding of the basic undergraduate aspects of materials chemistry. This will be complemented by seminars, group discussions and tutorials to allow you to apply this learning to specific exemplar problems.

You will study the major classes of materials and specifically learn how to describe many of the properties they possess with respect to their underlying electronic structure. The nature of the chemical bond with respect to ionicity will first be addressed. The models used to describe the metallic bond, the free electron model and its further extension the nearly free electron model, and which account for its conductivity will be addressed. These concepts will be further extended to describe the observed properties in alloys and non-crystalline metals.

Next, we will introduce further band theory, which has been successfully used to explain many physical properties of solids, such as electrical resistivity and optical absorption, and forms the foundation of the understanding of all solid-state devices (transistors, solar cells, etc.). These ideas will lead us to the principal notions underpinning the nature of semiconductors and particularly the optical transitions which these materials exhibit in the solid state. Subsequently the use of crystals, both solid and liquid crystals, in electronics will be introduced and the use and advantages of liquid crystals for flexible electronic applications will be developed.

The nature of the solid/liquid interface (junction) will then be introduced and the theories behind the interfacial structure and its role and implications for charge transfer presented. The role that this interface plays in many optoelectronic applications will be introduced. This will form the background for a more in-depth discussion of the concepts that lie behind charge transfer at interfaces.

Finally the use of instrumentational techniques that may be employed to interrogate the solid-liquid interface will be introduced with particular emphasis being placed on electrochemical methods such as cyclic voltammetry, impedance, photoelectrochemical spectroscopy, impedance spectroscopy, and decay transients.

Directed study provides you with the opportunity to undertake guided reading and to develop your own portfolio of learning to enhance transferable skills and knowledge relating to evaluation of your own role and subject provision.

The VLE will be used to provide access to online resources, lecture notes and external links to websites of interest.

Assessment 1: An assessed problem based workshop
Assessment 2: A summative examination

Mode of Assessment

Type	Method	Description	Length	Weighting
Summative	Examination - closed book	Closed book written examination	2 hours	60%
Summative	Coursework	Problem based workshop	-2000 words	40%

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.