UNIVERSITY of BRADFORD

Module Descriptor

Module Details	
Module Title	Biomaterials with implant design and technology
Module Code	MHT6013-B
Academic Year	2024/5
Credits	20
School	School of Engineering
FHEQ Level	FHEQ Level 6

Contact Hours	
Type	Hours
Lectures	24
Tutorials	24
Independent Study	74
Directed Study	78

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

Module Aims

For semester one, this module aims to develop the critical knowledge base biomaterials for tissue/joint replacement including metals, ceramics and biodegradable/bioresorbable polymers and fracture fixation devices, their properties, hip and knee design, testing, evaluation and manufacturing for orthopaedic applications meeting the MDA/FDA requirements. For semester two, the module aims to integrate and apply the existing knowledge from semester one to a wider implant design and technology and to apply general design procedures/methodology to medical devices such as joint replacements , stents, scaffolds and fixation devices. Also, the following codes of conduct will be covered in lectures and tutorials across two semester and will be assessed in the assignments: Professional and ethical conduct in engineering aspects such as the use of biomaterials as implants, commercial, economic and social context of the engineering processes, management techniques, legal requirements governing engineering activities including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues as well as risk issues including health and safety, environmental and commercial risk, risk assessment and risk management techniques.

Outline Syllabus

For biomaterials in semester 1: Introduction to biomaterials- Applications, Properties and Processing. Pre-requisites of biomaterials (biocompatibility concepts). Structure and properties of tissues, metals, polymers/composites and ceramics as biomaterials. Surface engineering of biomaterials, processing and forming techniques. Degradation of biomaterials, corrosion, bio-tribology (wear, friction and lubrication), and adsorption. Polymer applications in artificial joints. Shape memory polymers. Bioresorbable polymers. Case study 1: Production, design, properties, selection and evaluation of ceramic femoral heads and cups. Case study 2: Fracture fixation devices such as bone plates and screws. Legislative aspects (MDA/FDA requirements), patents, pre-clinical and clinical trials. For implant design in semester 2: General design considerations including design procedures, design specifications and regulatory issues; Surgical considerations; Bearing surfaces; Implant fixation; Implant loosening and wear; Implant manufacturing; Pre-clinical evaluation of orthopaedic implants; Hip/knee joint replacements. Research-led areas of recent developments: shape memory polymer devices; bioresorbable polymer devices; associated manufacturing techniques. Also, the following codes of conduct will be covered in lectures and tutorials across two semester and will be assessed in the assignments: Professional and ethical conduct in engineering aspects such as the use of biomaterials as implants, commercial, economic and social context of the engineering processes, management techniques, legal requirements governing engineering activities including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues as well as risk issues including health and safety, environmental and commercial risk, risk assessment and risk management techniques.

Learning Outcomes

Outcome Number	Description
01	Critically evaluate the structure, properties and manufacturing of biomaterials for orthopaedic applications along with professional and ethical conduct in engineering aspects of biomaterials as implants.
02	Understand the important factors in selecting tissue replacement biomaterials to meet the MDA/FDA requirements.
03	Design concepts for implant applications.
04	Sustainability and viability.
05	To solve problems systematically considering biocompatibility, mechanisms of implant failure.
06	Economics, cost, performance and implant testing.

Learning, Teaching and Assessment Strategy

Concepts are introduced using online lectures, tutorials, and case studies. Deeper/better understanding is developed during tutorials by solving practical problems. Oral feedback is given during tutorial and case studies. For the biomaterials part in semester 1, one assignment (35%) in week 12 or 13 to answer three questions, and two case studies (15%) as coursework (2000 words in total) to be submitted in week11. The case studies will also include online virtual testing of implants using hip/knee simulators. For the implant design part in semester 2, one assignment to answer three questions.

LO1: SM1b, SM2b, EA1b, EA2, EA4b, D6, EL1, P1, P2, P11 LO2: D4, EL2, EL5, P6 LO3: D1, LO4: D2, EL4 LO5: EL6, G1, G2, G4 LO6: D5, EL2, P3

Mode of Assessment			
Type	Method	Description	Weighting
Summative	Coursework - Written	Biomaterials in Semester 1	35%
Summative	Coursework - Written	Two Case Studies including implant testing via hip/knee simulators	15%
Summative	Coursework - Written	Assignment - Implant Design in Semester 2	50%

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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