Engineering Tripos Part IIA, 3G5: Biomaterials, 2017-18

Module Leader

Dr Y Huang [1]

Lecturers

Dr S Huang, Dr M Birch, Dr R Daly, Dr A Markaki

Lab Leader

Dr M Oyen [2]

Timing and Structure

Michaelmas term. 16 lectures.

Aims

The aims of the course are to:

- Develop an understanding of the materials issues associated with implanting man-made materials in the human body for medical purposes. Specific case studies will be considered in addition to the general framework.

Objectives

As specific objectives, by the end of the course students should be able to:

- Identify the mechanism by which medical devices and implants come to market.
- Know about the classes of and materials used in medicine.
- Understand the requirements for materials used in the body and assess potential for implant-body interactions.
- Perform quantitative evaluations of drug delivery.
- Identify appropriate tissue engineering approaches for different tissues and organs.

Content

Introductory concepts (1L)

- General application overview, history and development
- Classes of materials used in medicine
- Medical device definition and classification

Materials for medical implants and tissue engineering (3L)
Biomaterial selection
Hydrolysis and resorbable polymers

Nanoparticles and drug delivery (1L)
- Nanoparticles and molecular targeting
- Drug delivery systems (diffusion-driven, osmotically-controlled, microencapsulation)

Bioprinting and biofabrication (1L)
- Bioprinting techniques
- Bioprinting materials

Host Response to Implants (1L)
- Wound repair
- Innate immunity
- The biological response to biomaterials

Adaptive Immunity (1L)
- How can biomaterials be used to treat the consequences of autoimmune diseases
- What happens when biomaterials fail

Using Cells in Tissue Engineering (1L)
- Cell therapy
- Combining cells with scaffolds
- Implant integration and vascularisation

Sector Analysis and Regulatory Affairs (1L)
- Market analysis
- Role of standards
- EU and US approval process

Sterilisation of Biomaterials (1L)
- Sterilisation techniques
- Choosing a technique

Orthopaedic Implants - Hip Replacement (2L)
- Types of implant fixation
- Materials in hip implants
- Surface engineering approaches
- In vivo loading of hip joint.

Cardiovascular Stents (2L)
- Balloon expandable & self expanding stents
- Materials in stents
- Stent mechanics and design

Further notes
Examples papers
Coursework
Optional coursework is available.

[Coursework Title]

Learning objectives:

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Practical information:

- Sessions will take place in [Location], during week(s) [xxx].
- This activity [involves/doesn't involve] preliminary work ((estimated duration)).
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Full Technical Report:

Students [will/won't] have the option to submit a Full Technical Report.

Booklists

Biomedical Engineering: Bridging Medicine and Technology by W. Mark Saltzman

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

UK-SPEC

The UK Standard for Professional Engineering Competence (UK-SPEC) [4] describes the requirements that have to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has been developed, and is regularly updated, by panels representing professional engineering institutions, employers and engineering educators. Of particular relevance here is the 'Accreditation of Higher Education Programmes' (AHEP) document [5] which sets out the standard for degree accreditation.

The Output Standards Matrices [6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition document is addressed within the Engineering and Manufacturing Engineering Triposes.

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