Engineering Tripos Part IIA, 3G5: Biomaterials, 2018-19

Module Leader

Dr A Markaki [1]

Lecturers

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lab Leader

Dr S Huang [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 man-made and naturally-derived materials 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 materials used in medical materials and the associated reasons.
- Understand the requirements for materials used in the body and assess potential for implant-body interactions.
- Perform quantitative evaluations of drug delivery.
- Identify appropriate implants and tissue engineering approaches for tissue and body function replacements.
- Understand bioethics and safety regulations associated with medical devices and implants.

Content

Introductory concepts (1L)

- History of biomaterials
- Five therapies for missing organs
- Classes of Biomaterials overview

Biomaterials as integral parts of medical devices (1L)

Biocompatibility; sterilisation techniques (1L)

- Sterilisation techniques
- Choosing a technique

Sector analysis and regulatory affairs (1.5L)

- Market analysis
- Role of standards
- EU and US approval process

Advanced medical devices and biomaterials of the future (0.5L, non-examinable)

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

Synthetic polymers for tissue engineering applications (2L)

- Introduction to polymers
- Synthetic biodegradable polymers

Host response to implants (1L)

- Wound repair
- Innate immunity
- The biological response to biomaterials

Using cells in tissue engineering (1L)

- What happens when biomaterials fail
- Cell therapy
- Combining cells with scaffolds
- Working with biology - implant integration and vascularisation

Naturally derived polymers for tissue engineering application (1L)

Drug delivery and diffusion (2L)

- Drug delivery systems
- Diffusion controlled systems in drug delivery

Further notes

Examples papers

Example papers are available on Moodle.

Coursework

Full Technical Report:

Students will not have the option to submit a Full Technical Report.

Booklists

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

Biomaterial Science: An Introduction to Materials in Medicine. Edited by Ratner et al.

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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Links
[1] mailto:am253@cam.ac.uk
[2] mailto:yysh2@cam.ac.uk
[3] http://teaching.eng.cam.ac.uk/content/form-conduct-examinations
[4] http://www.engc.org.uk/ukspec.aspx
[5] http://www.engc.org.uk/standards-guidance/standards/accreditation-of-higher-education-programmes-ahep/
[6] http://teaching.eng.cam.ac.uk/content/output-standards-matrices