Engineering Tripos Part IB, 2P8: Bioengineering, 2021-22

Course Leader

Dr G Treece [1]

Lecturers

Dr Guillaume Hennequin, Dr Y Ahmadian , Dr Graham Treece, Dr S Huang [2]

Timing and Structure

Weeks 1-4 Easter term, 14 lectures + 2 examples classes, 4 hours/week.

Aims

The aims of the course are to:

- enable students to appreciate the vast potential for the application of engineering principles in biology and medicine, and learn about four specific application areas in which Part I engineering principles can be applied to
- gain insight into visual processing and optimality in eye design.
- study the structure and function of the eye.
- study the design of ocular prostheses.
- study medical imaging of the components of the eye.

Content

Visual processing (3L, Dr Guillaume Hennequin)

- From eye to brain.
- Spatial, depth & colour vision.
- Retinal and cortical neural prostheses.

Biological vision with an engineers eye (3L, Prof Máté Lengyel)

- Evolution in eye design:optimal optics.
- Approaching physical limits; retinal patterning and processing.
- Encoding visual scenes in the brain; optimal information processing.

Imaging of the eye (4L, Dr Graham Treece)

- Optical fundus imaging and the scanning laser ophthalmoscope.
- 2D and 3D optical coherence tomography.
- Ocular ultrasonography.
- Visualisation of 3D data.

Introduction and Ocular biomechanics and biomaterials (4L, Prof Michael Sutcliffe)

- Healthy eye and ocular biomechanics.
- Structural and mechanical diseases of the eye.
- Lens and cornea replacement and transplantation.
- Future eye repair practices:tissue engineering.

Booklists

Wang, L.V. & Wu, H.-I. Biomedical Optics: Principles and Imaging, Wiley, 2007.

Examination Guidelines

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

UK-SPEC

This syllabus contributes to the following areas of the UK-SPEC [4] standard:

Toggle display of UK-SPEC areas

- Engineering Library: **DB.158** and Part IB Tripos shelves

GT1

Develop transferable skills that will be of value in a wide range of situations. These are exemplified by the Qualifications and Curriculum Authority Higher Level Key Skills and include problem solving, communication, and working with others, as well as the effective use of general IT facilities and information retrieval skills. They also include planning self-learning and improving performance, as the foundation for lifelong learning/CPD.

IA1

Apply appropriate quantitative science and engineering tools to the analysis of problems.

IA3

Comprehend the broad picture and thus work with an appropriate level of detail.

KU1

Demonstrate knowledge and understanding of essential facts, concepts, theories and principles of their engineering discipline, and its underpinning science and mathematics.

KU2

Have an appreciation of the wider multidisciplinary engineering context and its underlying principles.

D1

Wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations.

D2

Understand customer and user needs and the importance of considerations such as aesthetics.

D3

Identify and manage cost drivers.

S1

The ability to make general evaluations of commercial risks through some understanding of the basis of such risks.

S3

Understanding of the requirement for engineering activities to promote sustainable development.

E1

Ability to use fundamental knowledge to investigate new and emerging technologies.

E2

Ability to extract data pertinent to an unfamiliar problem, and apply its solution using computer based engineering tools when appropriate.

E3

Ability to apply mathematical and computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.

P1

A thorough understanding of current practice and its limitations and some appreciation of likely new developments.

P3

Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc).

P5

Awareness of nature of intellectual property and contractual issues.

US1

A comprehensive understanding of the scientific principles of own specialisation and related disciplines.

US3

An understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in engineering projects.

US4

An awareness of developing technologies related to own specialisation.

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