Engineering Tripos Part IIB, 4G2: Biosensors, 2016-17

Leader
Prof A Seshia [1]

Lecturers
Prof A Seshia and Professor E A Hall

Timing and Structure
Lent term. Lectures and coursework. Assessment: 100% coursework.

Aims
The aims of the course are to:

- link engineering principles to understanding of biosystems in sensors and bioelectronics

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

- extend principles of engineering to the development of bioanalytical devices and the design of biosensors.
- understand the principles of linking cell components and biological pathways with energy transduction, sensing and detection
- appreciate the basic configuration and distinction among biosensor systems.
- demonstrate appreciation for the technical limits of performance.
- make design and selection decisions in response to measurement problems amenable to the use of biosensors.

Content
This course covers the principles, technologies, methods and applications of biosensors and bioinstrumentation. The objective of this course is to link engineering principles to understanding of biosystems in sensors and bioelectronics. It will provide the student with detail of methods and procedures used in the design, fabrication and application of biosensors and bioelectronic devices. The fundamentals of measurement science are applied to optical, electrochemical, mass, and pressure signal transduction. Upon successful completion of this course, students are expected to be able to explain biosensing and transducing techniques, design and construct biosensors instrumentation.

Introduction
- Overview of Biosensors
- Fundamental elements of biosensor devices
- Engineering sensor proteins

Electrochemical Biosensors
Electrochemical principles
- Amperometric biosensors and charge transfer pathways in enzymes
- Glucose biosensors
- Engineering electrochemical biosensors

Optical Biosensors
- Optics for biosensors
- Attenuated total reflection systems

Acoustic Biosensors
- Analytical models
- Acoustic sensor formats
- Quartz crystal microbalance

Micro- and Nano-technologies for biosensors
- Microfluidic interfaces for biosensors
- DNA and protein microarrays
- Microfabricated PCR technology

Diagnostics for the real world
- Communication and tracking in health monitoring
- Detection in resource limited settings

Coursework
The coursework will be assessed on two marked assignments. The first assignment will involve a laboratory session illustrating the functional demonstration of glucose sensor technology. This assignment will be marked on individual reports handed in Monday 13 February. The second assignment will involve a laboratory session illustrating the principle of a quartz crystal microbalance and related acoustic sensor technologies. This assignment will be marked on individual reports to be handed in Wednesday 15 March.

Booklists
Please see the Booklist for Group G Courses [2] for references for this module.

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.