Engineering Tripos Part IIA, 3G1: Molecular Bioengineering I, 2021-22

Module Leader

Prof. G Micklem [1]

Lecturers

Prof. G Micklem, Dr S Bakshi

Lab Leader

Prof. G Micklem [1]

Timing and Structure

Michaelmas term. 16 lectures, 1 virtual laboratory class. This is an intensive introductory level undergraduate course targeted at third year Engineering students.

Prerequisites

None

Aims

The aims of the course are to:

- To provide a basic grounding in biomolecular engineering along with underpinning molecular biology.
- To increase awareness for the opportunities for bioengineering within modern biology.
- To have enough background knowledge and familiarity with the terminology to be able to play a productive role collaborating with biologists.
- To provide the grounding for a new Part IIB course, Molecular Bioengineering II, that is expected to run for the first time in 2022-2023.

Objectives

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

- An appreciation of the potential of engineering living systems
- An appreciation of the capabilities of applying evolution in a laboratory setting
- Understanding of the fundamental molecules and processes required for gene expression and replication
- Understanding gene structure and regulation in simple organisms
- To have a basic knowledge of what is feasible with genetic engineering, and the underpinning molecular techniques
- Designing synthetic genetic circuits: understanding basic mathematical and molecular biological frameworks
- Designing synthetic genetic circuits: living systems vs cell-free systems
- To understand the latest technologies for genome sequencing, genome analysis, and genome-scale experimental methods

- An appreciation for DNA as a construction material for information storage and other applications

Content

The structure of the course will be as follows.

Lectures 1-5 (GM): Evolution; genetic information; molecular cloning, DNA amplification; example applications

Lectures 6-12 (SB): Gene expression and regulation; circuit design, construction and characterisation; noise; cell-free systems

Lectures 13-16 (GM): Genomes, genome sequencing and transcriptomics; sequence alignment; sequencing applications; DNA for construction and data storage; DNA dynamics

Further notes

Pandemic adaptations 2021-2022

We need to take account of individuals who may be vulnerable or need to self-isolate in thinking about how we deliver the lectures, labs and supervisions of 3G1. While currently it is intended that all activities will be in person, please bear in mind that all arrangements are subject to change depending upon Government and University guidance. In addition, the specific needs of individuals leading teaching may result in some sessions being online. We will post such changes on Moodle and also notify the class by email.

Masks: current University Guidance is that masks are "strongly recommended" but not compulsory. We encourage you to wear them during lectures, labs and supervisions. We should all show courtesy towards others. Please bear in mind that some will have medical reasons for not wearing a mask.

Lectures: it is intended that lectures will be held in person – where possible please sit in alternate seats. Recordings of the lectures will be made available via Moodle.

Labs: it is intended to hold the (computational) lab in person in a lecture theatre on your own laptops - where possible please sit in alternate seats.

Supervisions: please follow the guidance of your supervisor regarding use of the venue they book for the supervisions.

Recordings: the terms under which the University provides recordings means that they are strictly for your personal use only and should not be distributed further in any form.

Examples papers

See the course Moodle site

Coursework

Laboratory Practical - the lab is computational and will concern the design of a COVID-19 test and vaccine.

Learning objectives:

- To become familiar with basic tools for viewing nucleic acid sequences
- To consider the overall workflow for a PCR-based virus test and design the necessary primer sequences
- To consider the overall workflow for generation of a fusion protein and to design the necessary sequences

Practical information:

- Preliminary work (~1hour) and completing an online test in advance of the lab will be worth 1 point. The test will be available through Moodle.

Full Technical Report:

There is no Full Technical Report (FTR) associated with this module.

Booklists

Please refer to the Booklist for Part IIA Courses for references to this module, this can be found on the associated Moodle course.

Examination Guidelines

Please refer to Form & conduct of the examinations [2].

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