

Engineering Tripos Part IIB, 4G6: Cellular & Molecular Biomechanics, 2023-24

Module Leader

[Prof. V.S. Deshpande](#) [1]

Lecturers

[Prof V Deshpande and Prof N Fleck](#) [2]

Timing and Structure

Lent term. 14 lectures + 2 examples classes. Assessment: 100% exam

Prerequisites

3C7 useful.

Aims

The aims of the course are to:

- deal with the relation between microstructure of and properties such as strength, stiffness and actuation capability of natural materials such as cells and tissues.

Objectives

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

- understand the relation between micro-structure of soft biological materials and their mechanical properties.
- have a working understanding of the various components within plant and animal cells with a more detailed knowledge of the cytoskeletal components.
- develop an understanding of muscles as actuators at the tissue, cell and protein length scales.
- Understand active and passive transport mechanisms within cells

Content

Overview Lecture (Prof. V.S. Deshpande 1L)

The microstructure of the cell – animal cells, plant cells and the sub-cell building materials.

Mechanical Properties of Soft Solids (4L) (Prof. N.A. Fleck)

- The mechanical properties of natural materials – property maps
- Bending versus stretching micro-structures and entropic networks
- The notion of persistence length
- Models of stiffness and strength
- Mechanics of skin: stress v. strain responses, toughness and skin injection

Muscle Mechanics (5L) (Prof. V.S. Deshpande)

- Twitch and tetanus and the Hill model
- Structure of the muscle: fibers, fibrils and contractile proteins
- Sources of energy in the muscle- Lohmann reaction
- Huxley Sliding filament model
- Models of myosin

Cellular transport (4L) (Prof.V.S. Deshpande)

- Overview of cellular homeostasis
- Passive transport mechanisms
- Active transport mechanisms

Further notes

Further details and online resources:-

<http://www-g.eng.cam.ac.uk/lifesciences/courses.html> [3]

Booklists

Please refer to the Booklist for Part IIB 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](#) [4].

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Links

[1] <mailto:vsd20@cam.ac.uk>

[2] <mailto:vsd20@cam.ac.uk>, naf1@cam.ac.uk

[3] <http://www-g.eng.cam.ac.uk/lifesciences/courses.html>

[4] <https://teaching.eng.cam.ac.uk/content/form-conduct-examinations>