

## **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](mailto:naf1@cam.ac.uk)

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

[4] <https://teaching23-24.eng.cam.ac.uk/content/form-conduct-examinations>