



Indian Institute of Science

Department of Bioengineering



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Course Title: Cell Mechanics
Course Code: BE 211
Course Schedule: Aug Semester
Credits: 3:0

Course Coordinator: Prof. Vaishnavi Ananthanarayanan
Pre-Requisites: None
Eligibility: Only for students enrolled in the M. Tech. or Ph.D. program at BE IISc

Description

This course will provide an in-depth understanding of mechanics of the cell including theory of cellular architecture, mechanical forces, deformations, and adhesions, leading up to force generation and interaction of cells with the external environment. Additionally, practical aspects, including measurement of cell mechanics using experimental techniques such as micropipette aspiration, single particle tracking and atomic force microscopy will be presented. The topics covered will culminate in broad applications of cell mechanics in physiology, cell biology and biophysics with the syllabus comprising cell shapes, biomaterials (soft filaments and sheets in cells), forces inside cells, random walks, movement in a viscous fluid, viscoelasticity (background, constitutive models and measurement in cells), complex filaments, rheology of cytoskeletal filaments, biomembranes (bilayers, micelles, vesicle formation), cell-cell and cell-matrix interactions, micropipette aspiration, single particle tracking, atomic force microscopy, applications of cell mechanics viz. cell division, migration, morphogenesis, cancer metastasis.

Course outcomes

After taking the course, the students will be able to:

1. understand the mechanical phenomena that operate inside cells
2. relate cell mechanics to biology and physiology of the cell in normal and disease states
3. plan and execute experiments that probe cellular mechanics at multiple levels

Resources

1. David Boal, Mechanics of the Cell, Cambridge University Press (2012)
2. Christopher R. Jacobs, Hayden Huang, Ronald Y. Kwon, Introduction to Cell Mechanics and Mechanobiology, Garland Science (2013)
3. Ronald Kaunas, Assaf Zamal, Cell and Matrix Mechanics, CRC Press (2014)

4. Jonathon Howard, Mechanics of Motor Proteins and the Cytoskeleton, Sinauer Associates Inc. (2001)

Additional information

Traditionally, biochemical signals have been at the crux of all aspects of biology. Recently, there has been a growing body of science implicating mechanical phenomena in the functioning of cells in the context of both health and disease.