



# INTRODUCTION TO MECHANOBIOLOGY

## PROF. SHAMIK SEN

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IIT Bombay

**INTENDED AUDIENCE** : Biotech/Biosciences/Bioengineering/Physics/Mechanical Engineering/Chemical Engineering

**PRE-REQUISITES** : B.Sc/B. Tech: Biotech/Biosciences/Bioengineering MSc/M.Tech: Biotech/Biosciences/  
Bioengineering

**INDUSTRIES APPLICABLE TO** : Industries that will recognize this course Academic Institutes, Startups working in the area of tissue engineering

## COURSE OUTLINE :

Mechanobiology is an upcoming interdisciplinary field of science where concepts of mechanics, biology and engineering are combined to understand the basics of different cellular processes ranging from cell division to cell differentiation and death.

## ABOUT INSTRUCTOR :

Prof. Shamik Sen joined IIT Bombay in July 2010 as an Assistant Professor in the Department of Biosciences and Bioengineering. Dr. Sen earned a B.E. in Mechanical Engineering from Jadavpur University, Kolkata, and a M. Tech in Mechanical Engineering from IIT Kanpur. He then completed his PhD in Mechanical Engineering from University of Pennsylvania, where he worked in the area of mechanobiology. He is currently working in the area of mechanobiology where he is integrating mechanics and biology for probing stem cell biology and cancer cell biology. He is combining experiments with simulations for addressing his research questions.

## COURSE PLAN :

- Week 01** : Need to study Mechanobiology, Cell as a Tent, individual components, Cell-ECM crosstalk, ECM proteins: Collagen, Measuring properties of collagen networks.
- Week 02** : Properties of collagen networks, Rheology, Rheology of biopolymer networks, Atomic Force Microscopy (AFM), Design of protein constructs for AFM.
- Week 03** : Protein unfolding using AFM, Focal adhesions: focal adhesion proteins, Focal adhesion organization, Focal adhesions: role of forces.
- Week 04** : Cytoskeleton: Actin, Force-velocity relationships of actin networks, Mesenchymal cell migration, Actin dynamics during mesenchymal migration.
- Week 05** : Adhesion Independent Migration, Adhesion Independent & Collective Cell Migration, Collective Cell Migration, Mechanobiology of Stem Cell Fate I & II
- Week 06** : Mechanobiology of Stem Cell Fate III, Mechanobiology of Diseases: Cancer I, II, III, Mechanobiology of Diseases: Atherosclerosis & Hypertension.
- Week 07** : Mechanobiology of Diseases: Muscular Dystrophy, Nuclear Mechanotransduction: LINC complex, Nuclear Mechanotransduction: LINC complex in cell migration, Nuclear Mechanotransduction: Gene regulation, Mechanical Forces & DNA damage.
- Week 08** : Techniques in Mechanobiology: Hydrogels, AFM, Traction Force Microscopy, Trypsin Deadhesion & Laser Ablation, techniques in Mechanobiology: Microfabrication, FRET.