



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170417

Mechanobiology

B.E. 7th SEMESTER

Type of course: Open Elective

Pre requisite: Advanced Molecular biology, Cell Biology, Biochemistry, Basic Physics

Rationale: This subject is directed towards students who are interested towards cutting edge research that is happening at the interface of biology, mechanics and chemistry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	0	3	70	30	0	0	100

Course Contents:

Sr. No.	Topics	Teaching Hours
1	UNIT I: Introduction to Mechanobiology What is a cell, the plasma membrane, transmembrane proteins, cell signalling via juxtacrine signals, Extracellular matrix, cytoskeleton, Cell- ECM cross talk, Mechanosensitive ion channels, stress fibres and focal adhesions, Mechanosensing, Mechanotransduction, Durotaxis.	3
2	UNIT II: Key players of mechanosensing Contributors to cellular mechanosensing, passive and active mechano sensing, Role of the ECM in mechanobiology, Integrins, Signaling pathways- Outside: In and Inside: Out mechanotransduction, The cytoskeleton (CSK), Focal Adhesion assembly (paxillin, vinculin, zyxin, VASP, FAK, Tensin).	13
3.	UNIT III: Techniques for studying mechanical properties of cells and ECM Rheology studies, AFM and AFM probe designs, Moving forward from 2D to 3D using hydrogels, Traction Force Microscopy, Trypsin Deadhesion & Laser Ablation, Microfabrication, FRET.	7
5.	UNIT IV: Studying Mechanobiology of Cytoskeleton, ECM and Focal adhesion. Rheology studies with collagen an ECM protein, Protein Unfolding as a means for mechano transduction- study using AFM, Understanding actin networks,	14



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	Adhesion independent cell migration.	
6.	UNIT V: Mechanobiology of diseases Mechanobiology of Atherosclerosis, Mechanobiology of cancer, Mechanobiology of Muscular dystrophy.	8

Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	15	10	10	5	0

Legends: R=Remembrance; U= Understanding; A= Application; N = Analyze;E = Evaluate; C = Create and above Levels (**Revised Bloom's Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Johnson, A. Wagoner, and Brendan Harley, eds. *Mechanobiology of cell-cell and cell-matrix interactions*. Springer Science & Business Media, 2011.
2. Kobayashi, Takeshi, and Masahiro Sokabe. "Sensing substrate rigidity by mechanosensitive ion channels with stress fibers and focal adhesions." *Current opinion in cell biology* 22.5 (2010): 669-676.
3. Jansen, Karin A., et al. "A guide to mechanobiology: where biology and physics meet." *Biochimica et Biophysica Acta (BBA)-Molecular Cell Research* 1853.11 (2015): 3043-3052.
4. Wang, J. H-C., and B. P. Thampatty. "An introductory review of cell mechanobiology." *Biomechanics and modeling in mechanobiology* 5.1 (2006): 1-16.

Course Outcome:

After learning the course, the students should be able to:

Sr. No.	CO Statement	Marks % Weightage
CO-1	Understand the key players and need to study Mechanobiology	20
CO-2	To interpret properties of ECM, Cellular proteins involved in mechanobiology.	50
CO-3	Understand role of mechanobiology for understanding diseases.	30



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List of Open Source Software/learning website:

Students can refer to video lectures relevant to subject, available on the websites, including NPTEL- Introduction to Mechanobiology course by Prof Shamik Sen. Student can also use <https://www.mbi.nus.edu.sg/> for following mechanobiology research by NUS. Student may also make use of <https://www.mechanobio.info> for understanding basics of mechanobiology.