Course Number: 28185

Course Name: Fundamentals of Bioengineering

Course Type: Theory	Type & Max Unit: constant 3
Prerequisite: none	Corequisite: none
Level: Graduate	First Presentation: Fall 1391
Group: Energy conversion	Last Edition: 1396

Objectives:

This course is designed to make students familiar with basic concepts of biological engineering research in which the engineers can take part. Engineers are well equipped with mathematical and numerical skills for problem solving while there is a lack of knowledge about basic concepts of cell biology. This course is aimed to remove the deficiency and open the field of bioengineering to the students with no background.

Topics:

Section 1: Introduction to bioengineering literature
Biological component groups: DNA, Proteins, Amino acids
Cell structural elements: Protein folding, Protein structural hierarchy, Intracellular structural proteins, Antibody and antigen, cell membrane and lipids
Genes: RNA and DNA, Watson and Crick's double helix, DNA renaturation, Translation and transcription, Gene expression and DNA sequencing, DNA Lab methods

Section 2: Introduction to bio-mems and microfluidics
Diffusion and Brownian motion, Trajectory of Brownian particles, convective diffusion equation, Diffusion in 1,2 and 3 dimensions, Particle equations of motion Reynolds and Peclet number limits in microfluidics, Applications of microfluidics, Flow in micro channels, Concentration gradient, Traditional and modern tissue culture, Micro-fabrication methods, Negative vs. positive resist photolithography, soft-lithography

Section 3. Introduction to cell mechanics
Fundamentals: Cell structural components: stress fibers, microtubules and intermediate filaments, Cell ECM interactions, Cell migration, Mechanotransduction, Focal adhesion proteins
Rheology of viscoelastic materials: Maxwell's model, Voigt model, SLS model, Experimental methods, Rheology statics and dynamics
Polymer physics and cellular cytoskeleton: Random walk model, Gaussian model, FJC model, WLC model, Six fold connectivity model
Micro pipette aspiration, Mechanics of plates and shells, Bending vs. tension dominant cases

Section 4. Tissue engineering

Introduction to regenerative medicine, stem cells, natural biomaterials, synthetic biomaterials, engineered biomaterials, case studies for the regeneration of skin tissue, case study for the regeneration of heart tissue.

References:

Molecular Biology of the Cell, Bruce Alberts et al.,Garland Science, 2002
Essential Cell Biology , Alberts et al., Garland Science, 2004
Nanostructures and Nanomaterials, Guozhong Cao, Imperial College Press, 2004.
Fundamentals of Microfabrication, by Marc Madou
Mechanics of Motor Proteins and the Cytoskeleton, Jonathan Howard, Sinaver Associates, 2001.
Intermolecular and Surface Forces, Jacob Israelichvili, Academic Press 1991.
Random Walks in Biology, Howard Berg, Princeton Press, 1993.
مبانی زیست ملکولی و مهندسی ژنتیک. دکتر گیتی امتیازی-دانشگاه اصفهان انتشارات مانی