

**ME 251 (JAN) 3:0**

**BIOMECHANICS**

**Instructor: NAMRATA GUNDIAH**

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### **Course Description**

Mechanical behavior of living matter is governed not only by the short-term elastic or viscoelastic response to loading, but also by growth and remodeling at longer time scales. This remodeling plays an important role in tissue properties and adaption. The course will cover mechanics essential to describe *skeletal mechanics*, *ocular biomechanics*, *circulatory system*, and *cellular mechanobiology*. The course will include topics on (1) elastic and viscoelastic mechanics; (2) rubber elasticity; (3) cell biology; and (4) mechanics of biological growth. This class is intended for graduate students who have taken basic courses in solid mechanics at an undergraduate level. A background in biology is not expected. Undergraduate students with atleast one basic course in mechanics may be permitted to take the course with approval of the instructor.

### **References**

Fung, Y. C., Biomechanics, Springer-Verlag, 1990.

Ethier, R.C. and Simmons, C. A., Introductory Biomechanics, Cambridge University Press, 2007.

Humphrey, J. D., Cardiovascular Solid Mechanics, Springer-Verlag 2002.

Humphrey, J. D. and Delange, S.L., An Introduction to Biomechanics, Springer 2003.

Goriely, A., The Mathematics and Mechanics of Biological Growth, Springer 2016.

Nelson, P.C., Biological Physics, Chillagon Science, 2020.

### **Class Meeting Times and Location**

Tu Thu, 11:30-1:00 PM in the Mini Class room.

Week	Date		Topic
1		01/05	Introduction and Class Policy
2	01/10	01/11	Stress, Transformations, Principal Stress, Strain ( <b>HW#1</b> )
2	01/17	01/19	Constitutive behavior ( <b>HW#2</b> )
3	01/24	01/31	Skeletal biomechanics ( <b>HW#3</b> )
4	02/02	02/07	Muscles ( <b>HW#4</b> )
5	02/09	02/14	Gait and movement, prosthesis
6	02/17	02/21	Viscoelasticity ( <b>HW#5</b> )
7	02/24	02/28	Hydrogels and cartilage
8	03/03	03/07	Ocular biomechanics
9	03/09	03/14	Cardiovascular biomechanics (blood and arterial walls)
10	03/16	03/21	Rubber proteins and Statistical mechanics ( <b>HW#6</b> )
11	03/24	03/28	Nonlinear problems: Constitutive properties of tissues ( <b>HW#7</b> )
12	03/30	04/04	Cell Mechanobiology: Composition, structure, actin treadmilling
13	04/06	04/11	Traction microscopy, Cells under stretch/ shear ( <b>HW#8</b> )
14	04/13	04/18	AFM of cells, Growth and Remodeling ( <b>HW#9</b> )
15	04/20	04/25	Growth and Remodeling

### Guest Lectures

1. Arko/ Abhijit Sinha Ray (Ocular mechanics)
2. Cardiovascular biomechanics (Srilakshmi Adhyapak/ Seetharam Bhat)