Updated Topic Guide for Module II

Course BB101 is comparatively new as part of the undergraduate curriculum at IIT Bombay. This course being taught only since last two years. Unfortunately, there is no single text book which instructors can use to teach module II at the level of undergraduates. This is why instructor has to use following three different text books to teach the Module II

Reference Book 1: Physical Biology of the cell, R. Phillips, J. Kondev, J. Theriot, H. Garcia (Publisher: Garland Science)

Reference Book 2: Biological Physics, Philip Nelson (Publisher: W. H. Freeman)

Reference Book 3: Mechanics of Motor Proteins and the Cytoskeleton, Jonathan Howard (Publisher: Sinauer Associates Inc.)

Below I have listed where one can find topics discuss in lectures

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Lecture 1

Topic: Introduction of Physical Biology or Biophysics

http://www.biophysics.org/Education/WhatisBiophysics/tabid/2287/Default.aspx

Topics: Physical Properties of a globular protein, force, Forces acting on a protein molecule, Motion of Mechanical element: Mass, spring and dashpot, Motion of combination of mechanical elements

Chapter 2 of Reference Book 3

Lecture2

Topic: Inertia of moving bacterium

Example 2.3 in Chapter 2 of Reference Book 3 or uploaded supplementary material for Lecture2

Sedimentation of a 100 kDa globular protein

See uploaded supplementary material for Lecture2 and Example 2.1 in Chapter 2 of Reference Book 3

Topic: Motion of combination of mechanical elements:Mass and Spring with Damping

Chapter 2 of Reference Book 3

Topic: Viscosity and fluid flow, Newtonian fluid, Viscous Critical Force, Reynolds number

Chapter 5 of Reference Book 2

Other topics:

Lecture notes are enough

Lecture 3

Topic: Life at low Reynolds number, Symmetry-Breaking (natural microorganisms)

Chapter 5 of Reference Book 2

Other topics:

Lecture slides are enough as these topics have been taught using research papers

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Lecture 4

Topics: Fick's Law, Continuity Equation, Diffusion Equation, Free diffusion from a point source

Chapter 4 of Reference Book 3

Topic: Einstein and Einstein relation

Lecture slides are enough

Topic: Conformation of polymers

Section 8.2.1 in Chapter 8 of Reference Book 1

Lecture 5

Topics: Worm Like Chain model for polymers, Bending stiffness, Energy required to bend DNA in a circle

Section 9.2.2 and 9.2.3 in Chapter 9 of Reference Book 2

Other topics:

Lecture slides are enough

Lecture 6

Topic: Persistence Length

Section 10.2.2 in Chapter 10 of Reference Book 1

Topics: Buckling of Filaments, Buckling Force

Section 10.5.4 in Chapter 10 of Reference Book 1

Finding the cell center using microtubules?

Section 16.3.2 in Chapter 16 of Reference Book 1

Actin-based crawling of epithelial cells

Section 15.1.2 in Chapter 15 of Reference Book 1

Actin polymerization driven motility of bacteria Listeria monocytogenes

Section 15.1.2 in Chapter 15 of Reference Book 1

Measuring force exerted by microtubule

Section 16.3.2 in Chapter 16 of Reference Book 1

Measuring force exerted by actin network

Section 16.3.2 in Chapter 16 of Reference Book 1

Lecture 7

Topic: Microtubule Dynamics

Section 10.5.1 in Chapter 10 of Reference Book 1

Topics: Dynamics Instability and Microtubule Treadmilling

Section 15.4.4 in Chapter 15 of Reference Book 1

Topic: Actin Dynamics

Section 10.5.1 in Chapter 10 of Reference Book 1

Topic: Actin Treadmilling

Lecture slide is enough

Topic: Models of Cytoskeletal Filament Polymerization

Beginning of Section 15.4 in Chapter 15 of Reference Book 1

Topic: A Simple Model for Cytoskeletal Filament Polymerization

Section 15.4.2 in Chapter 15 of Reference Book 1

Topics: A Simple Model for Treadmilling

Section 15.4.3 in Chapter 15 of Reference Book 1

Topic: A Simple Model for Dynamics Instability

Problem 15.6 in Chapter 15 of Reference Book 1 and Section 11.2 in Appendix of Reference Book 3

Lecture 8

Topic: Proteins and their structures

Molecular Biology of the Cell (© Garland Science 2008) or any other standard Biology Textbook

Topics: Protein Structures and Folding, Protein Structures are free energy minimizers, Free Energy and Entroy

Lecture Slides are enough

Topic: Micro-state and Macro-state

Page 76-78 of Chapter 5 as well as Section 5.1 in Appendix of Reference Book 2. Some useful discussion is also given in Section 6.1.3 of Reference Book 1.

Topic: Actin Treadmilling

Lecture slide is enough

Topic: HP Model of Protein Folding

Lecture Slides are enough. However, one can also look at section 8.4.3 in Chapter 8 of Reference Book 1.

Topic: Another Toy Models of Protein Folding

Lecture Slides are enough.

Topics: Protein Folding in Reality and Ramachandran Plot

Lecture Slides are enough.

Lecture 9

Topic: Gene-expression and Protein-DNA binding

Lecture Slides are enough

Topics: Why Enzymes are required?

Lecture Slide is enough

Topic: Enzymes, The Activation Barrier, Substrate specificity of Enzymes, Enzymatic Reaction and Lowering of Activation Barrier

Text book Campbell Biology by Reece, Urry, Cain, Wasserman, Minorsky, Jackson or Any other Standard Biology Textbook.

Topic: A Simple Model of Enzymatic Kinetics

Lecture slides are enough. An alternative derivation is also given in section 15.2.7 of chapter 15 of Reference Book 1.