PHY4091: Introduction to biophysics

Target audience: B.Tech. (Final year) Year: IV Semester: VII
Elective category: OE Credits: 3 Hours: 40

Course overview (100 words):

This course is designed mainly for final year B.Tech. students who are willing to think about the biological systems at the Nano scale. Biophysics is the area where problems related to structure, dynamics and functioning of biomolecules are addressed using physical methods, underlying theories and models. The goal of this course is to present (or refresh) the necessary concepts of physics and biology as well as map their application on a rapidly expanding interdisciplinary interface, combining biology, chemistry, computer science, and physics. The course aims to balance the need for rigorous mathematical treatment with the simplicity of presentation. Thus it is intended to train students in mathematical and physical modeling of biological systems and the complex biological phenomena.

Prerequisite Courses: First year Physics course, and calculus-based physics, and a distant memory of high school chemistry and biology will be advantageous.

Course Outcomes (COs):

By the end of the course, students will be able to :	
CO1	use physical techniques to get inside the nanoworld of cells, tweak them in physical ways, and measure the results quantitatively.
CO2	familiar with various analytical and experimental techniques and aware about various biological systems and related complex phenomena.
CO3	appraise recent Nano scale advances in biophysics
CO4	recognize and evaluate the role of free energy, heat, entropy, temperature, and random thermal motion in various biological processes.
CO5	understand how simplified physical model(s) can express the richness and complexity of various biological systems and processes
CO6	learn about an interdisciplinary area like Biophysics and apply the knowledge in various related fields.

Course Topics:

Topics	Lecture Hours
UNIT 1: Principles from the sciences	14
1. Basic notions of thermodynamics	
2. Basic notion of statistical mechanics	
3. Physical kinetics	
4. The molecular dance	
5. Molecular forces in biological structures	
UNIT 2: Molecules, Structures, and Mechanisms	12
1. Structure of Macromolecules	
2. Enzyme catalysis	
3. Biomechanics	
4. Single molecule force spectroscopy techniques	
UNIT 3: Complexity of biological systems and processes	14
1. Dynamics of molecular motors	
2. Mystery of protein folding	
3. Life in crowded and disordered environments	
Total	40

References

Text Book:

1. Philip Nelson, *Biological Physics*, (WH Freeman New York, 2004)

Reference books:

2. Bruce Alberts et al., *Molecular Biology of the Cell*, (Garland, 2002).
3. Rodney Cotterill, *Biophysics: An introduction*, (John Wiley & Sons, LTD, 2002)
4. M. Schliwa, *Molecular Motors*, (Wiley).
5. M. Rubinstein and R. H. Colby, *Polymer Physics*, (Oxford University Press, 2004)
6. Lecture notes and various Journal papers (will provide before the class).

Evaluation Methods:

Evaluation criteria will be shared by the concerned course instructor.

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