

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSc
BRANCH: PHYSICS

SEMESTER :
SESSION: SP/2024

SUBJECT: PH328 BIOPHYSICS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

		CO	BL
Q.1(a)	Many biological processes occur in isobaric condition with constant pressure P where the total volume V and the number of particles N may vary. Discuss about the energy required to create a living system.	[5] 1	4
Q.1(b)	The Lennard Jones potential between biomolecules is sometimes written without a factor 2 multiplying the second term. Compare the separation distance at which the two molecules will be in mutual equilibrium with the one without a factor of 2 in the second term.	[5] 1	3
Q.2(a)	Laplacian of Temperature is analogous to a Poisson's type (e.g., electrostatic case) equation. Analyse such equation mathematically, and express the rate of change of heat in a cell membrane of thickness δ .	[5] 2	4
Q.2(b)	Suspended biomolecules in the body fluid often encounters polarizability related issues. How this polarizability is related to the relative permittivity of the medium? Evaluate such phenomenon mathematically.	[5] 2	5
Q.3(a)	Propagation of a bioelectric signal through the nerve was proposed by the Nobel laureates, write the name of the Nobel laureates and year in which Nobel prize was awarded. Elaborate the principle of nerve signal transmission.	[5] 3	2
Q.3(b)	The membrane surface is positively or negatively charged surface. How this charging effect will lead to the development of electric double layer? Deduce the expression of Debye length using Poisson's equation.	[5] 3	3
Q.4(a)	How does a biomolecule consisting of eight atoms having alternate single and double bonds absorbs light. Discuss wavelength dependence with the number of atoms present in the biomolecule.	[5] 4	4
Q.4(b)	A biomolecule in the blood stream is exposed to an alternating electric field of strength $ \vec{E}_0 $, write down the expression of equation of motion. Additionally, evaluate velocity of the biomolecule under the same situation.	[5] 4	5
Q.5(a)	Discuss the phenomenon of bioimpedance with respect to the flow of time harmonic current in a biological tissue.	[5] 5	4
Q.5(b)	Identify and correct the error in the schematic below. Calculate the resistance of the peripheral protein (R_{ph}) for the polarized state of the cell considering any node in the extracellular region as a reference node. Ignore C_m	[5] 5	6

