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

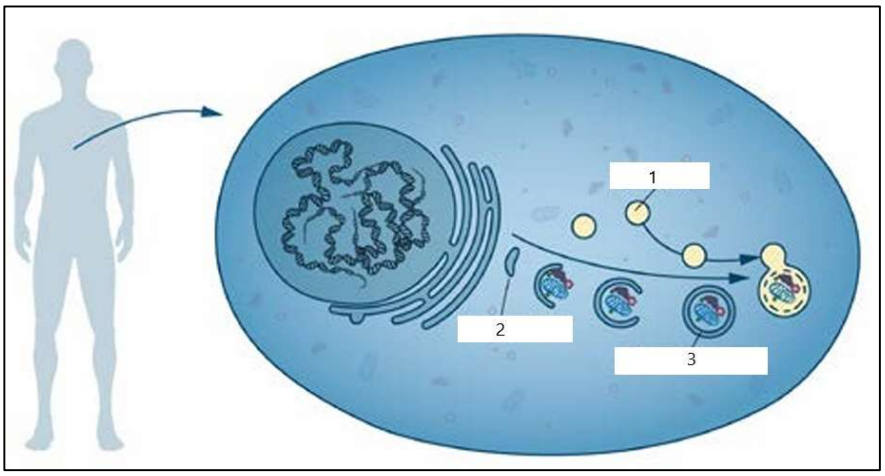
CLASS: IMSc **SEMESTER : IV**
BRANCH: PHYSICS **SESSION : SP/2025**

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.

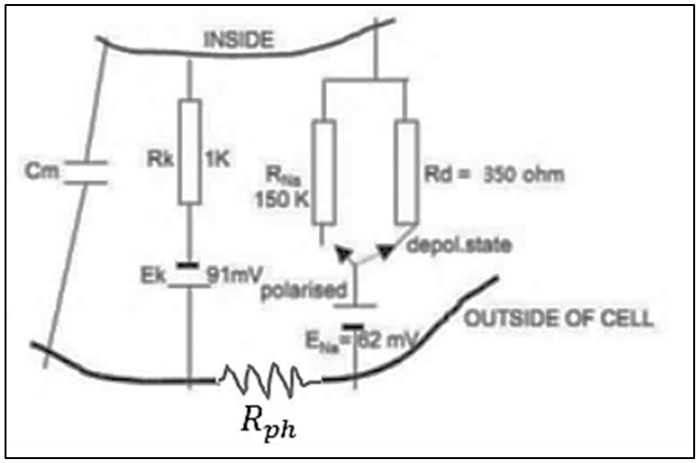
			CO	BL
Q.1(a)	Write the names of the processes 1, 2 and 3 as shown in the image below and subsequently, analyse the biological mechanism.	[5]	1	IV



Q.1(b)	The partition function in the DNA stretching of the individual molecules is written as $Z = (2\cosh\beta fL)^N$, where N is the total number of molecules, f is the force required to stretch the individual polymer chains over a distance L. Evaluate the average energy and variance in the energy of the DNA stretching system.	[5]	1	V
Q.2(a)	Describe mathematically the two laws of diffusion that are used to model transport processes in lipids, living cells, and neurons.	[5]	2	II
Q.2(b)	What is the role of Navier-Stokes equation in the biological processes? Explain the physical interpretation of the mathematical terms in the Navier-Stokes equation.	[5]	2	II
Q.3(a)	Chose the correct answer for the questions written below: (a1). A protein is also called as □ Polypeptides □ Amino acid □ Peptide □ All the three of them (a2). The cell intracellular concentration ratio of sodium to potassium is □ 1:30 □ 10:1 □ 30:1 □ 1:10 (a3). The cell extracellular concentration ratio of sodium to potassium is □ 1:30 □ 10:1 □ 30:1 □ 1:10 (a4). The cardiac action potential was investigated through □ DiFrancesco-Noble model □ Hodgkin-Huxley model □ Cole-Cole model □ Gouy-Chapman model (a5). The refractory period of mammalian cell is of the order of □ 1000 μs □ 2 μs □ 10 μs □ 100 μs	[5]	3	I
Q.3(b)	Elaborate the underlying mechanism of propagation of nerve action potential utilizing the concept of gated channels.	[5]	3	II

PTO

Q.4(a)	Optical Coherence Tomography (OCT) imaging technique is a minimally invasive modality in the clinical pathogenesis such as deep tissue imaging. Elaborate the analytical approach of the extended depth of focus (E-DoF) related to the deep tissue imaging.	[5]	4	III
Q.4(b)	The current produced in the glucose strip is proportional to the concentration of reduced mediator and its effective diffusion to the working electrode in the blood capillary. Analyse the mathematical modeling of the diffusion process in a planar electrode system.	[5]	4	IV
Q.5(a)	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. Hint: Ignore C_m and consider proper sign of E_K and E_{Na}.	[5]	5	V



Q.5(b)	Explain the principle of Cole's model to determine the total body water (TBW) content in terms of intracellular and extracellular water components.	[5]	5	II

::::::25/04/2025::::::M