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

CLASS: MTECH **SEMESTER : II**
BRANCH: BIOTECHNOLGY **SESSION : SP/2025**

SUBJECT: BE508 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)	Construct one-dimensional steady state Brownian/random motion and write its solution. Develop Fick's second law of diffusion and correlate with the above.	[5]	2	3
Q.1(b)	Describe mathematically different types of Van-der-Waals forces. Considering only van der Waals attraction, what is the force and energy of adhesion between two particles of radius 1 um with A = 10^{-19} J ? (H = H_0 = 3Å).	[5]	3	4
Q.2(a)	Compare analytical zonal-sedimentation and Equilibrium density-gradient centrifugation. What is Svedberg Constant? A protein has a sedimentation coefficient of 7.16 S, a diffusion coefficient D = 4.45 x 10^{-7} cm^2 sec^{-1} and v_p = 0.73 cm^3 g^{-1} (all measured at 20°C). (a) How long will it require to migrate from r = 10 cm to r = 10.5 cm in a rotor spinning at 50,000 rpm (5 x 10^4 rpm)? (Assume constant velocity throughout this time). (b) What is the molecular weight of the protein?	[5]	2,4	4
Q.2(b)	Analyze and depict the methodology for following techniques, FTIR, ESI-Quadrapole and Chemical shift with J-J coupling (NMR)	[5]	2,4	3
Q.3(a)	Express in brief the 2Θ method for X- ray diffraction crystallography. Illustrate in brief the instrumentation of FACS (fluorescence assisted cell sorting) flow-cytometry.	[5]	3,4	4
Q.3(b)	Explain briefly with the schematic diagram: Molecular interaction study with Atomic Force Microscopy and Optical tweezers	[5]	3,4	3
Q.4(a)	Write the principle and mechanism of electrical double layer, Zeta potential, Electro-osmosis, Electrophoresis.	[5]	2	4
Q.4(b)	Design double-electrode based circuit diagram for voltage clamp technique. Draw the I-V graph of Na+, K+ channel. Compose equilibrium membrane potential for following ions distribution (5 mM potassium outside, 140 mM inside, 12 mM sodium inside and 140 mM outside).	[5]	3,4	5
Q.5(a)	Write the mechanism ECG waveform formation and electrical conduction activity across heart.	[5]	3,2	3
Q.5(b)	What are 6-12 leads system for ECG waveform recording? Briefly illustrate with example; a) PET scanning in nuclear diagnostic with Radioisotopes (*In-vivo* & *In-vitro*) and b) recording of brain signal using EEG (alpha, beta, Gamma and delta wave).	[5]	1,4	4

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