CLASS: MTECH / PRE-PHD   SEMESTER : II/NA
BRANCH: BIOTECHNOLOGY   SESSION : SP/2023

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)	Synthesize and solve one-dimensional time dependent diffusion equation. Combine root mean square free path of Brownian motion, diffusion coefficient and Reynolds number.	[5]	CO1, CO2, CO3	4
Q.1(b)	Describe the different types of Van-der-Waals forces. Develop a mathematical expression for molecular Force-Fields.	[5]	CO2, CO3	3
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 $D = 4.45 \times 10^{-7} \, cm^2 \, sec^{-1}$ and $v_p = 0.73 \, cm^3 \, g^{-1}$ (all measured at 20ºC). (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 (5×10^4 rpm)? (Assume constant velocity throughout this time). (b) What is the molecular weight of the protein?	[5]	CO4, CO1, CO2, CO5	5
Q.2(b)	Analyze and express the methodology for following techniques, FTIR, ESI-Quadrapole/TOF and J-J coupling (NMR)	[5]	CO4, CO6, CO3, CO5	4
Q.3(a)	Express the 2ө method (powder method) for X- ray diffraction crystallography. Compose and sketch the methodology of FACS.	[5]	CO4, CO1, CO5	5
Q.3(b)	Summarize and depict briefly the following bio-techniques with possible application, Different mode of mode AFM and Optical tweezers.	[5]	CO4, CO1, CO5, CO2	4
Q.4(a)	Interpret and compose the electrical double layer, Zeta potential, Electro-osmosis, Electrophoresis with Helmholtz-Smoluchowski equation.	[5]	CO3, CO1, CO5	4
Q.4(b)	Compose equilibrium membrane potential for following ions distribution (5 mM potassium outside, 140 mM inside, 12 mM sodium inside and 140 mM outside). Design and compose double-electrode based circuit diagram for voltage clamp technique. Draw the I-V graph.	[5]	CO2, CO6, CO3	5
Q.5(a)	Co-relate the electrical conduction phenomena across heart and ECG waveform. What are 12-leads system for ECG waveform recording?	[5]	CO4, CO1, CO3, CO5	4
Q.5(b)	Briefly illustrate with example; a) nuclear diagnostic with Radioisotopes (*In-vivo* & *In-vitro*) and b) recording of brain signal using electroencephalography.	[5]	CO2, CO1, CO3, CO4	4

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