U.G. 6th Semester Examination-2021

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHY-H-DSE-T-04

(Biophysics)

Full Marks : 60 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **five** questions : 3×5=15

   a) What is Casimir interaction?

   b) What do you mean by SAR value of radiating system?

   c) What will be the change in entropy if 1 mole of an ideal gas undergoes a free expansion from a volume of 20 cm^3 to 40 cm^3?

   d) If two state system with energy E_1=3 aJ and E_2=1 aJ, with probabilities of their appearance P_1=0.25 and P_2=0.75. Calculate the average energy of such system.

   e) What is the significance of chemical potential in biological reaction?

   f) Explain the functional structure of ATP synthase.

   g) Calculate the change in Gibb's free energy (ΔG) per millimetre combining a solution of red and white blood cells with respective concentrations of 10^7 and 10^4 per millimetre at body temperature T=310K.

   h) State and explain Navier-Stokes equation.

2. Answer any **five** questions: 5×5=25

   a) State and derive Fick's second law of diffusion. Explain how this law is applied to calculate the concentration profile in a centrifuge. 3+2

   b) Does life violate the second law of thermodynamics-Explain. Using the form of Helmholtz free energy F = –NKT ln Z shows that $S = NK\left[\ln Z + \beta\bar{E}\right]$. 3+2

   c) Explain the importance of Boltzmann constant in Biology. Calculate the number of ways a biological system can arrange $6\uparrow$ and $6\downarrow$ dipoles in arbitrary ways. 2+3

   d) What do you mean by entropy of a biological system? Explain the protein folding and unfolding process in the vision of entropy change. 2+3

e) Write a short note on (i) sedimentation of cell culture and (ii) bio-diffusion in electric field. 2½+2½

f) Explain the process of active and passive membrane transport. Why is this transportation necessary for living system? 4+1

g) Using Navier-Stokes equation deduce the Bernoulli's equation for a streamline flow. What is Venturi effect? 3+2

h) Explain the electron transport chain reaction for ATP synthesis. 5

3. Answer any **two** questions: 10×2=20

a) What do you mean by the heat capacity of a biological system? If a two state system has two allowed states Ω_1 and Ω_2 with respective energies E_1 and E_2 what will be the average energy in terms of energy difference $(\Delta E = E_2 - E_1)$ of the system at high temperature? Explain the casimir contribution to the free energy in lipid bilayer tube and rouleaux. 2+3+5

b) What is Kinesin motor? How this process is differed from Dynein motor? Explain the basic

principle of Feynman ratchet. How does Feynman ratchet explain the molecular motor phenomena? 2+3+3+2

c) Explain how do covalent and hydrogen bonds influence the molecular recognition process in the biological molecule. What do you mean by life? What is domain of life and characteristics of life? (2+2)+2+(2+2)

d) What do you mean by activation energy and rate constant of a bio-chemical process? How the rate constant related to the activation energy? From this relation anyone can explain the temperature dependence of activation energy—explain your answer with an example. Explain the process of ATP hydrolysis. 2+3+3+2

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