BT 301: Biophysics **ENDSEM 17 Nov 24** Instr: R. Swaminathan

Total marks = 50. Section A carries 20 marks; Section B carries 30 marks

SECTION A (2 x 10 = 20)

1. Show that $[\theta] = 3300\ \Delta\varepsilon$
2. The m/z spectrum of a sample from a MALDI-TOF spectrometer often contains several peaks of mass <500 Da. Explain the origin of these peaks.
3. Draw and show a HYDROGEN BOND in a protein.
4. Draw a β-turn in a protein.
5. Plot a heating induced DENATURATION CURVE for a simple protein.
6. Name the technique used to measure the fluorescence lifetime.
7. Calculate $(n_L - n_R)$ if a sample of 1 cm pathlength rotates 400 nm polarized light by 0.03 deg.
8. In a protein that has no prosthetic groups, name two intrinsic chromophores.
9. Calculate the rate of Förster Resonance Energy Transfer if R_0 = 100 Å; r = 150 Å; and fluorescence lifetime of the Donor alone is 10 ns.
10. Describe briefly about LACTOSE PERMEASE.

SECTION B (3 x 10 = 30)

11. Show the different transitions: Absorption; Fluorescence; Internal conversion; Inter System Crossing; and Phosphorescence; in a JABLONSKI DIAGRAM.
12. Calculate the Time of Flight for a protein of mass 5 kDa travelling a distance 0.1 m in TOF mass spectrometer under an accelerating potential difference of 100 V.

[$z = 1$; $e = 1.6 \times 10^{-19}$ C]

13. Calculate the radiative and non-radiative kinetic rate constants for a fluorophore that has a quantum yield of 0.14 and a lifetime of 2.8 ns.

14. Calculate the bimolecular quenching rate constant k_q if fluorescence in absence of quencher is 100 and the same in presence of the 0.1 M concentration of the quencher is 60. The fluorescence lifetime in absence of the quencher is 3 ns.

15. Explain briefly about LIPID RAFTS.

16. In a certain MS experiment done with a pure homogeneous protein sample, prominent peaks at the following m/z values were obtained:

1101.1368, 1192.8085, 1301.0574, 1430.9525, 1589.8125, 1788.5289, 2044.1063.

Indicate the charge value for each peak. Calculate the molecular mass of the sample.

17. Describe briefly the difference between van der Waals interaction and electrostatic interaction. Write the relevant equations and explain how they vary with distance.

18. Explain why and under what conditions does a Stern-Volmer Plot depicting fluorescence quenching displays an UPWARD CURVATURE?

19. What is inner filter effect? How does it affect fluorescence measurements?

20. Draw a schematic depicting a simple minimal INSTRUMENTAL SETUP for measuring steady-state fluorescence from a liquid sample.