B.TECH/BT/6TH SEM/BIOT 3242/2017

BIOPHYSICS OF MACROMOLECULES

(BIOT 3242)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Interaction between hydrogen and a highly electronegative atom is called

(a) covalent bond (b) hydrogen bond
(c) ionic bond (d) coordinate bond.

(ii) Methyl-lysine is an example of

(a) standard amino acid (b) modified amino acid
(c) non-protein amino acid (d) essential amino acid.

(iii) The structure of a DNA-RNA hybrid is

(a) A form (b) B form (c) between A and B form (d) Z form.

(iv) The pairs of amino acids that contribute to protein conformation by forming electrostatic interaction are

(a) glycine and leucine (b) glutamate and lysine
(c) phenylalanine and lysine (d) lysine and arginine.

(v) Which of the following most accurately describes how secondary structures in proteins are stabilized?

(a) Through ionic bonds between side chains of amino acid residues
(b) Through covalent bond of the backbone structure
(c) Through hydrogen bonds between side chains of amino acid residues
(d) Through hydrogen bonds joining different parts of the backbone structure.

(vi) The major stabilizing force of a DNA molecule is

(a) base stacking interaction or hydrophobic interaction
(b) hydrogen bonds
(c) solvation energy
(d) ionic bonds.

(vii) Three dimensional structure of a protein can be determined by
(a) infra red spectroscopy (b) X ray crystallography
(c) UV spectroscopy (d) scanning electron microscopy.

(viii) Which of the following wavelength ranges is associated with UV spectroscopy?
(a) 0.8 - 500 μm (b) 400 - 100 nm
(c) 380 - 750 nm (d) 0.01 - 10 nm.

(ix) Dichromate ion absorbs near 500 nm. Based on this information, it can be concluded that
(a) dichromate ion absorbs in the visible region
(b) solution of dichromate salt is colourless
(c) dichromate ion absorbs in the UV region
(d) dichromate ion absorbs outside the visible region.

(x) Number of amino acid residues present in a 55.5Å long alpha helix
(a) 37 (b) 27 (c) 16 (d) 26.

Group – B

2. (a) When sodium chloride is mixed with water, hydrogen bonds are broken. In spite of that sodium chloride dissolves in water and the system is stable. Explain how the energy input to break the bonds is compensated.

(b) Hydrophobic amino acid residues are usually found in the interior of a protein molecule. However, there are proteins which have these residues on their surface. Explain how these amino acid residues remain stable on the surface in such exceptional cases.

(c) Where do you expect the following amino acids to be present in a protein molecule? State the reason.
i) Phenylalanine ii) Proline.

4 + 4 + (2 + 2) = 12

3. (a) According to the fluid mosaic model, cell membrane contains a lipid bilayer with scattered protein molecules. How lipid molecules form a stable bilayer in an aqueous environment?

(b) Describe the structure of tRNA molecule.

(c) State the characteristic features of B-DNA and A-DNA molecules. In which conditions B-DNA can be converted to A-DNA?

3 + 4 + (3 + 2) = 12

Group – C

4. (a) What do you mean by kinetically stable protein and a thermodynamically stable protein? With the energy diagram, explain their denaturation and renaturation.

(b) Explain why a protein with short chain length and a large number of disulfide bonds are resistant to denaturation.

(4 + 5) + 3 = 12

5. (a) What is an allosteric enzyme? Draw the graph showing kinetics of an allosteric enzyme.

(b) With the symmetry model, explain the cooperative nature of an allosteric enzyme. State one limitation of the symmetry model.

(2 + 3) + (5 + 2) = 12

Group – D

6. (a) Define luminescence. State the difference between fluorescence and phosphorescence.

(b) Discuss the basic principles of UV/visible spectroscopy.

(c) Define bathochromic, hypsochromic, hyperchromic and hypochromic shift.

(2 + 2) + 4 + (1 × 4) = 12

7. (a) State the frequency region in the electromagnetic wave that gives the IR spectrum.

(b) Discuss the basic principle of IR spectroscopy.

(c) Define bathochromic, hypsochromic, hyperchromic and hypochromic shift.

2 + 6 + (1 + 1 + 1 + 1) = 12

Group – E

8. (a) Discuss the fundamental principle of scanning electron microscopy (SEM).

(b) Draw a schematic diagram of the scanning electron microscope and label the essential components. State two applications of SEM.

5 + (5 + 2) = 12

9. (a) Derive Bragg's equation for X ray diffraction.

(b) Discuss how X ray diffraction helps in detection of protein structure.

6 + 6 = 12