



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (BT)/SEM-7/BT-703A/2010-11

2010-11

BIOPHYSICS OF MACROMOLECULES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

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

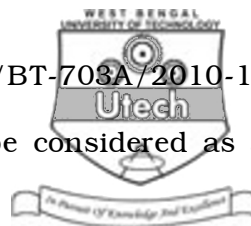
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$
 - i) Which pair of amino acids will have the highest absorbance at 280 nm ? (assume equimolar concentrations)
 - a) Thr & His
 - b) Phe & Pro
 - c) Trp & Tyr
 - d) Phe & His.
 - ii) The example of a sulphur containing amino acid is
 - a) Methionine
 - b) Aspartic acid
 - c) Lysine
 - d) Histidine.



- iii) The phenomenon of fluorescence occurs when
- a) a molecule absorbs energy and moves from a ground state energy level to excited state
 - b) an excited molecule returns to ground state by emitting light
 - c) an excited molecule returns to ground state by non-radiative transition
 - d) a molecule collides with another molecule in the excited state.
- iv) N-terminal amino acids are usually determined by Sanger's method using
- a) Ninhydrin reagent
 - b) 2, 4 dinitro-fluorobenzene
 - c) Hydrazine
 - d) Concentrated nitric acid.
- v) In the helix what would be the angle of φ and ψ ?
- a) $\varphi = -57^\circ$ and $\psi = -47^\circ$
 - b) $\varphi = -67^\circ$ and $\psi = -37^\circ$
 - c) $\varphi = -57^\circ$ and $\psi = -37^\circ$
 - d) $\varphi = -47^\circ$ and $\psi = -57^\circ$.
- vi) Glycosidic bonds are found in
- a) DNA
 - b) RNA
 - c) Sucrose
 - d) all of these.



vii) Which one of the following cannot be considered as a weak interaction ?

- a) van der Waals forces
- b) Peptide bond
- c) Hydrogen bonds
- d) Ionic interactions.

viii) The Michaelis-Menten constant K_m is a measure of

- a) the rate of the reaction
- b) the affinity of the enzyme for the substrate
- c) the concentration of the enzyme-substrate (ES) intermediate
- d) none of these.

ix) The length of an α -helical polypeptide chain of 25 amino acids is

- a) 36 nm
- b) 37.5 nm
- c) 40 nm
- d) none of these.

x) How many base pairs are present per turn of Z-DNA ?

- a) 10
- b) 8
- c) 12
- d) None of these.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Draw a hairpin structure and cruciform structure for a single stranded nucleic acid. State three differences between A and B forms of DNA. 2 + 3
3. Discuss the major stabilising forces of an alpha helix.
4. What are hydrophobic amino acid residues ? Give an example. Explain why they are found at the core of a protein molecule. 1 + 1 + 3
5. What are amphipathic molecules ? Discuss their interactions with water. 2 + 3
6. Discuss the role of IR spectroscopy in determination of molecular structure.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.

3 × 15 = 45

7. What are Stokes and anti-stokes shift in fluorescence ? What are intrinsic and extrinsic fluorophores that are used in our biological studies ? What is fluorescence quenching ? Give some examples of fluorescence quenchers and its advantages & disadvantages during the biomolecular study. Describe the significance of Tryptophan fluorescence in protein. Write short note on FRET ? 2 + 2 + 2 + 3 + 3 + 3



8. a) State the Lambert and Beer's law and its limitation during UV/VIS spectroscopy.
- b) Illustrate different absorption spectra with simple example.
- c) A solution of reduced cytochrome *c*, concentration of 10 μM , in a 1 cm path length cell absorbs 44% of the incident radiation at 550 μM . On oxidation, the solution absorbs about 17% of the incident radiation. Calculate the molar extinction coefficients of the 2 forms of cytochrome *c*.
- d) A mixture of reduced and oxidised cytochrome *c* in a 1 cm cell, a total protein concentration of 10 μM absorbed 38% of the incident radiation at 550 μM . Calculate the concentration of the oxidised and reduced spectra present.

4 + 3 + 4 + 4



9. Describe the effects during spectroscopic analysis of biological macromolecules : Bathochromic, Hypsochromic, Hyperchromic and Hypochromic effects. What is cot curve ? Define Isosbestic points of two absorbing species A & B. A solution of a protein whose sequence includes three tryptophan residues, no tyrosine residues, and no phenylalanine residues has an absorbance of 0.1 at 280 nm in a cell with a path length of 1 cm. Estimate the concentration of the protein in units of molarity. If the protein has a molecular mass of 100 kDa, estimate the concentration in units of milligrams of protein per millilitre of solution.
- 5 + 3 + 2 + 5
10. Predict with justification where the following amino acid residues are likely to be found on the surface or at the interior of a protein molecule :
- a) Histidine
 - b) Valine
 - c) Aspartic acid
 - d) Serine
 - e) Proline
 - f) Glycine
 - g) Tryptophan
 - h) Cysteine
 - i) Phenylalanine
 - j) Tyrosine.



11. Describe the procedures to grow crystal of biological macromolecules. Describe X-ray diffraction and Bragg's law. Write short notes on Axial Ratios, Weiss Parameters, Miller Indices during X-ray diffraction of crystallography. 5 + 5 + 5
12. How can NMR spectroscopy be used for the structure determination of biopolymer ? Describe the basic principle of circular dichroism (CD) and optical rotatory dispersion (ORD). What are negative cotton effects and positive cotton effects in CD and ORD ? Write brief application of CD and ORD in biological macromolecules. 5 + 5 + 2 + 3
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