

BIOPHYSICS OF MACROMOLECULES
(BIOT 3232)

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) Examples of acidic amino acids are
(a) Glutamic acid and Aspartic acid (b) Glycine and Leucine
(c) Histidine and Lysine (d) Methionine and Lysine.
- (ii) If number of amino acid residues is 110, molecular weight of the protein is
(a) 15000 (b) 11000 (c) 12100 (d) 13800.
- (iii) Which amino acid residues are usually buried inside a protein?
(a) Hydrophobic (b) Positively charged amino acids
(c) Negatively charged amino acids (d) Amino acids containing-SH group.
- (iv) The most important stabilizing force of a DNA is
(a) ion-ion interaction (b) hydrogen bonding
(c) stacking interaction (d) solvation.
- (v) Which of the following is NOT a weak interaction?
(a) Hydrophobic interaction (b) Hydrogen bond
(c) Electrostatic interaction (d) Disulphide bond.
- (vi) Ethanol causes denaturation of a protein by
(a) decreasing the dipole moment of the solvent
(b) breaking the hydrogen bond
(c) both (a) and (b)
(d) none of the above.
- (vii) Which of the following statement is INCORRECT for Z-DNA?
(a) Right handed DNA
(b) Mostly found in alternate purine-pyrimidine sequences
(c) Only one deep, narrow groove
(d) Contains glycosidic linkage.

- (viii) IR spectrum arises due to
(a) movement of electrons from lower to higher orbitals
(b) movement of electrons from higher to lower orbitals
(c) changes in vibration of the bonds in a molecule
(d) both movement of electrons and vibration of bonds.
- (ix) In a Mass Spectrometry, Faraday Cup is used as
(a) Ion analyzer (b) Ion detector
(c) Ion production (d) None of the above.
- (x) Virtual, erect and magnified image as that of the object is formed in
(a) Telescope (b) Photocopier
(c) Camera (d) Magnifying glass.

Group- B

2. (a) Describe Reverse Turns. [(CO3)(Describe/IOCQ)]
(b) Give a comparative analysis of A, B and Z DNA. [(CO1)(Compare/HOCQ)]
7 + 5 = 12
3. (a) Justify the statement “Amino acids are known as Ampholytes”. [(CO3)(Justify/LOCQ)]
(b) Illustrate the Ramachandran plot. [(CO1)(Illustrate/LOCQ)]
(c) Analyze the reason of rare occurrence of 3_{10} helix in the body. [(CO1)(Analyze/IOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) Opposite charges of amino acid residues on a protein surface are usually uniformly distributed in a staggered array which is called anisotropic charge distribution. This stabilizes the three dimensional structure of a protein molecule than a clustered charge distribution. Justify the statement. [(CO3)(Justify/HOCQ)]
(b) Nonpolar amino acids residues are usually found in the core of the proteins. Discuss the exceptions where nonpolar amino acid residues are found on the surface. [(CO3)(Describe/IOCQ)]
(c) Describe the role of disulfide cross-links in maintaining three dimensional structure of a protein molecule. [(CO3)(Understand/LOCQ)]
4 + 5 + 3 = 12
5. (a) What is the melting point of a DNA double helix? Design an experiment to determine the melting point of a DNA? [(CO3)(Understand, Design/LOCQ, HOCQ)]
(b) A DNA renaturation curve (Cot curve) shows two distinct phases. The first phase shows a very fast renaturation and the second phase a moderate renaturation

process. Do you get any idea of the nature of base composition of the DNA from the curve? [(C04)(Analysis/IOCQ)]

(c) A DNA sample is put in a solution containing high concentration of sodium chloride. Will it affect the melting point of DNA? Justify your answer.

[(C04)(Justify/HOCQ)]

(2 + 4) + 3 + 3 = 12

Group - D

6. (a) What is quantum efficiency in fluorescence? Can it be more than unity? Justify your answer. [(C05)(Remember, Justify/LOCQ, HOCQ)]

(b) Explain how Raman Effect interferes with fluorescence.

[(C05)(Understand/LOCQ)]

(c) How fluorescence is applied in real time PCR? [(C05)(Apply/IOCQ)]

(2 + 2) + 3 + 5 = 12

7. (a) Differentiate between phosphorescence and fluorescence.

[(C05)(Differentiate/IOCQ)]

(b) UV-visible spectrum of a molecule is an absorption spectrum whereas fluorescence spectrum is an emission spectrum. Justify the statement with diagram of the two spectra. [(C05)(Justify/HOCQ)]

(c) Protein absorbs at 280 nm. The absorption increases when the protein is denatured. Explain. [(C05)(Explain/IOCQ)]

2 + 6 + 4 = 12

Group - E

8. (a) Derive the (m/z) with the help of Time-of-flight analyzers in a mass spectrometer. [(C05)(Derive/HOCQ)]

(b) Explain how can you reduce the wavelength of an electron?

[(C05)(Explain/IOCQ)]

(c) Analyze the necessity of creating a vacuum system in TEM or SEM?

[(C06)(Analyze/LOCQ)]

5 + 4 + 3 = 12

9. (a) Design the process of X-ray production. [(C06)(Design/IOCQ)]

(b) Elaborate the principle of Mass Spectrometry? [(C05)(Elaborate/IOCQ)]

8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	21.87	35.42	30.20

Course Outcome (CO):

After completing the course, the students will be able to:

1. Describe the structure of different macromolecules.
2. Elucidate structure-function relations of enzymes
3. Explain the interactions of macromolecules.
4. Illustrate the thermodynamics and kinetics of macromolecular transition.
5. Describe the spectroscopic techniques for biomolecular structural analysis.
6. Explain the working principle of some non-spectroscopic techniques for structural analysis.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question;
HOCQ: Higher Order Cognitive Question