

**BIOPHYSICS OF MACROMOLECULES
(BIOT 3232)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) ΔG is negative for which process?
(a) Melting of ice and evaporation of water
(b) Oxidation of nitrogen
(c) Oxidation of gold
(d) None of the above.
- (ii) Real, inverted and same size image as that of the object is formed in
(a) Telescope (b) Photocopier
(c) Camera (d) Spotlight.
- (iii) *Lathyrus odoratus* contains a toxin beta-amino-propionitrile and causes lathyrism. This is because
(a) The toxin binds to lysyl oxidase and prevents aldol condensation type of crosslinking
(b) The toxin binds to lysyl oxidase and prevents hydrogen bonding
(c) The toxin binds to proline hydroxylase and prevents hydrogen bonding
(d) The toxin binds to cysteine residues and prevents disulphide linkage formation.
- (iv) Number of amino acid residues in a protein of molecular weight 58300 is
(a) 110 (b) 253 (c) 530 (d) 330.
- (v) The most important stabilizing force of DNA is
(a) Hydrogen bond (b) Base stacking interaction
(c) Ionic interaction (d) Solvation.
- (vi) Which of the following forces is most important for protein folding?
(a) Hydrophobic interaction (b) Electrostatic interaction
(c) Ion-dipole interaction (d) Hydrogen bond.
- (vii) Examples of acidic amino acids are
(a) Glutamic acid and Aspartic acid (b) Glycine and Leucine
(c) Histidine and Lysine (d) Methionine and Lysine.

- (viii) IR spectrum arises due to
 (a) Movement of electrons to higher orbitals
 (b) Movement of electrons to lower orbitals
 (c) Changes in vibrations in the bonds of the molecules
 (d) Changes in the positions of protons in the nucleus.
- (ix) If the absorption of electromagnetic radiation by matter results in the emission of radiation of the same or longer wavelengths for a short time, the phenomenon is called
 (a) Luminescence (b) Phosphorescence
 (c) Fluorescence (d) Spontaneous emission.
- (x) Order of the electromagnetic waves in terms of wavelength is
 (a) UV > visible > IR > microwave > Radio wave
 (b) UV < visible < IR < microwave < Radio wave
 (c) UV < visible < IR < Radio wave < microwave
 (d) UV < visible < microwave < IR < Radio wave.

Fill in the blanks with the correct word

- (xi) F8His is called _____ in hemoglobin.
- (xii) Full form of 2,3BPG is _____.
- (xiii) The wavelength range for UV region is _____.
- (xiv) Example of an allosteric enzyme is _____.
- (xv) The amino acid predominant in silk fibroin β -sheet is _____.

Group - B

2. (a) Elucidate the biological function of Z-DNA. [[CO3](Elucidate/IOCQ)]
 (b) Analyze why 3_{10} Helix and π Helix are rarely found in body? [[CO1](Analyze/LOCQ)]
 (c) What do you mean by Dihedral angles? Name the dihedral angles in a protein backbone. [[CO1](Remember/LOCQ)]
5 + 5 + 2 = 12
3. (a) State where can you observe A-DNA? [[CO3](Analyze/IOCQ)]
 (b) Draw and explain the titration curve of Histidine. [[CO3](Explain/HOCQ)]
6 + 6 = 12

Group - C

4. (a) How charged amino acid residues are stabilized on the surface of a protein? [[CO1](Remember,Understand/LOCQ, IOCQ)]
 (b) Each globin chain of a hemoglobin molecule contains two histidine residues in the core of the molecule. How the histidine residues are stabilized? What is the role of these two histidine residues in the biological function of hemoglobin? [[CO1](Comment/HOCQ)]

- (c) What is Bohr effect? How does it help to transfer oxygen from lung to cells through haemoglobin?

[[CO1](Justify/IOCQ)]

$$3 + (2 + 2) + (2 + 3) = 12$$

5. (a) What is melting of alpha helix? Derive the relation between the melting point (T_m), ΔH and ΔS for an alpha helix.
- (b) Describe the base stacking interaction in a DNA molecule.
- (c) Explain why phosphate groups of a DNA molecule cannot be placed in the core of the DNA strand.

[[CO4](Understand/IOCQ)]

[[CO3](Describe/IOCQ)]

[[CO3](Reasoning/HOCQ)]

$$(2 + 4) + 3 + 3 = 12$$

Group - D

6. (a) What is quantum yield? Discuss the application of fluorescence in PCR.
- (b) UV-visible spectroscopy is an absorbance spectroscopy whereas fluorescence spectroscopy is an emission spectroscopy. Justify the statement.
- (c) State how CD spectrum is used for determination of a protein structure.
7. (a) What are near IR and far IR regions? What is stretching of a bond? What are symmetric and anti-symmetric stretching?
- (b) What is the role of interferometer in an IR spectrometer?
- (c) IR spectroscopy can be used for identification of functional groups and structure elucidation. Explain.

[[CO5](Understand/IOCQ)]

[[CO5](Justify/HOCQ)]

[[CO5](Understand/IOCQ)]

$$(1 + 4) + 3 + 4 = 12$$

[[CO3](Remember/LOCQ)]

[[CO3](Remember/LOCQ)]

[[CO3](Explain/IOCQ)]

$$(2 + 3) + 4 + 3 = 12$$

Group - E

8. (a) Design the different processes of ion analysis in Mass Spectrometer.
- (b) What do you mean by a Resolution of a Microscope?
9. (a) Draw and explain the Surface Plasmon Resonance Measurement (SPR) by Sensogram.
- (b) Briefly explain the production of X-rays.

[[CO6](Design/HOCQ)]

[[CO6](Understand/LOCQ)]

$$8 + 4 = 12$$

[[CO6](Explain/IOCQ)]

[[CO6](Analyze/IOCQ)]

$$8 + 4 = 12$$

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	20.83	54.17	25

Course Outcome (CO):

After the completion of the course 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.*