



Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (BT)/SEM-1/MBT-102/2011-12

2011

BIOPHYSICAL CHEMISTRY

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

(Objective Type Questions)

1. Answer any *ten* of the following questions. $10 \times 1 = 10$

A. Choose the correct alternatives :

i) Which one of the following pieces of information cannot be obtained from an infrared spectrum ?

- a) Molecular mass
- b) Presence of C = O bonds
- c) Presence of O-H bonds
- d) Identity of a compound through comparison with other spectra.

ii) Which of the following transitions is the highest energy transition ?

- a) $n - \sigma^*$
- b) $n - \pi^*$
- c) $\sigma - \sigma^*$
- d) $\pi - \pi^*$



- iii) Myoglobin has 153 amino acid residues. If it was a continuous α -helix, the length of myoglobin would be
- a) 36 nm b) 53 nm
c) 55 nm d) 23 nm.
- iv) In β -turn the CO group of residue i of the polypeptide chain is hydrogen bonded to which NH group of residue to stabilize the turn ?
- a) $i + 1$ b) $i + 2$
c) $i + 3$ d) $i + 4$.
- v) For a molecule to absorb IR, why must the molecule's vibrations cause fluctuations in the dipole moment of the molecule ?
- a) Because a change in dipole moment lowers the energy required for electronic transitions
b) Because for absorption to occur, the radiation must interact with the electric field caused by changing dipole moment
c) Because fluctuations in the dipole moment allow the molecule to deform by bending and stretching.



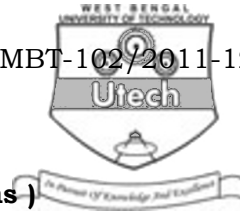
- vi) Ribonuclease has four disulphide bonds which were reduced by DTT in presence of 8M urea. These reagents were removed by dialysis so that the protein could refold and the disulphide bonds reformed. If the reformation of S-S bonds occurred randomly, the expected recovery of the biological activity would be
- a) 100 % b) 80%
c) 0.95% d) 95%.
- vii) X-ray diffraction studies are used to determine
- a) the sequence of amino acids in protein molecules
b) the sequence of nucleic acids in nucleic acid molecules
c) the distances between atoms of molecules
d) the type of chemical under investigation.
- viii) Which one is correct for bathochromic shift ?
- a) Towards longer wavelength
b) Towards shorter wavelength
c) Increase in peak absorbance
d) Decrease in peak absorbance.



- ix) Absorption of RF signals by a molecule results in
- a) vibrational transitions
 - b) electronic transitions
 - c) rotational transitions
 - d) nuclear transitions
 - e) none of these.

B. State whether the following statements are True or False :

- x) Auxochromes — groups that modify absorption of neighboring chromophores.
- xi) The light emitted from a laser source is coherent.
- xii) Enantiomers are optically active.
- xiii) Lasing action occurs when an electron spontaneously returns to its ground state and produces a photon.
- xiv) Laser radiation will continue as long as energy is applied to the lasing medium.
- xv) A population inversion is achieved when the majority of atoms have reached this metastable state during laser radiation.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Describe the different weak forces that stabilize protein and nucleic acid structure. Describe the interaction of biological macromolecules with non-aqueous environments. $4 + 1$
3. What is stokes and anti-stokes shifting process in fluorescence spectra ? Define polarization and anisotropy in fluorescence with one application of each of them. $1 + 4$
4.
 - a) Write the differences between IR & Raman spectroscopy.
 - b) Why is it not possible to view live samples using electron microscope rather it is possible by SPM ?
 - c) What are the chromophoric groups of DNA and protein that are responsible to give the UV-visible absorption spectra ? $2 + 2 + 1$
5. You wish to study the thermal stability of a protein with a single buried tryptophan residue. What methods would you consider using and why ? $1 + 4$
6. Certain groupings of secondary structural elements, called supersecondary structures or motifs, occur in many unrelated globular proteins. Explain with some examples.

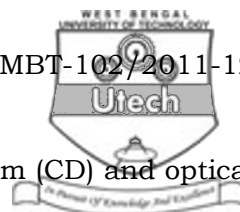


GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. What is scanning probe microscopy ? What is electron tunnelling ? What are the basic principles of Scanning Tunnelling Microscopy (STM) and Atomic Force Microscopy (AFM) ? What are the modifications of AFM over STM for the imaging of biological macromolecules and organisms ? What are the advantages and disadvantages of the 3 main types of AFM ? $1 + 2 + 4 + 4 + 4$
8. Describe the procedures to grow crystal of biological macromolecules. Why is *X-ray* suitable for detailed crystallographic studies ? of biological macromolecules than other radiation. Describe *X-ray* diffraction and Bragg's Law. Write short notes on Bravais lattices, Point groups, Space groups, Miller indices during *X-ray* diffraction of crystallography. $3 + 2 + 5 + 5$
9. What are the different parameters to describe an NMR spectrum ? Write in brief the application of NMR to determine the conformation of biomolecules. What are the principles and applications of Flow Cytometry and FACS in clinical chemistry and in various parts of biology ? Describe in brief the Jablonski's diagram for fluorescence and phosphorescence. $5 + 3 + 5 + 2$



10. Describe the principles 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.

6 + 4 + 5

11. What is spontaneous and stimulated emission of electromagnetic radiation and what are the main operating principles of different types of laser ? What are continuous wave and pulsed lasers ? Describe in brief the applications of lasers for biomolecular structure determination especially by Laser Induced Fluorescence (LIF) and to medicine especially to surgery and ophthalmology.

6 + 4 + 5
