

- (c) Derive the equation for renaturation kinetics of a ssDNA molecules into dsDNA.

$$(2 + 2) + (1 + 3) + 4 = 12$$

Group – E

8. (a) What is UV/VIS spectroscopy? Describe the principle of UV/VIS spectroscopy with a label diagram of spectrophotometer.
- (b) Describe the principle of cryoelectron microscopy and its application in biotechnology.
- (c) A solution containing GTP has molar extinction coefficient of $1.55 \times 10^4 \text{ mol}^{-1}\text{dm}^3\text{cm}^{-1}$ at a given wavelength. The concentration of GTP solution was $1.29 \times 10^{-5} \text{ mol dm}^{-3}$. Calculate the absorbance of GTP solution in 1 cm cuvette at the same wavelength.
- 3 + (1 + 4) + 4 = 12**
9. (a) What is the difference between absorption and emission spectroscopy?
- (b) Define bathochromic, hypochromic, hypsochromic and hyperchromic shifts.
- (c) Explain the principle of IR spectroscopy and its application in biotechnology.
- 3 + 4 + (3 + 2) = 12**

CHEMISTRY OF BIOMOLECULES (BIOT 2101)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

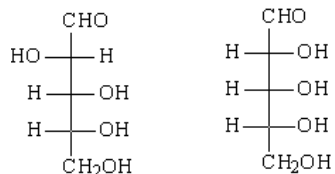
Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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) The property that applies for glycine is
 (a) Hydrophilic, acidic, charged (b) Hydrophilic, basic, charged
 (c) Hydrophobic (d) Optically inactive.
- (ii) Optically active molecules which rotate plane-polarized light in a counterclockwise direction are said to be
 (a) levorotary (b) of R configuration
 (c) dextrorotary (d) of S configuration.
- (iii) Example of a ketoaldose is
 (a) Glucose (b) Fructose
 (c) Ribose (d) Erythrose.
- (iv) Choose the incorrect statement
 (a) Melting point of a fatty acid increase with increase in number of double bonds
 (b) Lipid membrane mostly contains unsaturated fatty acids
 (c) Naturally occurring unsaturated fatty acids are mostly in trans configuration
 (d) Wax contains mostly esters of fatty acids and fatty alcohols.
- (v) Ninhydrin gives purple colour with all amino acids except
 (a) Glycine (b) Proline
 (c) Alanine (d) Valine.
- (vi) In X-ray diffraction of a biomolecule, assume $n = 1$, angle of reflection is 45.0 degree and wavelength of X-ray used in the experiment is 1.54 Å, what is the distance between the atomic plane?
 (a) 0.905 Å (b) 1.09 Å
 (c) 0.655 Å (d) 0.918 Å.

- (vii) Assign the correct term describing the relationship to the following two isomers



- (a) enantiomers
(c) mesomers
- (b) diastereomers
(d) isomers.
- (viii) T_m of the following DNA (5'-ATTTAAGGCCATATATGGCCA-3') is
(a) 60°C
(c) 85°C
- (b) 55°C
(d) 58°C.
- (ix) An optical measurement of a protein is taken both before and after digestion of the protein by protease. In which of the following spectroscopic measurement, there will be change in signal value, i.e., before vs after protease treatment, could be maximum?
(a) $A_{280\text{nm}}$
(c) $A_{340\text{nm}}$
- (b) fluorescence value
(d) CD value.
- (x) Consider a short linear dsDNA molecule of 10 complete turns, with 10.5 bp/turn. The ends of the DNA molecule are sealed together to make a relaxed circle. This relaxed circle will have a linking number.
(a) 105
(c) 10.0
- (b) 20.5
(d) 10.5.

Group – B

2. (a) The pKa value of acetic acid is 4.76. State the physical significance.
(b) Name the buffer systems that maintains in physiological pH in our body. Discuss how $\text{H}_2\text{CO}_3 / \text{HCO}_3^-$ acts as a buffer in a living system.
(c) Consider two weak acids having pKa values of 4.0 and 6.0. Which one dissociates to a greater extent? Explain your answer.
- 3 + 3 + (2 + 4) = 12**
3. (a) Define with example: (i) disaccharide, (ii) aldose and (iii) reducing sugar.
(b) Human beings cannot digest cellulose and therefore it is often used as a component of laxatives. Which structural phenomenon of cellulose is responsible for this behaviour?

(3 × 2) + (3 + 3) = 12

Group – C

4. (a) What is the structural difference between a saturated fatty acid and an unsaturated fatty acid? Draw the structure of (i) palmitic acid and (ii) oleic acid.
(b) Explain why coconut oil freezes in winter but mustard oil does not.
(c) For historical reason, vitamin D is still called vitamin D. But it is really a steroid hormone synthesized in our body from cholesterol. Justify the statement.
- (2 + 2) + 3 + 5 = 12**
5. (a) What happens when
(i) Triglyceride is treated with NaOH.
(ii) Oleic acid is treated with iodine.
(iii) Cholesterol is treated with glacial acetic acid in presence of concentrated sulphuric acid.
(b) Which classes of lipids the following compounds belong to: (i) lecithin, (ii) prostaglandin and (iii) lanolin.

(3 × 2) + (3 × 2) = 12

Group – D

6. (a) The following peptides have been passed through a cation exchanger (CM-cellulose column) at pH 7.0. Which peptide (s) will bind the column? Explain your answer.
(i) Met-Gly-Glu-Leu-Leu-Val-Phe-Val-Trp-Val-Glu-Ala
(ii) Met-Gly-Ala-Lys-Lys-Val-Arg-Lys-Ile-Glu-Ala-Arg
(iii) Met-Trp-Ile-Lys-Lys-Ile-Val-Pro-Asp-Glu-Ile-Glu.
(b) Why SDS is used in SDS-polyacrylamide gel electrophoresis (SDS-PAGE) for separation of protein? In SDS PAGE, a protein shows two different bands – one having a molecular weight of 70 KD and the other with molecular weight of 50 KD. In the native gel electrophoresis, the same protein solution shows a single band of molecular weight around 120 KD. Explain the observation.
- 4 + (4 + 4) = 12**
7. (a) What is T_m of a DNA molecule? On what factors the T_m of DNA molecules depends?
(b) What is supercoiling of DNA? How many base pairs per turn would there be in the DNA if the DNA was not able to adopt any supercoil structure for this length of DNA with a linkage number of 490?