

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

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

### Group - E

8. (a) Describe the principle of CD spectroscopy.  
 (b) How protein folding can be studied with CD spectroscopy?  
 (c) Monochromatic light is passed through a 1mm path length cell containing 0.006 moles/dm<sup>3</sup> solution. The light intensity is reduced to 18% of its value. Calculate molar extinction coefficient of the sample. What will be the transmittance if the cell path length is 2 mm?

$$4 + 4 + 4 = 12$$

9. (a) Discuss the limitations of Lambert-Beer's law with example.  
 (b) Derive the expression of Bragg's equation for X-ray diffraction.  
 (c) Describe the method of structure determination of biomolecules by X-ray crystallography.

$$3 + 4 + 5 = 12$$

### 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 absorbance of a solution of tryptophan measured at 280 nm in a cuvette of 2.0 cm path length is 0.56 at pH 7. The molar extinction coefficient ( $\epsilon$ ) for tryptophan at 280 nm is 5600 M<sup>-1</sup> cm<sup>-1</sup> at pH 7. The concentration of tryptophan in the solution is  
 (a) 25  $\mu$ M      (b) 0.5  $\mu$ M      (c) 50  $\mu$ M      (d) 500  $\mu$ M.
- (ii) Determine the correctness or otherwise of the following Assertion [A] and the Reason [R]  
 Assertion: The association constant in water for the G-C base pair is three times lower than that for the A-T base pair.  
 Reason: There are three hydrogen bonds in the G-C base pair and two in the A-T base pair.  
 (a) Both [A] and [R] are true and [R] is the correct reason for [A]  
 (b) [A] is false but [R] is true  
 (c) Both [A] and [R] are false  
 (d) Both [A] and [R] are true and [R] is not the correct reason for [R]
- (iii) Which one of the following techniques can be used to determine the structure of a 15 kDa globular protein at atomic resolution?  
 (a) Raman spectroscopy      (b) IR spectroscopy  
 (c) UV spectroscopy      (d) NMR spectroscopy.
- (iv) If the nucleotide composition of a viral genome is A = 10, U = 20, C = 40, and G = 30, which one of the following is this genome?  
 (a) Double stranded RNA      (b) Single stranded RNA  
 (c) Single stranded DNA      (d) Double stranded DNA.

- (v) The spectroscopic method for detection of functional groups is:  
 (a) CD spectroscopy (b) FTIR spectroscopy  
 (c) ESR spectroscopy (d) UV-VISIBLE spectroscopy.
- (vi) Which pair represents epimers?  
 (a) Glucose and galactose (b) Glucose and ribose  
 (c) Glucose and mannose (d) Glucose and lactose.
- (vii) The two amino acids having R groups with a negative net charge at pH 7.0 are  
 (a) Aspartate and glutamate (b) Arginine and histidine  
 (c) Cysteine and methionine (d) Proline and valine.
- (viii) If  $pK_1 = 2.34$  and  $pK_2 = 9.60$ , (for a neutral amino acid) then the isoelectric point  $pI$  is  
 (a) 5.87 (b) 5.97 (c) 3.67 (d) 11.94.
- (ix) Which of the following pair can act as storage polysaccharides?  
 (a) Glycogen and starch (b) Starch and chitin  
 (c) Starch and cellulose (d) Starch and glucose.
- (x) The X-ray crystallography studies of Rosalind Franklin and Murice Wilkins showed that  
 (a) DNA contains only four kinds of nucleotides  
 (b) DNA has helix major regularity of 0.34 nm  
 (c) The amount of adenine found in DNA is equal to the amount of thymine  
 (d) The same base pairing rules apply to all species.

**Group - B**

2. (a) Derive Henderson equation.  
 (b) How many moles of Na-acetate and acetic acid would you add to prepare 1 L of a 0.1M buffer solution with pH 5.0?  
 (c) Explain the buffering action of Histidine.  
**(3 + 5 + 4) = 12**
3. (a) D-Glucose has specific rotation of  $+112^\circ$ . When dissolved in water, its specific rotation becomes  $+52.7^\circ$ . Explain the observation.  
 (b) Enzymatic method using glucose oxidase is a better method for determination of blood glucose than chemical method. Do you agree with the statement? Justify your answer.

- (c) Name the carbohydrates and state their nature (mono-, di- or polysaccharides) which are commonly found in, (i) fruits, (ii) milk, (iii) sugarcane, (iv) rice.

**4 + 4 + 4 = 12****Group - C**

4. (a) Triglycerides are so named because of some common features. Describe the features they have in common.  
 (b) Fats like butter and lard are solid at room temperature. What nature of the fatty acids in their structure would support this trend?  
 (c) If a sample of a lipid contains fatty acids that are 89% saturated, would you expect the lipid to be solid at room temperature or liquid? What if the fatty acids were only 13% saturated? Explain your answer. Define: wax and sphingolipids.
5. (a) Draw the structure of Sphingosine and Sphinganine. Sphingomyelin can be classified both as a sphingolipid and a phospholipid. Justify the statement.  
 (b) Explain why phospholipids and not triglycerides are major component of cell membrane.

**(2 + 2) + 4 + 4 = 12****(2 + 2) + 4 + 4 = 12****Group - D**

6. (a) Name the protein that is found in silk. Describe its structure. Draw the structure of (i) Greek key motif and (ii) beta-alpha-beta motif.  
 (b) Describe the principle of affinity chromatography for protein purification.
7. (a) What is  $T_m$  of a DNA molecule and what is melting curve of a DNA? Write the names of factors on which the  $T_m$  of a ds-DNA molecules depends and tell how?  
 (b) What is supercoiling of DNA? A closed circular B-DNA of 4000 base pairs is negatively supercoiled by introduction of 4 writhes. Calculate the super helical density of the resultant DNA molecule.

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