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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Biotechnology **Duration: 3 hrs.**

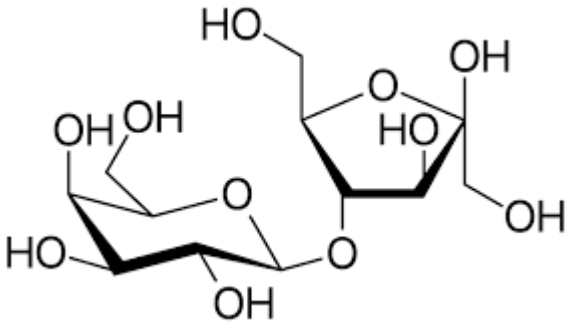
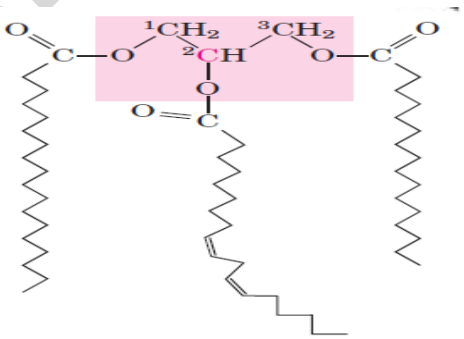
Course code: 23BT3PCBBM / 22BT3PCBBM **Max Marks: 100**

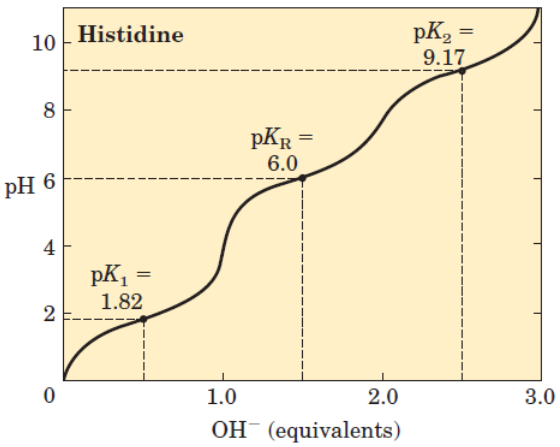
Course: Basics Of Biomolecules

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

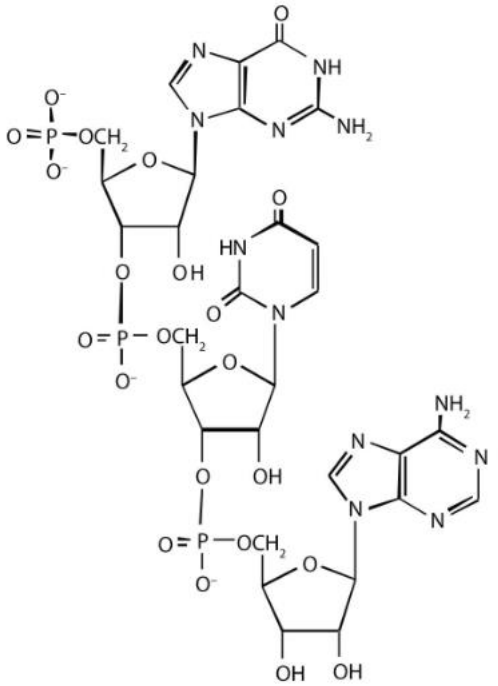
Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	In a hospital laboratory, a 10.0 mL sample of gastric juice, obtained several hours after a meal, was titrated with 0.1 M NaOH to neutrality; 7.2 mL of NaOH was required. The patient's stomach contained no ingested food or drink; thus assume that no buffers were present. What was the pH of the gastric juice?	CO 2	PO 1	**4**
	b)	What is the pH of a solution containing 0.12 mol/L of NH_4Cl and 0.03 mol/L of NaOH (p*K*a of $NH4^+$ /NH3 is 9.25)?	CO 2	PO 1	**4**
	c)	Describe the common structural features and the differences for each pair: **(i)** cellulose and glycogen; **(ii)** D-glucose and D-fructose; **(iii)** maltose and sucrose.	CO 1	-	**6**
	d)	Draw the structure of gentiobiose and circle the part of the structure which represents : (i) the glycosidic bond (ii) part of this structure that makes the compound a reducing sugar	CO 3	PO 2	**6**
		OR			
2	a)	What concentration of K_2HPO_4 do you need to prepare the buffer at pH 7 . consider that a solution of 0.1M KH_2PO_4 is available. pKa=6.86	CO 2	PO 1	**4**
	b)	Which is the conjugate base in each of the pairs below? (i) RCOOH, $RCOO^-$ **(ii)** RNH_2, RNH_3^+ **(iii)** $H_2PO_4^-$,H_3PO_4 **(iv)** H_2CO_3, HCO_3^-	CO 2	PO 1	**4**

		c)	Which bond(s) should be broken in the following cases? Identify if the change involved is "configuration or conformation". (i) Conversion of α -D-glucose to β-D-glucose? (ii) Conversion of D-glucose to D-mannose? (iii) Convert "chair" form of D-glucose to the other	*CO 3*	*PO 2*	**6**
		d)	The structure of lactulose, a disaccharide widely used as a colonic acidifier is given below :  (i) Identify the monomeric units (ii) draw their Fishers representation of the monomers (iii) identify the Linkage involved (glycosidic bond)	*CO 3*	*PO 2*	**6**
			UNIT - II			
	3	a)	The melting points of a series of fatty acids are as given below : *Melting point (°C)* Palmitic acid — 63.1 Palmitoleic acid — 1–0.5 Arachidonic acid — - 49.5 Arachidic acid — 76.5 stearic acid — 69.6 What structural aspect of these fatty acids can be correlated with the melting point? Provide a molecular explanation for the trend in melting points. (and draw the structure)	*CO 3*	*PO 2*	**10**
		b)	A lipid has the following structure:  (i) Identify the type of lipid (ii) Identify the fatty acids present	*CO 3*	*PO 2*	**4**

		c)	Draw the structure of cholesterol and add a note on its biological role.	*CO 1*	-	**6**
			OR			
	4	a)	Complete hydrolysis of a glycerophospholipid yields glycerol, two fatty acids (16:1 Δ^9 and 16:0), phosphoric acid, and serine in the molar ratio 1:1:1:1:1. Name this lipid and draw its structure.	*CO 3*	*PO 2*	**5**
		b)	Compositional analysis of lipids showed the following ratios of fatty acid to inorganic phosphate Identify the lipids? (i) Lipid A – 1:1 . (ii) Lipid B – 2:1 (iii) Lipid C – 2:3 (iv) Lipid D- 4:2 (v) Lipid E – 1:0	*CO 3*	*PO 2*	**10**
		c)	What are waxes? Add a note on the biological importance of waxes giving any two examples.	*CO 1*	-	**5**
			UNIT - III			
	5	a)	Identify and draw the structures of the amino acids based on the descriptors given below : (i) Achiral amino acid (ii) Amino acid with indole R group (iii) amino acid having an ionizable side chain with a pKa near neutrality. (iv) Acidic amino acid (any 1) (v) Amino acid with nonpolar aliphatic R group (any 1)	*CO 3*	*PO 2*	**10**
		b)	Differentiate between the primary and secondary structure of protein.	*CO 1*	-	**4**
		c)	Given below is the titration curve for histidine.  Draw the structure of histidine at the different pKa representing its ionization state.	*CO 3*	*PO 2*	**6**
			OR			

	6	a)	Consider all possible tripeptides made of the amino acids tyrosine, histidine and proline. Answer the following questions. (i) Give the names of each possible tripeptide using 3-letter code. (ii) draw the structure of the tripeptide which has a C terminal proline and a N-terminal tyrosine at pH 1.0 (iii) What charge will this tripeptide have at pH 12? Explain.	*CO 3*	*PO 2*	**10**
		b)	What are the steps involved in determining the amino acid sequence by Sangers method. How is it different from Edmans degradation strategy?	*CO 3*	*PO 2*	**10**
			UNIT - IV			
	7	a)	Explain in detail the Ramachandran plot or stearic contour diagram taking any one example. Add a note on its significance.	*CO 1*	-	**8**
		b)	The protein calcineurin binds to the protein calmodulin with an association rate of 8.9 X 10^3 $M^{-1}s^{-1}$ and an overall dissociation constant, *K*d, of 10 nM. Calculate the dissociation rate, *k*d, including appropriate units.	*CO 3*	*PO 2*	**4**
		c)	Two major models have been proposed to explain the cooperative binding of ligands to multisubunit proteins. List the two models and explain their salient features.	*CO 1*	-	**8**
			OR			
	8	a)	"Protein folding in cells probably involves multiple pathways." Justify this statement explain the thermodynamics of protein folding with the help of a suitable diagram.	*CO 3*	*PO 2*	**8**
		b)	Which of the following peptides is more likely to take up an α-helical structure, and why? (i) LKAENDEAARAMSEA (ii) CRAGGFPWDQPGTSN	*CO3*	*PO 2*	**4**
		c)	Explain the experiment which provided the first evidence that the amino acid sequence of a polypeptide chain contains all the information required to fold the chain into its native three-dimensional structure.	*CO1*	-	**8**
			UNIT - V			
	9	a)	Explain why the absorption of UV light by double-stranded DNA increases when the DNA is denatured.	*CO 3*	*PO 2*	**4**
		b)	Draw the structure of the nucleosides found in DNA.	*CO 1*	-	**10**
		c)	One strand of a double-helical DNA has the sequence (5^1)GCGCAATATTTCTCAAAATATTGCGC(3^1). (i) Write the base sequence of the complementary strand. (ii) What special type of sequence is contained in this DNA segment? (iii) Does the double-stranded DNA have the potential to form any alternative structures?	*CO 3*	*PO 2*	**6**
			OR			

	10	a)	For this nucleic acid segment,  (i) Classify this segment as RNA or DNA and justify your choice. (ii) Determine the sequence of this segment labelling the 5' end & 3' end (iii) Identify the nitrogenous bases present in this segment (iv) Draw the structure of nucleic acid that would be obtained by elongating the above segment with the sequence 5' UGC 3'.	*CO 3*	*PO 2*	**8**
		b)	List the salient features of the tertiary structure of tRNA.	*CO 1*	-	**5**
		c)	Define the melting temperature of DNA and give a mathematical equation for calculating the melting temperature. Graphically illustrate this process.	*CO 3*	*PO 2*	**7**

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