

MICROBIOLOGY

PAPER-MCBA-I

Time Allotted: 4 Hours

Full Marks: 100

 $2 \times 5 = 10$

The figures in the margin indicate full marks. Candidates should answer in their own words and adhere to the word limit as practicable. All symbols are of usual significance.

Use separate answer books for each Group.

GROUP-A

Question No. 1 is compulsory and answer any four questions from the rest

- 1. Answer any *five* questions from the following:
 - (a) Which structural features differentiate cellulose from starch?
 - (b) What do you mean by torsional angle?
 - (c) What is the function of grooves in DNA?
 - (d) Write down the structures of an epimer and an anomer of D(+) glucose.
 - (e) Write the name of a biologically active peptide that acts as an hormone and indicate it's function.
 - (f) Amino acids may be acidic, basic or neutral. Why?
 - (g) What do you mean by hyperchromic shift of DNA?
 - (h) Mention the four nucleotides present in deoxyribonucleic acid.

2.	(a)	"Although meso-tartaric acid has two asymmetric carbon atoms but it is optically inactive"— Explain.	2
	(b)	Write the name and structure of a disaccharide present in milk emphasizing on its reducing property and nature of glycosidic bond.	2
	(c)	Explain why chair conformation is stabler than boat. Write the most stable structure of 1, 2 dimethyl cyclohexane.	2+1
	(d)	A molecule of amylopectin consists of 1000 glucose residues and is branched every 25 residues. How many reducing ends does it have?	2
	(e)	Which monosaccharide is used as the preferred source of energy for the brain cells?	1
3.	(a)	Arrange the following fatty acids in order from lowest melting point to highest:	3
		Myristic acid, linolenic acid, stearic acid, oleic acid — Explain.	
	(b)	What is meant by saponification of lipid? Differentiate saponifiable and non saponifiable lipid.	2+2

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	(c)	What are phospholipids? State their function.	1+1
	(d)	Write down the structure of linoleic acid and give its IUPAC nomenclature.	1
4.	(a)	Why is RNA more labile under alkaline condition compared to DNA?	2
	(b)	State the main features of Watson-Crick structure of B-DNA.	3
	(c)	Why is uracil not present in DNA?	2
	(d)	Compare A and Z DNA with respect to their	1+1+1
		(i) Number of residues in each turn	
		(ii) Diameter of the helix	
		(iii) Conformation along N-glycosyl bond.	

5.	(a)	Explain briefly a suitable chromatographic method for separation of glycine and value from their mixture.	2
	(b)	Draw the titration curve of glutamic acid with 0.1 M NaOH. Draw the structure of glutamic acid before and after the titration.	3
	(c)	Describe the function of Dansyl chloride in primary protein structure determination. What is the drawback of using this chemical?	2+1
	(d)	What happens to a solution of a globular protein if $(NH_4)_2SO_4$ is added to it from very low to high concentration.	2
6.	(a)	Give an example of omega-3 fatty acid.	1
	(b)	Define	1^{1} 1^{1}
		(i) Axis of symmetry (ii) Plane of Symmetry	$\frac{1-1}{2}$ $\frac{1-1}{2}$
	(c)	Write the RS nomenclature of	1+1
		(i) Isoleucine (ii) L-cysteine	
	(d)	What are the differences between meso compound and its chiral diasteroisomer? Cite an example.	2+1
	(e)	Define sterols.	1
7.	(a)	Why are humans unable to digest fibres?	2
	(b)	β -D glucopyranose undergoes oxidation with bromine water at a faster rate than α -D glucopyranose. Explain why?	2
	(c)	What is the basic principle of ion exchange chromatography? Name one ion exchanger and one anion exchanger.	2+2
	(d)	Define domain. How does domain and motif differ?	1+1
8.	(a)	Define T_m of DNA metting. Explain how T_m depends on base composition of DNA.	1+1
	(b)	How unsaturated fatty acids keep membrane more fluid at lower temperature?	2
	(c)	At what pH polyhysine will form its most stable α -helical structure?	2
	(d)	Sucrose does not exists as $\alpha \& \beta$ anomers unlike lactose – Give reasons.	2
	(e)	What would be the molecular weight of a protein having 300 amino acids?	2

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- 9. (a) Examine the lipid structure below and answer the following questions 1+(1+1)
 - (i) Is this lipid classified as a phospholipid or a glycolipid? Explain.
 - (ii) What fatty acid chains are present in the lipid? Are they saturated or unsaturated?



- (b) Explain why soaps in aqueous solution assemble into micellar structures? 2
- (c) What is meant by hardening of an oil? How is it achieved?
- (d) Why is hydrogenation an important step for fat preservation? 2

GROUP-B

Answer Question No. 10 compulsorily and any four from the rest

10.	Answer any <i>five</i> questions from the following:	$2 \times 5 = 10$
(a)	What is osmotic pressure?	
(b)	Differentiate between simple diffusion and facilitated diffusion.	
(c)	Which of the following molecules absorb in the IR region? Give reasons in support of your answer: Br_2 , CO_2 , NH_3 , O_2 .	
(d)	Give example of one extrinsic fluorophore for proteins and one for nucleic acids.	
(e)	What are fluorescence quenchers? Give two examples.	1+1
(f)	Mention the difference between red shift and blue shift.	
(g)	What is enthalpy? What is its relation with entropy?	
(h)	What is buffer capacity? Why is it always a positive quantity?	
11. (a)	What is a chromophore?	2
(b)	What is the relation between pathlength and absorbance of a sample observed in a spectrophotometer?	2
(c)	What is the basis of fluorescence in proteins and nucleic acids?	2
(d)	Calculate the amount of	2+2
	(i) H^+ ions and (ii) OH^- ions present in 250 ml of solution of pH 3.	
12. (a)	Draw a schematic diagram of a spectrophotometer with proper labelling.	3
(b)	What is the basis of generation of infrared spectra in molecules?	2
(c)	What amount of solid sodium nitrate is needed to prepare a buffer of $pH = 5.00$ from 1 Litre of 0.1 M acetic acid? [pKa of acetic acid = 4.75, Molecular weight of sodium acetate = 82.0 gram]	3
(d)	What is chromatic aberration and how can it be removed?	2

1 + 2

(i) Phase contrast microscope21/2 × 2 = 5(ii) Fick's law of diffusion21/2 × 2 = 5(iii) Loclectric focussing(iv) Agarose gel electrophoresis(b) Distinguish between any <i>two</i> of the following: $2\frac{1}{2} \times 2 = 5$ (i) Action spectrum and absorption spectrum(iii) Light microscope and electron microscope(iii) Infrared spectroscopy and Raman spectroscopy(iv) Radioimmunoassay (RIA) and Enzyme-linked immunosorbent assay (ELISA).14. (a) State the relation between enthalpy change and entropy change of a system. Define the different terns in this relation and mention their units.1+4+2(b) Calculate the weight of one Curie of ¹³¹ I. The decay constant, K, for ¹³¹ I is 10 ⁻⁶ per second.315. (a) What is Donnan membrane potential? Explain.3(b) Discuss the basic principle of an osmometer. How does osmosis differ from reverse osmosis?2+116. (a) What is surface tension?2(b) Discuss the physical basis of hydrophobic interaction using the example of a biomolecule.4(c) Ome gram of water at 100°C requires 536 calories of heat for conversion into steam at 100°C. Calculate the increase in internal energy per mole of water assuming water vapour to behave as an ideal gas.317. (a) Compare active transport with facilitated diffusion. Give examples.3(b) For the hydrolysis of ATP to ADP in aqueous solution at 310 K, $\Delta H^{U} = -20.1 kJ$ mole ⁻¹ and $\Delta S^{U} = +33.5 kJ/K.mole-1. Calculate the free energy change for this reaction.4(c) What is the difference between a visible light spectrophotometer and an Infraredspectrophotometer?2(d) Why is ATP called an energy rich mol$	13. (a)	Write short notes on any <i>two</i> of the following:	$2\frac{1}{2} \times 2 = 5$
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