



Indian Association for the Cultivation of Science  
(Deemed to be University under *de novo* Category)  
End-Semester Examination-Autumn 2024

Subject: Molecules of life  
Full Marks: 50

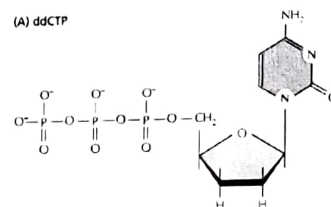
Subject Code(s): BIS1101  
Time Allotted: 3 h

Answer Part A and Part B separately  
Part A

- Q1 An RNA polymerase is transcribing a segment of DNA that contains the sequence below. If the polymerase transcribes this sequence from left to right, what will the sequence of the RNA be? What will the RNA sequence be if the polymerase moves right to left? (2)

5'-GTAACGGATG-3'  
3'-CATTGCCTAC-5'

- Q2 What would you expect to happen if dideoxycytidine triphosphate (ddCTP, figure right) were added to a DNA replication reaction in large excess over the concentration of deoxycytidine triphosphate (dCTP)? Would it be incorporated into the DNA? If it were, what would happen after that? Give your reasoning. (2)



- Q3 Describe the factors that lead to the self-assembly of lipids in water. Depict different probable structures that lipid molecules can self-assemble into in a) Water and b) oil (2)

- Q4 When egg white is heated, it hardens. This cooking process cannot be reversed, but hard-boiled egg white can be dissolved by heating it in a solution containing a strong detergent (such as sodium dodecyl sulfate) together with a reducing agent, like 2-mercaptoethanol. Neither reagent alone has any effect. A. Why does boiling an egg white cause it to harden? B. Why does it require both a detergent and a reducing agent to dissolve the hard-boiled egg white? (2)

- Q5 Describe the difference between the primary, secondary, tertiary, and quaternary structures of protein and discuss the role of different interactions in these structures (2)

- Q6 Discuss why a lipid bilayer in XY plane has 2D fluid-like properties in the XY direction and has an elastic modulus in the z-direction (5)

- Q7) A) Describe lateral and axial resolution. How do they impact the quality of the image? (2.5+2.5)

Or

- B) Describe the schematic and working of the phase contrast microscopy

- Q8) Name the following molecules. (5)

- Artificial phospholipid bilayer vesicle formed from an aqueous suspension of phospholipid molecules.
- Small region of the plasma membrane enriched in sphingolipids and cholesterol.

- c) Any glycolipid having one or more sialic acid residues in its structure; especially abundant in the plasma membranes of nerve cells.
- d) Having both hydrophobic and hydrophilic regions, as in a phospholipid or a detergent molecule.
- e) The main type of phospholipid in animal cell membranes, with two fatty acids and a polar head group attached to a three-carbon glycerol backbone.

### Part B

Answer any 5

1. a) Where and how detoxification of xenobiotic compounds occurs?  
b) What kind of modification of protein is observed in cis cistern, medial cistern and trans cisterna of Golgi apparatus. (2+3)
2. a) Mention the major differences between N-linked glycosylation and O-link glycosylation.  
b) How does the N-linked oligosaccharide of lysosomal proteins differ from that of secreted and plasma membrane protein? (3+2)
3. a) Describe the major functions of lysosome.  
b) How does deficiency of the enzyme beta-hexosaminidase A is related with Tay-Sachs disease (3+2)
4. a) What are the functions of enzymes present in granular matrix of peroxisomes?  
b) How D-Amino Acid Oxidase (DAAO) activity in peroxisomes is related to schizophrenia? (3+2)
5. a) How Mitochondria can be transferred between cells? Why Cardiac muscle mitochondria are more electron dense than other cell types  
b) ATP synthesis takes place in F1 particles of mitochondria, why it is called ATPase? (2+1+2)
6. a) What is cotranslational transport and posttranslational transport, mention the name of the organelle involved in each type of transport.  
b) Signal sequences are necessary and sufficient for protein targeting—explain. (3+2)
7. a) What are the functions of SRP during translation of a peptide across the ER membrane?  
b) What is the function of signal recognition particle (SRP) receptor associated RNA? (3+2)
8. a) What is the significance of the KDEL sequence in the c terminus of protein? What will be the effect if KDEL sequence is lost?  
b) What is the mechanism of Endoplasmic-reticulum-associated protein degradation? (2+1+2)
9. a) Which type of protein coat are found in receptor mediated endocytosis in eukaryotic cells? How this coat formed and why they are removed later?  
b) Which type of pinocytosis occurs in adipocytes (fat cells) and endothelial cells? (1+3+1)