Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: M.Sc.I**

Sub_Code: FCYC1001

10th Semester Regular Examination: 2024-25

SUBJECT: Bioinorganic & Supramolecular Chemistry

BRANCH(S): M.Sc.I(AC)

Time: 3 Hours

Max Marks: 70

Q.Code: S010

Answer Question No.1 (Part-I) which is compulsory, any five from rest (Part-II)

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions :** **(2 x 10)**

a) What are the differences between essential and trace metal ions in biological systems?

b) What is biomineralization, and how do metal ions contribute to this process?

c) How is intracellular calcium (Ca^{2+}) concentration regulated in cells?

d) How does superoxide dismutase use copper and zinc to neutralize superoxide radicals?

e) What is biological nitrogen fixation, and why is it essential for the nitrogen cycle?

f) What is the role of chlorophyll in the light-dependent reactions of photosynthesis?

g) What are the key structural differences between hemocyanin and hemerythrin in oxygen binding?

h) What is the significance of ion-dipole interactions in the binding of cations by crown ethers?

i) What is the fundamental difference between supramolecular chemistry and traditional molecular chemistry?

j) How does the cavity size of a crown ether influence its selectivity for different metal ions?

Part-II

Long Answer Type Questions (Answer Any five)

Q2 **a)** Discuss the structure of ferritin and transferritin. **(4 + 6)**

b) Discuss the mechanisms of iron uptake, storage, and transport in humans, including the roles of transferrin, ferritin, and siderophores. How do disruptions in these processes lead to diseases?

Q3 **a)** Discuss the roles of inositol triphosphate (IP_3), calmodulin, and troponin C in calcium-regulated processes. **(5 + 5)**

b) Describe the mechanisms of intracellular calcium transport, including the roles of Ca^{2+}-ATPase, Na^+/Ca^{2+} exchange, and mitochondrial calcium influx/efflux.

Q4	**a)**	Explain the role of coenzyme vitamin B_{12} (cobalamin) in enzymatic reactions, focusing on its cobalt center.	**(5 + 5)**
	b)	Describe the structure, function, and catalytic mechanism of molybdenum nitrogenase.	
Q5	**a)**	Compare and contrast the mechanisms of Photosystem I (PSI) and Photosystem II (PSII) in the photosynthetic electron transport chain. How do these systems work together to generate ATP and NADPH?	**(5 + 5)**
	b)	Discuss the significance of synthetic model complexes (cobalt Schiff bases, iron porphyrins, and copper dinuclear systems) in studying O_2 transport and activation.	
Q6	**a)**	Explain the phenomenon of molecular recognition with examples of natural (enzyme-substrate) and synthetic (crown ethers) systems.	**(5 + 5)**
	b)	Explain the concept of allosteric binding in supramolecular systems using examples from macrobicyclic and macropolycyclic hosts.	
Q7	**a)**	Describe the structure and function of cyclodextrins as molecular containers.	**(5 + 5)**
	b)	Discuss the structural features, selectivity for different guests (ions/molecules), and applications of crown ether in chemistry and biology.	
Q8	**a)**	Discuss the design principles and applications of acyclic receptors in supramolecular chemistry.	**(5 + 5)**
	b)	Explain the structural features and binding advantages of cryptands over simpler crown ethers in supramolecular chemistry.	