PG/IIIS/CEM/303/24

# M.Sc. 3rd Semester Examination, 2024

## CHEMISTRY

PAPER – CEM-303

*Full Marks* : 50

*Time* : 2 hours

Answer **all** questions

*The figures in the right hand margin indicate marks*

*Candidates are required to give their answers in their own words as far as practicable*

## ( Physical Chemistry Special )

### GROUP – A

Answer any **four** questions : 2×4

1. State Stefan-Boltzmann law of radiation.

2. The surface number density of Schottky defect is lower than Frenkel defect.–Explain.

3. What is meant by Bose-Einstein condensation ?

4. Define Hall angle and Hall mobility with its Mathematical expression.

5. Define spectral energy density.

6. Explain what is meant by phenomenological co-efficients.

## GROUP – B

Answer any **four** questions : 4×4

7. Consider a system which is composed of two parts, each enclosed within the same rigid adiabatic enclosure. Obtain the expression for the rate of entropy production due to flow of heat.

8. How would you identify NaCl crystal by calculating geometrical structure factor ?

9. Establish Prigogine's principle of minimum entropy production.

10. Why presence of excess of potassium makes KCl crystal violet ?

11. Starting from the expression for bosons derive Bose-Einstein distribution law.

12. Eu, which crystallizes as a bcc lattice, has a density of 5.243 $gcm^{-3}$ at 20°C. Calculate the crystallographic radius of a Eu atom at 20°C. Given Eu = 152.0 g/mole.

## GROUP – C

Answer any **two** questions : 8 ×2

13. Derive the expression of ideal gas equation given by Einstein.

14. Derive Planck's law of radiation and hence show that both Wien's law and Rayleigh's law are simply particular cases of it.

15. Derive a suitable relation showing inter relationship between two thermoelectric effects.

16. Derive Von Laue equation for determination of crystal structure.

**[ Internal Assessment – 10 Marks ]**

**( Inorganic Special )**

GROUP – A

Answer any **four** questions : 2×4

1. How could you prove that in CuZnSOD enzyme the role of Cu(II) is primarily the disproportionation of super oxide but the role of Zn(II) is structural ?

2. What are the effects of Alcohol dehydrogenase isoenzyme ?

3. Write the name of different types of amino-peptidases.

4. What are the characteristic differences between assimilatory and dissimilatory nitrate reductase ?

5. What do you mean by DOSENCO state ?

6. What are static and dynamic quenching of fluorescence ?

## GROUP – B

Answer any **four** questions : 4 × 4

7. Outline the structure of the active site of Nitrogenase and discuss its structure.

8. Draw and discuss the active site structure of catalase.

9. Discuss the active site structure of cytochrome-P450.

10. Write the mechanism of reduction of xanthene to uric acid by a suitable enzyme.

11. How THEXI state can be prepared ? Write down the properties of this state.

12. Derive an expression for the quantum yield of fluorescence in terms of life time ($\tau$).

## GROUP – C

Answer any **two** questions : $8 \times 2$

13. Why Galactose oxidase is called free radical enzyme ? Draw the active site structure of the enzyme. $1 + 3 + 4$

14. What are the main sources of sulphite in life forms ? Draw and discuss the active site structure of sulphite oxidase. Give mechanism of its action. $1 + 3 + 4$

15. Discuss how the photochemical reduction and oxidation of $H_2O$ molecules can be achieved using $[Ru(bpy)_3]^{2+}$ as a photosensitizer.

16. Write down the equation of efficiency ($\eta$), of resonance energy transfer. Discuss the condition of Förster theory of resonance energy transfer. Discuss about the bimolecular quenching. 2 + 3 + 3

**[ Internal Assessment — 10 Marks ]**

**( Organic Chemistry Special )**

GROUP — A

Answer any **four** questions : 2×4

1. Elaborate the structural features of 18-Crown -6 in the uncomplxed and complxed forms. How does 18-Crown-6 bind a monovalent cation ?

2. What is Protein denaturation ?

*Or*

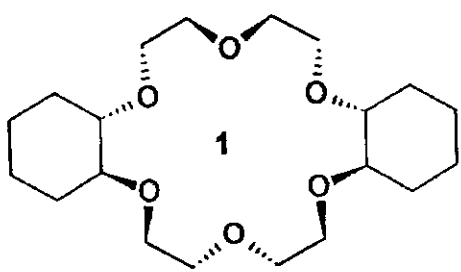
What is the helical pitch in a DNA double helix ?

3. Show schematically the structure of collagen protein.

4. How DNA replication is semi-conservative ?

5. What is Ramachandran map ?

6. Write IUPAC name of the following compound and propose a synthetic route.




## GROUP – B

Answer any **four** questions : 4 × 4

7. (*a*) What are cyclodextrins ?

   (*b*) p-chlorination of anisole is preferred in

water in the presence of β-CD with rate acceleration. How do you explain this observation ? 2 + 2

8. (*a*) Design a molecular receptor for the complexation of adepic acid.

   (*b*) Synthesize the molecular receptor.

   (*c*) How can one study the complexation of adepic acid ?

9. How can one use cryptands as a Light Conversion Device ? Give an example.

10. Give an example of green synthesis of metal nanoparticles with plausible mechanism.

11. Briefly sketch the 'U'-tube transport experiment and write the principle of it. Write its usefulness.

12. Design a receptor for urea, synthesize it and show the mode of its complexation.

## GROUP – C

Answer any two questions : $8 \times 2$

13. (*a*) Define self-assembly.

(*b*) What are the types of interactions involved in the self-assembly process ?

(*c*) Write the different types of supramolecular structures that can be formed by self-assembly.

(*d*) Give examples of two triterpenoids that spontaneously self-assemble in liquids. $2 \times 4$

*Or*

(*a*) What is self-replication ?

(*b*) Write briefly the significance of such studies.

(*c*) Propose a self-replicating scheme based on a model compound and explain how a simple template molecule can amplify without enzymes. $2 + 2 + 4$

14. (*a*) What is a 'supramolecular gel' and how is it formed ?

(*b*) What are the major differences between a 'supramolecular' and a 'polymeric' gel ?

(*c*) Give a few examples of Low Molecular Mass Organogelators.

(*d*) How can one study the morphology of a supramolecular gel ? 2×4

15. Define the following secondary structural elements of a folded protein : α-helix, β-pleated sheet, β-turn, 3.10 helix ? 2×4

16. (*a*) Define hydrophobic effect.

(*b*) How can water act as a better solvent than common organic solvents for a simple Diels-Alder reaction ? Illustrate with examples.

(*c*) What are 'salting in' and 'salting out' agents ? 2 + 3 + 3

*Or*

(*a*) How unconventional energy sources are used in green synthesis ? Give an example.

(*b*) Biocatalytic procedure is more superior than classical chemical procedure for the preparation of 6-aminopenicillanic acid from penicillin G.–Explain.

(*c*) Synthesize caprolactam from cyclohexanone (By Sumitomo process). 2 + 3 + 3

**[ Internal Assessment – 10 Marks ]**