

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2024
(First Semester)

Branch - CHEMISTRY

TRANSITION METAL CHEMISTRY

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Which of the following is the primary postulate of Werner's theory of coordination compounds? a) The central atom forms only ionic bonds b) The coordination number of the metal ion is variable c) The central metal atom has two types of valencies, primary and secondary d) The coordination compounds exhibit color due to ligand-field transitions	K1	CO2
	2	Which of the following statements is correct about Crystal Field Stabilization Energy (CFSE) in an octahedral field? a) Electrons in t_{2g} orbitals experience repulsion b) Electrons in t_{2g} orbitals are more stabilized than those in e_g orbitals c) Electrons in e_g orbitals experience more stabilization d) CFSE is independent of the ligand field strength	K2	CO3
2	3	Which electronic transition is responsible for the color of coordination compounds? a) s-s transitions b) p-p transitions c) d-d transitions d) f-f transitions	K1	CO3
	4	Which of the following complexes is expected to be diamagnetic? a) $[\text{Ni}(\text{CN})_4]^{2-}$ b) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ c) $[\text{CoF}_6]^{3-}$ d) $[\text{Cr}(\text{NH}_3)_6]^{3+}$	K2	CO2
3	5	Which of the following ligands has the strongest trans effect? a) NH_3 b) Cl^- c) CN^- d) H_2O	K1	CO2
	6	In an inner-sphere electron transfer mechanism, which of the following is true? a) The electron transfer occurs between two complexes without ligand interaction b) A bridging ligand facilitates electron transfer between the metal centers c) A metal-ligand bond forms and breaks during the process d) There is no involvement of ligands in the process	K2	CO3
4	7	Which of the following complexes can show geometrical isomerism? a) $[\text{Ni}(\text{NH}_3)_4]^{2+}$ b) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ c) $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ d) $[\text{Cu}(\text{NH}_3)_4]^{2+}$	K1	CO2
	8	Which of the following types of complexes is most likely to exhibit optical isomerism? a) Tetrahedral complexes with all identical ligands b) Square planar complexes c) Octahedral complexes with bidentate ligands d) Octahedral complexes with monodentate ligands only	K2	CO3

Cont...

5	9	Hemoglobin contains which metal ion in their metalloporphyrin structure? a) Copper (Cu) c) Magnesium (Mg)	b) Zinc (Zn) d) Iron (Fe)	K1	CO2
	10	Which of the following vitamins contains a metal ion as a key component? a) Vitamin A c) Vitamin C	b) Vitamin B ₁₂ d) Vitamin D	K2	CO2

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry **EQUAL** Marks

$$(5 \times 7 = 35)$$

Module No.	Question No.	Question	K Level	CO
1	11.a.	Explain the Werner's theory of coordination complexes.	K4	CO3
		(OR)		
	11.b.	Discuss the Jahn-Teller distortion with example.		
2	12.a.	Describe the Orgel's diagram of d^3 and d^5 ions.	K5	CO3
		(OR)		
	12.b.	Explain the types of magnetic properties.		
3	13.a.	Explain the theories of trans effect.	K4	CO2
		(OR)		
	13.b.	Discuss the mechanism of inner sphere electron transfer reaction.		
4	14.a.	Explain the constitutional isomers with example.	K4	CO3
		(OR)		
	14.b.	Describe the optical isomerism of octahedral complexes.		
5	15.a.	Explain the binding of dioxygen to myoglobin.	K5	CO3
		(OR)		
	15.b.	Discuss the role of manganese in photosynthesis.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks

$$(3 \times 10 = 30)$$

Module No.	Question No.	Question	K Level	CO
1	16	Explain the molecular orbital theory with example.	K4	CO2
2	17	Discuss the electronic spectra of coordination complexes.	K5	CO3
3	18	Explain the nucleophilic substitution reaction in square planar complexes.	K4	CO2
4	19	Explain different types of isomerism in coordination compounds.	K5	CO3
5	20	Describe the structure and functions of vitamin B-12 and haemoglobin.	K4	CO2

Z-Z-Z

END

**PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)**

MSc DEGREE EXAMINATION DECEMBER 2024

(First Semester)

Branch- CHEMISTRY

THERMODYNAMICS, ELECTROCHEMISTRY AND PHASE EQUILIBRIUM

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	As P approaches zero, the ratio of fugacity to P for a gas approaches a. ∞ b. unity c. zero d. indeterminate value	K1	CO1
	2	Partial molar property is a/an ----- property. a. Extensive b. Intensive c. Colligative d. Escaping	K2	CO1
2	3	Third law of thermodynamics states that if $T \rightarrow 0$ then, a. $G=0$ b. $V=0$ c. $H=0$ d. $S=0$	K1	CO2
	4	The equilibrium constant for the reaction $H_{2(g)} + S_{(g)} \leftrightarrow H_{2S(g)}$ is 20.2 atm^{-1} at 945°C and 9.1 atm^{-1} at 1.065°C . Calculate ΔH° . a. 88.126 KJ/mole b. 8.8126 KJ/mole c. 881.26 KJ/mole d. 88.126 J/mole	K2	CO2
3	5	Ionic strength of solutions of strong electrolytes can be determined by a. $1/2 \sum Z_i c_i^2$ b. $1/2 \sum Z_i^2 c_i$ c. $1/2 \sum Z_i c_i$ d. $1/2 \sum Z_i$	K1	CO3
	6	Which one of the following is a strong electrolyte? a. AgI b. AgBr c. AgCl d. AgNO ₃	K2	CO3
4	7	Overvoltage is influenced by a. pH b. CD c. T d. All the above	K1	CO4
	8	Zeta potential can be measured for a. True solutions b. Suspension c. Colloidal solutions d. Super saturated solutions	K2	CO4
5	9	Meta stable state of sodium sulphate- water system is a. Na ₂ SO ₃ .10H ₂ O b. Na ₂ SO ₃ .7H ₂ O c. Na ₂ SO ₄ .10H ₂ O d. Na ₂ SO ₄ .7H ₂ O	K1	CO5
	10	In two component systems (A&B) at the congruent melting point, the compound possesses a. Same composition as that of solids b. less than the composition of solid c. more than the composition of solid d. None of these	K2	CO5

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	How will you determine the activity, by freezing point depression method?	K 3	CO1
		(OR)		
	11.b.	i. How to arrive the equation of chemical potential for real gases? (3m) ii. Derive Gibbs Duhem equation. (4m)		

Cont...

2	12.a.	Define the third law of thermodynamics and explain its importance.	K4	CO2
	(OR)			
	12.b.	i. Derive van't Hoff equation. (4m) ii. State Lechatlier-Braun principle and its applications. (3m)		
3	13.a.	Calculate the solubility product of AgBr in water at 25°C from the cell reation, $\text{Ag}, \text{Ag}^+\text{Br}(\text{satd. soln.}) \parallel \text{AgBr}_{(s)}, \text{Ag}$ Given that, $E^\circ_{\text{AgBr,Ag}} = 0.71\text{V}$ and $E^\circ_{\text{Ag}^+,\text{Ag}} = 0.799\text{V}$	K3	CO3
	(OR)			
	13.b.	How will you determine the pH of buffer solutions by conductance measurement and potentiometric method.		
4	14.a.	i. Explain Stern theory of electrical double layer. (5) ii. State Overpotential. (2)	K4	CO4
	(OR)			
	14.b.	Explain the following. i. Electro osmosis (2) ii. Electrophoresis (2) iii. Huckel-Bronsted equation. (3)		
5	15.a.	Explain the application of Phase rule for one component system.	K3	CO5
	(OR)			
	15.b.	Determine the number of components, phases and degrees of freedom in the following equilibria. i. $\text{N}_2\text{O}_{4(g)} \leftrightarrow 2\text{NO}_{2(g)}$ ii. $\text{NH}_4\text{Cl}_{(s)} \leftrightarrow \text{NH}_{3(g)} + \text{HCl}_{(g)}$ iii. $\text{NH}_4\text{Cl}_{(s)} \leftrightarrow \text{NH}_{3(g)} + \text{HCl}_{(g)}$ when $P_{\text{NH}_3} \neq P_{\text{HCl}}$ iv. A binary azeotrope.		

SECTION -C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	i. Derive Duhem-Margules equation.(5) ii. Deduce an expression for the variation of chemical potential with respect to temperature and pressure. (2.5+2.5)	K5	CO1
2	17	i. Explain Nernst heat theorem. How does it lead to the enunciation of third law of thermodynamics, ii. How the absolute entropy of a substance is determined with the help of third law of thermodynamics?	K5	CO2
3	18	What is the principle underlying in conductometric titration and discuss the curves obtained in the titration of i. NaOH Vs H ₂ SO ₄ ii. HCl Vs NH ₄ OH iii. Mixture of HCl and CH ₃ COOH Vs NaOH iv. AgNO ₃ Vs KCl.	K5	CO3
4	19	Illustrate and explain the following a. Sedimentation potential (3) b. Storage batteries (3) c. Acid and alkaline accumulators. (4)	K5	CO4
5	20	Draw the phase diagrams for two component system in which two components form i. Eutectic mixture ii. A stable compound with congruent melting point iii. Stable compound with incongruent melting point and apply phase rule to these diagrams.	K5	CO5

Z-Z-Z END

**PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)**

**MSc DEGREE EXAMINATION DECEMBER 2024
(First Semester)**

Branch - **CHEMISTRY**

BASIC ELECTRONICS FOR CHEMISTS

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Find the primary factor affecting the performance of a semiconductor device. a) Temperature b) Color c) Size d) Weight	K1	CO1
	2	Recall the type of rectifier that allows current to flow only during one half of the AC cycle. a) Full-wave rectifier b) Half-wave rectifier c) Bridge rectifier d) Inverter	K2	CO1
2	3	Match the primary function of an operational amplifier (op-amp)? a) To generate power b) To act as a resistor c) To convert AC to DC d) To amplify voltage signals	K1	CO2
	4	What is the typical response time for an LDR to changes in light intensity? a) Instantaneous b) Milliseconds to seconds c) Minutes d) Hours	K1	CO2
3	5	Show in a digital system, what range of values can an 8-bit binary number represent? a) 0 to 255 b) -128 to 127 c) 0 to 1023 d) 1 to 256	K2	CO3
	6	Which of the following flip-flops is primarily used for counting applications? a) SR Flip-Flop b) D Flip-Flop c) T Flip-Flop d) JK Flip-Flop	K1	CO3
4	7	Tell about which type of counter counts in both directions (up and down)? a) Up counter b) Down counter c) Ring counter d) Bidirectional counter	K1	CO4
	8	Infer, which type of A/D converter uses a staircase approximation to convert analog signals to digital? a) Flash A/D converter b) Delta-Sigma A/D converter c) Successive Approximation A/D converter d) Dual-slope A/D converter	K2	CO4
5	9	Select about specification defines the smallest change in input voltage that an A/D converter can detect. a) Sampling rate b) Resolution c) Linearity d) Dynamic range	K1	CO5
	10	Which component of a flame photometer is responsible for detecting the emitted light? a) Flame b) Prism c) Photo detector d) Filter	K1	CO5

Cont..

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Identify the concepts of intrinsic semiconductors.	K3	CO1
	(OR)			
	11.b.	Construct and explain the working principle of a full wave rectifier.		
2	12.a.	Analyze the operation of the inverting amplifier.	K4	CO2
	(OR)			
	12.b.	Categorize the working process of an astable multivibrator and its applications.		
3	13.a.	Explain the difference between binary, decimal, and hexadecimal number systems. Provide examples for each.	K2	CO1
	(OR)			
	13.b.	Show the function of the JK master slave flipflop with the truth table.		
4	14.a.	Summarize the operation of synchronous counters.	K3	CO4
	(OR)			
	14.b.	Illustrate the role of a reference voltage in an A/D converter and explain how it affects the converter's performance.		
5	15.a.	Categorize the function of a voltmeter.	K4	CO5
	(OR)			
	15.b.	Examine the effects of a flame photometer.		

SECTION - C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Discover the I-V characteristics of a PN junction diode, including forward and reverse bias regions. Explain the significance of each region.	K4	CO2
2	17	Identify the role of automatic street lights with these advantages.	K4	CO2
3	18	Construct and explain the working principle of the half adder and the full adder.	K4	CO3
4	19	Interpret the working model of a ring counter.	K4	CO3
5	20	Explain in detail the operation of a potentiometer.	K4	CO5

Z-Z-Z

END

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
MSc DEGREE EXAMINATION DECEMBER 2024
(Third Semester)
Branch – CHEMISTRY

**PHOTOCHEMISTRY, PERICYCLIC REACTIONS AND NATURAL
PRODUCTS**

Time: Three Hours

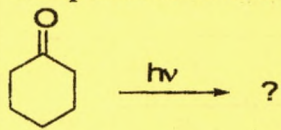
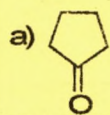
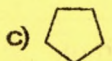
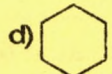
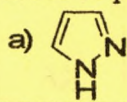
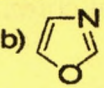
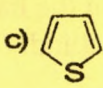
Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Q. No.	Question	K Level	CO
1	Radiative process from the following is a) Fluorescence b) Intersystem crossing c) Internal conversion d) All of these	K1	CO1
2	Complete the following reactions.  a)  b)  c)  d) 	K2	CO1
3	Which one is allowed for 4n system conrotatory mode? a) Δ b) $h\nu$ c) Δ or $h\nu$ d) both a & b	K1	CO2
4	Claisen rearrangement is an example of a) [1,3] sigmatropic rearrangement b) [2,4] sigmatropic rearrangement c) [1,5] sigmatropic rearrangement d) [3,3] sigmatropic rearrangement	K2	CO2
5	Which vitamin is also known as thiamine? a) Vitamin B1 b) Vitamin B2 c) Vitamin B6 d) Vitamin B12	K1	CO3
6	Starch is a a) Trisaccharide b) Amylose c) Amylopectin d) Mixture of amylase + amylopectin	K2	CO3
7	Which one of the following is a pigments? a) Morphine b) Codeine c) Monoterpenes d) Anthocyanins	K1	CO4
8	The 1,3-dipolar cycloaddition of diazoalkanes to alkynes leads to pyrazoles a)  b)  c)  d) None of these	K2	CO4
9	Which species is used for the production of chloromycetin? a) <i>S. ramosus</i> b) <i>S. venezuelae</i> c) <i>S. aureofaciens</i> d) <i>S. griseoflavus</i>	K1	CO5
10	Testosterone is secreted by a) Leydig cells b) Sertoli cells c) Histocyte d) Placenta	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer ALL questions

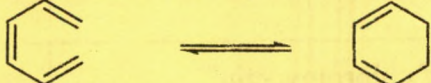
ALL questions carry EQUAL Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	Explain: Norrish type I and Norrish type II.	K3	CO1
(OR)			
11.b.	Write a brief account on: i) Di- π -Methane Rearrangement ii) Paterno-buchi reaction		
12.a.	Draw FMO diagram for [2+2] cycloaddition reaction.	K4	CO2
(OR)			
12.b.	Explain the following terms: i) Conrotatory and Disrotatory mode ii) HOMO and LUMO		
13.a.	Describe the structure elucidation of Zingiberene.	K5	CO3
(OR)			
13.b.	Discuss the structural elucidation of retinol.		
14.a.	Summarize the synthesis and applications of pyrazoles.	K4	CO4
(OR)			
14.b.	Elucidate the structure of cyanin chloride.		
15.a.	Illustrate the chemistry of Ergosterol.	K5	CO5
(OR)			
15.b.	Write a brief account on Androsterone and Testosterone.		

SECTION - C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	With neat diagram, explain the various processes depicted in Jablonski's diagram.	K5	CO1
17	Discuss the following inter conversion on the basis of correlation diagram, orbital symmetry and FMO Method. 	K6	CO2
18	Elucidate the structure of Morphine.	K4	CO3
19	Describe the synthesis and structure of flavones and isoflavones.	K5	CO4
20	Elucidate the structure of Penicillin.	K4	CO5

Z-Z-Z

END

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
MSc DEGREE EXAMINATION DECEMBER 2024
(Third Semester)

Branch - **CHEMISTRY**

SOLID STATE AND NUCLEAR CHEMISTRY

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	X-rays are generated by -----. a) Geiger tube b) Goniometer c) Coolidge tube d) Rotameter	K1	CO1
	2	One of the widely used target material for generation of X-ray spectral line is ----. a) Zinc b) Molybdenum c) Xenon d) Manganese	K2	CO1
2	3	The formation of energy band is preferred in --- a) solids b)liquids c)gases d)all the above.	K1	CO2
	4	Band gap energy is the energy required by electron to _____. (a)Jump from bottom surface of the solid to its top surface (b)Jump from centre of the solid to its top surface (c)Set free itself from valence band and start conduction (d)Move itself from one corner of solid to another corner	K2	CO2
3	5	Which isotope below has the highest binding energy? a) ⁴ He b) ¹⁶ O c) ³² S d) ⁵⁵ Mn	K1	CO3
	6	Which type of radiation is the least penetrating? a) alpha b) beta c) gamma d) x-ray	K2	CO3
4	7	A Geiger-Muller tube is a _____. a) gas ionization detector b) cloud chamber c) fluorescence detector d) spectrophotometer	K1	CO4
	8	Three types of radioactive elements are emitted when unstable nuclei undergo radioactive decay. Which of the following is not one of them? a)Beta b)Gamma c)Alpha d)delta	K2	CO4
5	9	Which one of the following would be most likely to undergo thermonuclear fusion? a) ² H b) ⁴ He c) ⁵⁶ Fe d) ¹⁴¹ Ba	K1	CO5
	10	The ¹⁴ C activity of some ancient Peruvian corn was found to be 10 disintegrations per minute per gram of C. If present-day plant life shows 15 dpm/g, how old is the Peruvian corn? The half-life of ¹⁴ C is 5730 years. a) 1455 years b) 1910 years c) 3350 years d) 3820 years	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Derive Bragg's law.	K2	CO1
		(OR)		
	11.b.	Write a note on structure factor.		
2	12.a.	Discuss on superlattice.	K4	CO2
		(OR)		
	12.b.	Define semiconductors. Discuss the types of semiconductors.		
3	13.a.	Describe the mass defect and binding energy of nucleus.	K5	CO3
		(OR)		
	13.b.	Write a short note on the meson theory of nuclear forces.		
4	14.a.	How is radioactivity detected by cloud chamber and spark chamber?	K4	CO4
		(OR)		
	14.b.	Illustrate the principle and working of synchrontron.		
5	15.a.	What is Nuclear fission? With a neat diagram explain how nuclear fission principle is used in nuclear fission.	K5	CO5
		(OR)		
	15.b.	Discuss the following nuclear transmutations with example. (i) Transmutation by alpha particle (ii) Transmutation by protons (iii) Transmutation by neutrons		

SECTION - C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Explain in detail about the principle and experimental method of neutron diffraction.	K4	CO1
2	17	Illustrate the types of defects in solids.	K5	CO2
3	18	Describe the nuclear liquid drop model and Fermi gas model.	K6	CO3
4	19	Explain the principle and working of multiplicative ion collection by G.M.Counter method.	K4	CO4
5	20	Describe the principle and working of neutron activation analysis and isotopic dilution analysis.	K5	CO5

Z-Z-Z

END

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2024
(Third Semester)

Branch - CHEMISTRY

CHEMICAL KINETICS AND STATISTICAL THERMODYNAMICS

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	According to Lindemann's theory of unimolecular reactions, at very high pressure the gaseous reactions follow: a) Zero order kinetics b) Pseudo first order kinetics c) First order kinetics d) Second order kinetics	K1	CO1
	2	Collision theory of a chemical reaction explains a) Rate of a reaction b) Order of a reaction c) Molecularity of a reaction d) Rate, order and molecularity	K2	CO1
2	3	For enzymatic reaction which follows Michaelis-Menten kinetics the condition for the reaction rate to be half its maximum value is a) $K_m = \frac{1}{2}[S]$ b) $K_m = 2[S]$ c) $K_m = [S]^2$ d) $K_m = [S]$	K1	CO2
	4	Acid-base catalyzed reactions are a) homogeneous solid phase reactions b) homogeneous liquid phase reactions c) heterogeneous reactions d) enzyme catalyzed reactions	K2	CO2
3	5	Which of the following statements best describes the hydrated reaction mode of the hydroxyl radical in the radiolysis of water? a) It rapidly combines with oxygen to form water. b) It acts as a strong reducing agent. c) It reacts with other molecules by abstracting hydrogen atoms. d) It remains stable in water for a long period.	K1	CO3
	6	The photochemical reaction is mainly of a) I order b) II order c) III order d) Zero order	K2	CO3
4	7	The rotational partition function (Q_{rot}) is a) $8\pi^2IkT/\sigma h$ b) $8\pi^2kT/\sigma Ih$ c) $8\pi^2IkT/\sigma h^2$ d) $8\pi^2IkT/\sigma^2h^2$	K1	CO4
	8	For H_2 assuming characteristic rotational as 100 K, q_{rot} at 2000 K is a) 15 b) 20 c) 30 d) 10	K2	CO4
5	9	According to Debye theory, specific heat at high temperature is proportional to: a) T b) T^2 c) T^3 d) Independent of T	K1	CO5
	10	Which one of the following is not obeying Bose-Einstein statistics? a) Hydrogen b) Proton c) Nitrogen d) Deuterium	K2	CO5

Cont...

SECTION - B (35 Marks)Answer **ALL** questions**ALL** questions carry **EQUAL** Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Apply Lindemann's theory to explain the kinetics of unimolecular reactions.	K3	CO1
		(OR)		
	11.b.	Make use of the ARRT to analyze the reaction kinetics between atoms and molecules.		
2	12.a.	Explain the primary and secondary kinetic isotopic effects with examples.	K2	CO2
		(OR)		
	12.b.	State and explain the Michaelis-Menton law.		
3	13.a.	Organize the G-value and hydrated electrons.	K3	CO3
		(OR)		
	13.b.	Discuss the Langmuir-Hinshelwood mechanism for the unimolecular reactions.		
4	14.a.	Derive the Sekur-Tetrode equation.	K4	CO4
		(OR)		
	14.b.	Calculate the translational partition function for benzene (molar mass = 78.0 g mol ⁻¹) in a volume of 1 m ³ at 25 °C.		
5	15.a.	Explain the concept of the heat capacity of diatomic gases.	K4	CO5
		(OR)		
	15.b.	Interpret the negative absolute temperature.		

SECTION -C (30 Marks)Answer **ANY THREE** questions**ALL** questions carry **EQUAL** Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Compare the collision theory and ARRT.	K4	CO1
2	17	Simplify the steps involved in flow methods for fast reaction studies, comparing stopped-flow and continuous-flow techniques.	K4	CO2
3	18	Analyze how H ₂ -Cl ₂ reactions are regulated by the photochemical mechanism and kinetics.	K4	CO3
4	19	The vibrational frequencies in m ⁻¹ for CO ₂ are $\bar{\nu}_1 = 1350 \times 10^2$, $\bar{\nu}_2 = 672.2 \times 10^2$ and $\bar{\nu}_3 = 2396 \times 10^2$. The second mode of vibration has a degeneracy of 2. Calculate the following for CO ₂ (g) at 298 K, i) Vibrational partition function (fv) ii) Vibrational contribution to Cv iii) Vibrational contribution to entropy and iv) Characteristic temperature for vibration for each vibrational frequency.	K4	CO4
5	20	Derive the equilibrium constant expression using the partition function.	K4	CO5

Z-Z-Z

END

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2024
(Third Semester)

Branch - CHEMISTRY

MAJOR ELECTIVE COURSE – II MOLECULAR SPECTROSCOPIC METHODS AND ITS APPLICATIONS

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Hydrogen bonding in organic compounds shifts the ultraviolet absorptions to: a) shorter wavelength b) shorter frequencies c) remain unchanged d) none of these	K1	CO1
	2	When a few drops of an acid is added to arylamine, absorption occurs at lower wave length? The reason is: a) increase in conjugation b) reduction in conjugation c) acid decomposes the compound d) compound remains insoluble	K2	CO1
2	3	Raman spectrum of a compound is not disturbed by a) frequency of incident radiation b) the presence of water c) absence of polarizability d) None of these	K1	CO2
	4	Primary amide (say RCONH ₂) shows two absorption bands between 3400-3500 cm ⁻¹ . On treatment with P ₂ O ₅ , the compound formed absorbs at a) 3500 cm ⁻¹ b) 1650 cm ⁻¹ c) 2256 cm ⁻¹ d) 3250 cm ⁻¹	K2	CO2
3	5	Which of the following solvents cannot be used in NMR spectroscopy? a) CCl ₄ b) CS ₂ c) CHCl ₃ d) (CCl ₃) ₂ C = O	K1	CO3
	6	The NMR spectroscopy is useful for the detection of a) hydrogen bonding b) aromaticity c) geometrical isomers d) all of these	K2	CO3
4	7	Which one of the following statements about ¹³ C NMR spectroscopy is not true? a) ¹³ C nucleus has a spin, I = ½ . b) The gyromagnetic ratio of ¹³ C nucleus is low as compared to that of proton. c) The intensities of the signals are exactly proportional to the number of carbon atoms in the molecule. d) The isotopic abundance of ¹³ C isotope is low as compared to ¹² C isotope.	K1	CO4
	8	The solvent normally used for recording ¹³ C NMR spectra is a) water b) n-hexane c) deuterated organic solvent d) TMS	K2	CO4
5	9	ESR spectrum of (SO ₃) ₂ NO ⁻ anion contains a) Singlet b) Doublet c) Triplet d) Quadruplet	K1	CO5
	10	The Moss Bauer spectroscopy involves absorption of a) Radio waves b) Micro wave c) Gamma radiation d) Cosmic ray	K2	CO5

Cont...

SECTION - B (35 Marks)Answer **ALL** questions**ALL** questions carry **EQUAL** Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Apply your knowledge to Calculate the absorption maximum (λ_{max}) for 1,3-butadiene using Woodward-Fieser rules.	K3	CO1
		(OR)		
	11.b.	Identify the types of electronic transitions in UV-visible spectroscopy? Give an example of each type of transition.		
2	12.a.	Elucidate the principle of Raman Spectroscopy and how it differs from absorption-based spectroscopy techniques like IR?	K3	CO2
		(OR)		
	12.b.	Describe the difference between Stokes and anti-Stokes lines in a Raman spectrum.		
3	13.a.	A molecule exhibits a chemical shift for a proton at 2.5 ppm when measured in CDCl_3 . What would happen to the chemical shift if the sample were measured in DMSO instead? Consider solvent effects on chemical shift.	K4	CO3
		(OR)		
	13.b.	A molecule shows a vicinal spin-spin coupling constant (J value) of 8 Hz in its ^1H NMR spectrum. Based on this, is the coupling likely cis or trans?		
4	14.a.	In an off-resonance decoupled ^{13}C NMR spectrum, a carbon atom attached to three protons (CH_3) shows a quartet. How many lines will a carbon attached to one proton (CH) show in its spectrum?	K4	CO4
		(OR)		
	14.b.	In 2D NMR, describe how COSY (Correlation Spectroscopy) can help in identifying spin-spin coupling between protons in a molecule?		
5	15.a.	Explain how the magnitude of the g-value in ESR spectroscopy is affected by the type of ligand field surrounding a metal ion in a transition metal complex?	K5	CO5
		(OR)		
	15.b.	Describe zero field splitting (ZFS) and how it impacts the ESR spectra of transition metal complexes with d^8 configurations?		

SECTION - C (30 Marks)Answer **ANY THREE** questions**ALL** questions carry **EQUAL** Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Analyze which of the following functional groups acts as a chromophore, and which acts as an auxochrome? Provide reasoning. a) -OH b) -NO ₂ c) -NH ₂ d) -C=O	K4	CO1
2	17	Examine how IR spectroscopy can be used to identify functional groups in an organic compound?	K4	CO2
3	18	Investigate how the anisotropic effect of an aromatic ring influences the chemical shift of protons in the ortho, meta, and para positions relative to the ring?	K4	CO3
4	19	The NMR spectrum of WF_6 shows multiple signals in the ^{19}F NMR due to fluorine-fluorine coupling. Analyze how the molecular symmetry of WF_6 would influence the complexity of the NMR spectrum?	K5	CO4
5	20	Explicate the concept of isomer shift in Mossbauer spectroscopy and how it can be used to determine the oxidation state of iron in $[\text{Fe}(\text{CN})_5\text{NO}]$?	K5	CO5

Z-Z-Z

END