

Satyug Darshan Institute of Engineering & Technology, Faridabad

Department of Applied Science and Humanities

Academic year 2025-26

Programme: B TECH CE/CSE	Year & Semester: I & I/II
Course Name: Chemistry	Course Code: CHU-141-V
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Unit I

Short answer questions

Q.N.	Question	KL
1	What is n- type semiconductor?	KL1
2	What is p- type semiconductor?	KL1
3	State the four criteria for aromaticity.	KL1
4	For a particle in one dimensional box write the equation for calculating the energy values corresponding to $n = 2$.	KL3
5	On the basis of CFT calculate spin only magnetic moment of $[\text{Fe}(\text{NH}_3)_6]^{3+}$.	KL3
6	Calculate the radial nodes and angular nodes associated with 5d orbital.	KL3
7	Draw an energy level diagram for N- type and P- type semiconductors according to band theory.	KL3
8	What is the role of doping on the band structures of solids?	KL1
9	Predict whether cyclopropane, cyclopropenyl cation and cyclobutadiene are aromatic or non-aromatic.	KL3
10	Give the Schrodinger wave equation for a particle in one dimensional box.	KL1
11	Explain crystal field theory.	KL2
12	What is the significance of Ψ and Ψ^2 ?	KL1
13	What are the intrinsic and extrinsic semiconductors?	KL1

Long answer questions

Q.N.	Question	KL
1	Solve the Schrodinger wave equation for particle in one dimensional box.	KL3
2	Describe the Schrödinger wave equation. Derive the expression for the total energy and normalised wave function for the particle of mass (m) in 1D Box with length L moving with potential $V(x) = 0$, $0 < X < L$ otherwise $V(x)$ is infinite.	KL2
3	Draw the molecular orbital diagram for the O_2 and predict its bond order and magnetic behaviour.	KL3
4	On the basis of molecular orbital theory draw the molecular energy diagram for N_2 molecule.	KL3
5	Draw a molecular orbital energy level diagram for NO showing clearly how the atomic orbitals interact to form MOs.	KL3
6	Draw molecular orbital diagram for NO and F_2 and predict their bond order and magnetic behaviour.	KL3

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7	Draw and explain molecular orbital diagram of O ₂ . Compare its bond order and magnetic properties with O ₂ ⁺ , O ₂ ⁻ , and O ₂ ⁻² .	KL3
8	Give three main postulates of crystal field theory. Explain the splitting of d orbitals under octahedral tetrahedral and square planar ligand field.	KL2
9	Explain crystal field theory and how it influences the energy level diagram of transition metals? Differentiate between the CFT diagram of tetrahedral and octahedral molecules.	KL2
10	What is CFSE? Calculate CFSE for d ⁵ (H.S.) and d ⁵ (L.S.) including pairing energy, P in octahedral complexes.	KL2
11	Draw the Pi- molecular orbital diagram of 1,3-butadiene. Fill it with Pi-electrons and label the HOMO and LUMO.	KL3
12	Draw the Pi- molecular orbital diagram of benzene. Fill it with Pi-electrons and label the HOMO and LUMO.	KL3
13	How does benzene contribute to the unique properties of aromaticity?	KL2
14	What are semiconductors? Discuss in brief band theory in metals.	KL2
15	What is meant by doping in a semiconductor? Explain the role of doping on the band structure of solids.	KL2
16	What are semiconductors? Discuss in brief band theory in metals.	KL2

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Unit II

Short answer questions

Q.N.	Question	KL
1	Predict the number of NMR signals in CH_3COCH_3 and $\text{CH}_3\text{COCH}_2\text{CH}_3$.	KL3
2	How many NMR peaks do the following compound show? HCL, CH_4 and CH_3 .	KL2
3	Draw the fundamental modes of vibration of CO_2 .	KL3
4	Which of the following molecule will show a pure rotational spectra and why? H_2 , CO and NH_3 .	KL4
5	What is bathochromic shift in UV visible spectroscopy?	KL1
6	Define NMR spectroscopy.	KL1
7	What is the principle of vibrational spectroscopy.	KL1
8	What do you mean by IR active molecule?	KL1
9	Explain bathochromic shift.	KL2
10	What are electromagnetic radiation? How they are related to Spectroscopy?	KL1

Long answer questions

Q.N.	Question	KL
1	What do you understand by the term “spectroscopy”? Discuss the various selection rules governing spectroscopy.	KL2
2	Discuss the principle and selection rules for the electronic spectroscopy. Also discuss the various electronic transitions in UV visible spectroscopy.	KL2
3	State and illustrate the basic principle and applications of rotational and vibrational spectroscopy.	KL1
4	Discuss the basic principle and applications of vibrational spectroscopy using the energy level expression and selection rule. Draw the spectral transitions of the vibrational spectrum of diatomic molecule at the simple harmonic oscillator.	KL2
5	Explain stretching and bending vibrations in AB_2 type (non- linear molecule). Write the selection rule for IR spectroscopy.	KL2
6	Differentiate between principle of fluorescence and phosphorescence using Jablonski diagram.	KL4
7	Compare the principals of NMR and MRI.	KL4
8	Explain the following terms- (i) Shielding and de-shielding of proton. (ii) Chemical Shift (iii) Bathochromic Shift (iv) Hypsochromic shift (v) Finger Print Region (vi) Fundamental vibrations and over tones	KL2
9	Explain the basic principle and applications of NMR spectroscopy.	KL2

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Unit III

Short answer questions

Q.N.	Question	KL
1	What is dipole - induced dipole interactions?	KL1
2	What are dipole - induced dipole and induced dipole - induced dipole forces?	KL1
3	State the basic difference between the London dispersive forces and dipole-dipole forces.	KL1
4	What are intermolecular forces? How they impact on physical properties of matter?	KL1
5	Define the term Vander Walls interactions.	KL1
6	Give the reason how ideal gas differ from real gas?	KL2
7	Write the expression for the Vander's equation with correction in pressure and volume.	KL1
8	What do you understand by polarity? Write some examples of polar and nonpolar compounds?	KL2
9	State the basic difference between the London dispersive forces and dipole-dipole forces.	KL1
10	What is the significance of Vander Walls constant 'a' and 'b'?	KL2

Long answer questions

Q.N.	Question	KL
1	Give a detailed account for any four intermolecular forces of attraction existing in molecules.	KL2
2	What are the main reasons for deviation of real gases from ideal behaviour derive the expression for the equation of state for real gases.	KL1
3	Derive the Vander Waal's equation for real gases and extend the derivation to critical phenomena.	KL4
4	What do you mean by critical state of a gas? What changes in the properties of a gas occur at this stage? Also write the expression for P_C , V_C and T_C .	KL2
5	Write short note on PES diagrams. Elaborate saddle point and mountain pass in a potential energy surface diagram.	KL2
6	What are Potential energy surfaces? Draw and explain the potential energy surface of H_3 .	KL2
7	Discuss the potential energy surface diagram of H_2F and its trajectories.	KL2

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Unit IV

Short answer questions

Q.N.	Question	KL
1	Write the mathematical expression for the change in internal energy (dU).	KL1
2	How the permanent hardness of the water be removed?	KL1
3	What is corrosion and how does it occur in iron?	KL1
4	Write the equation - How is free energy related to electromotive force EMF in electrochemical reactions?	KL1
5	Define residual entropy with a suitable example.	KL1
6	What do you understand by dry corrosion?	KL1
7	What is the role of free energy in determining chemical equilibrium.	KL1
8	Write the relationship between Helmholtz free energy and Gibbs free energy.	KL1
9	What are Arrhenius definition of an acid and base?	KL1
10	Write in brief about two methods of protection from corrosion?	KL1
11	How will you predict spontaneity in terms of entropy and free energy?	KL3
12	Explain electrochemical corrosion with suitable example.	KL2
13	Define the term solubility product (K_{sp}). Discuss its application in calculation of solubility of sparingly soluble salt.	KL1
14	Explain Bronsted-Lowry concept of protonic concept for acid and base with examples.	KL2
15	Give main difference between Wet and Dry corrosion with example	KL4
16	Define entropy and enthalpy of a reaction.	KL1
17	Give two points how scale and sludge formation can be prevented in boilers?	KL2
18	What does an Ellingham diagram signifies?	KL2
19	Explain the differences between temporary and permanent hardness.	KL2

Long answer questions

Q.N.	Question	KL
1	Discuss and derive the Nernst equation. Explain its various applications.	KL2
2	Explain the criteria of spontaneity and reversibility in terms of S , U , H and G .	KL2
3	What is corrosion? Explain the electrochemical theory of rusting of iron.	KL2
4	Describe the thermodynamic principles of metallurgy.	KL2
5	Explain the Ellingham diagram. Discuss, how is it constructed and interpreted? Explain its applications in metallurgy for the extraction of metals and describe its limitations.	KL2
6	Discuss the concept of Entropy and free energy? What are the methods used for calculating entropy and Free energy changes and their significance in predicting the feasibility of chemical reactions.	KL2
7	What is meant by hardness of water? How are they classified? Explain any two methods of softening of hard water.	KL2
8	What do you understand by Gibbs free energy (G) and Helmholtz work function (A) and what are their physical significance in thermodynamics?	KL2
9	What do you mean by corrosion? Explain the factors influencing corrosion.	KL2
10	Define the term	KL1

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	(i) EMF, (ii) Potential difference, (iii) Arrhenius acids and bases.	
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Unit V

Short answer questions

Q.N.	Question	KL
1	What is the concept of hard and soft acids and bases?	KL1
2	What is meant by an effective nuclear charge?	KL1
3	Arrange N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} , Al^{3+} increasing order of ionic radii.	KL3
4	Differentiate ionization energy and electron affinity.	KL4

Long answer questions

Q.N.	Question	KL
1	What do you mean by effective nuclear charge? Write Slater's rule to find out effective nuclear charge.	KL1
2	Calculate effective nuclear charge felt by valence electron of chromium atom $Z = 24$.	KL3
3	Explain electronegativity and the factors affecting the electronegativity.	KL2
4	Explain the different quantitative scales i.e., Pauling, Mulliken and Allred-Rochow for measuring the electronegativity.	KL2
5	Explain the trends in electronegativity across the periodic table and discuss its implications for bond polarity and chemical reactivity.	KL2
6	Explain the postulates and application of Fajan's rules.	KL2
7	Explain Fajan's rule of Polarizability and its significance.	KL2
8	Explain the hard and soft acids and bases theory and write its applications.	KL2
9	Explain in detail on coordination number and geometries with examples for each.	KL2
10	Discuss the geometry of ClO_3^- and PCl_5 .	KL2

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Unit VI

Short answer questions

Q.N.	Question	KL
1	Why eclipsed conformation is less stable than staggered conformation?	KL2
2	Why enantiomers have same physical and chemical properties while diastereomers have different?	KL2
3	Why eclipsed conformation is less stable than staggered conformation?	KL2
4	Explain the cause of optical activity.	KL2
5	What are optical active compounds? Explain with an example.	KL1
6	What are the essential conditions for a molecule to be chiral?	KL1

Long answer questions

Q.N.	Question	KL
1	Discuss various types of structural and stereoisomerism by taking example of organic molecules.	KL2
2	Discuss the structural, stereo and geometrical isomers in detail by taking examples of inorganic molecules.	KL2
3	What is chirality and how does it relate to the concept of optical activity in molecules?	KL2
4	Write the differences between the following along with examples. (i) Enantiomers and Diastereomers (ii) Cis- and Trans- isomers (iii) D-L and d-l notation (iv) Racemic mixture and meso compounds (v) Plane of symmetry and centre of symmetry (vi) Optical activity and chirality (vii) Ionisation isomers and Hydration isomers (viii) Configurational and conformational isomers	KL4
5	Define the following terms- (i) Metamers (ii) Tautomers (iii) Conformational isomers	KL1
6	What are optically active compounds? Discuss the essential conditions for optical isomerism, elaborate with examples.	KL2
7	Draw and discuss the various conformational isomers of n-Butane and their energy level diagram.	KL3
8	Draw the Flying Wedge, Sawhorse and Newmann projection of ethane. Write the enantiomeric and diastereomeric forms of 2,3-dibromopentane and write its (R,R), (R,S) and (S,S) configurations.	KL3

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Unit VII

Short answer questions

Q.N.	Question	KL
1	Write the structure and uses of Aspirin drug.	KL1
2	Justify the statement SN1 reactions occur with inversion of configuration.	KL5
3	Write the difference between E1 and E2 reaction.	KL4
4	What do you mean by ozonolysis? Explain with at least one suitable example.	KL2
5	Explain Diel's Alder reaction with suitable example.	KL2
6	Write the difference between SN ₁ and SN ₂ reactions.	KL4
7	Explain the synthesis of Paracetamol and Aspirin.	KL2
8	What do you understand by term cyclization reaction? Give example.	KL2
9	Why do SN ₂ reactions occur with inversion?	KL2

Long answer questions

Q.N.	Question	KL
1	Write notes on following: (i) SN1 and SN2 reactions (ii) Synthesis of paracetamol (iii) HSAB principle with examples (iv) Friedal Craft alkylation (v) Diels- Alder reaction	KL1
2	Write the short notes on following- (i) Oxymercuration – Demercuration Reaction. (ii) Diel's Alder Reaction (iii) Wolf – Kishner Reaction (iv) Synthesis of Aspirin	KL1
3	Explain the mechanism of nucleophilic bi-molecular substitution reaction with an example.	KL2
4	Compare the E1 and E2 reactions mechanisms giving examples of each type.	KL4
5	Explain in detail about synthesis of commonly used drug molecules 'Ibuprofen' with reactions.	KL2
6	Write the synthesis and uses of chloro-xyleneol and paracetamol.	KL2
7	Justify the statement- "Nucleophilic substitution and elimination reactions often compete with each other".	KL5
8	Explain elimination reaction with detailed mechanism by taking suitable example along with rules governing major product formation.	KL2
9	Describe how elimination reaction compete with substitution reaction.	KL2