

5.6 The upper age limit is also relaxed up to 47 years for "Persons with Disability" of Punjab.

Note: Provisions mentioned in Punjab Civil Services (General and Common Conditions of Service) Rules, 1994 amended from time to time may be considered.

6. PATTERN AND SCHEME OF COMPETITIVE EXAMINATION FOR SELECTION

6.1 PROCEDURE FOR SELECTION

The procedure for selection of candidates for the post of Lecturer Chemistry (Group-A) (Subordinate Institutions) in the Department of Technical Education and Industrial Training, Government of Punjab will be as per the following details:-

Subject Matter	No. of Questions	Total Marks
Written Competitive Examination	120	480
Interview	-	60
Total Marks	-	540

The written competitive examination for the post will be scheduled soon.

6.2 PATTERN OF THE WRITTEN COMPETITIVE EXAMINATION

The pattern for written competitive examination comprising of 120 questions (@ 4 marks for each question) is as follows:

S.No.	Topic	No. of Questions	Marks (Each Question carries 4 marks)	Type of Questions
1.	Questions from the Subject (Part-A of Syllabus)	100	400	MCQs (Multiple Choice Questions)
2.	Questions from General Knowledge & Current Affairs, General Mental Ability, Logical Reasoning & Quantitative Aptitude. (Part-B of Syllabus)	20	80	
Total		120	480	

The important points to note:

- I. The Question Paper will be in English language only.**
- II. Each question carries 4(four) marks and, for each correct answer candidate will get 4 (four) marks.**
- III. There will be Negative Marking (One Mark for each question) in the written examination for questions wrongly answered i.e. for each in correct answer, 1(One) mark will be deducted from the total score.**
- IV. To answer a question, the candidate has to find, for each question, the correct answer/best option.**
- V. Answer key will be uploaded on the PPSC website (after written examination), and the candidates will be permitted to raise objections (if any). Candidates will be given four days to deliberate before putting up the objections.**
- VI. Unanswered/Unattempted questions will be given no marks. In case, a question is withdrawn, all candidates will be given four(04) marks irrespective of the fact whether the question has been attempted or not attempted by the candidate.**

General Information regarding 05 posts of Lecturer Chemistry (Group-A) (Subordinate Institutions) in the Department of Technical Education and Industrial Training, Government of Punjab in the year of 2022

ANNEXURE (VIII)

PART-A

1. Thermodynamics

- (i) Recall: Concepts involved in first and second law of thermodynamics, Entropy, free energy chemical equilibrium. Thermodynamic equation of state. Maxwell relations.
- (ii) Non-ideal systems: Excess functions for non-ideal systems. Activity and activity coefficient their determination. Concept of fugacity and its experimental determination. Partial molal properties and their determination.
- (iii) Third law of the thermodynamics: Identification of statistical and thermodynamic entropy. Nernst postulate, Plank's contribution. Alternate formulation of third law. Cooling by adiabatic and demagnetisation. Evaluation of absolute entropy.
- (iii) Thermodynamic and living systems: Simultaneous or coupled reactions. Coupled reactions and metabolism. Free energy utilisation in metabolism. Terminal oxidation chain. Overall metabolic plan. General thermodynamic consideration of living systems.

2. Electrochemistry

- (i) Ion-solvent interactions: Born model of ion-solvent interactions, Structural models of ion-solvent interactions. Experimental determination of salt-solvent interactions. Relative heats of solvation of ions in the hydrogen scale. Evaluation of ion-solvent interactions from experimental data of solvent interactions.
- (ii) Ion-ion interactions: Debye-Huckel theory of ion-ion interactions. Verification of Debye-Huckel limiting law. Activity, coefficients at moderate concentrations and higher concentrations Activity coefficients as a function of ion-ion and ion-solvent interactions. Mean activity coefficients and their experimental determination.
- (ii) Conductance and Ionic mobilities: Conductance of electrolytic solution. Variation of equivalent conductance with concentration. Debye Huckel Onsager theory. Modification of Debye-Huckel-Onsager equation. Ionic conductances. Ion-association and ion-pair formation. Ion-triplets in electrolyte solutions. Ion-triplets and conductance. Corrosion and its mechanism, electrochemical series.

3. AngularMomentum

postulates in quantum mechanics, nodes, probability density, and wavefunction for particle in 1D and 3D box, expectation values. Ordinary angular momentum, the quantum mechanical operators for angular momentum. Eigen function and Eigen values of angular momentum using ladder operators, addition of angular momentum.

4. Chemical Kinetics

- (i) Introduction: Rate of reaction, empirical rate-equation, order and molecularity of a reaction, effect of temperature on reaction rates. Kinetics of consecutive reactions, equilibrium reactions, oscillating reactions.
- (ii) Theories of reaction rates: Number of bimolecular collisions and derivation of rate constant from it, steric factor & its calculation, factors determining effectiveness of collisions, Lindemann mechanism, statistical derivation of rate

equation (Eyring equation), transmission co-efficient, tunnelling effect, partition functions for translation, rotation & vibration, comparison of collision and transition state theories.

- (iii) Fast reactions: Study of fast reactions by stopped flow technique, relaxation methods, magnetia resonance technique.

5. Nature of Bonding in Organic Molecules

- (i) Introduction to fullerenes
- (ii) Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's Rule, anti-aromaticity, homo-aromaticity, PMO - approach.
- (iii) Bonding weaker than Covalent: Addition compounds, Crown ether complexes and Cryptands, inclusion compounds, Cyclodextrins, Catenanes and rotaxane.

6. Techniques used for determination of reaction mechanism

(Non-kinetic method):

Use of optical, Stereochemical and isotopic techniques. Reaction studies from identification of products. Trapping of intermediate, crossover experiments use of Catalyst etc. use of isotopes in reaction mechanism studies in case of Favorskii, Claisen's and Benzyne reactions.

7. Elimination Reactions

- (i) E_2 , E_1 and E_1 CB mechanism, Stereochemistry Product ratio, Orientation of double bond, Hofman Rule, Saytzeff Rule. Factors Governing E_2 & E_1 Mechanism.
- (ii) Cyclic Elimination: Amine Oxide, Esters, Xanthate, and Free radical elimination. Dehalogeneration by zinc. Triple bond by elimination. Elimination versus substitution. Effect of solvent, temperature, Nature of Base, Structure of the reactants.
- (iii) Aromatic Elimination: Benzyne, Nucleophilic aromatic substitution, addition elimination.

8. Stereochemistry

Stereoisomerism: Introduction and different types of stereoisomers.

Fischer, Newman and saw horse representations for organic Molecules.

Optical Isomerism: Requirement for a compound to be optically active, compounds with one asymmetric centre. Dissymmetry as a cause of optical activity. Compounds with two asymmetric centres. Racemic Modification
 Racemisation: Thermal, anionic, cationic, free radical, epimerisation, Mutarotation
 Racemic compounds, mixtures and solid solutions.

9. Disastereoisomerism

Resolution of acids, bases, aminoacids, alcohols, aldehydes and ketones, Absolute and Relative configuration, Different systems of rotation. Assymmetric induction, methods of determining the configuration. Cram's Rule and Prelog's Rule.

10. Conformation Isomerism

Meaning of conformation, Conformation and reactivity in alicyclic compounds. Conformation and Physical properties, dipole moment, NMR, IR and X-rays, conformational effects on stability and reactivity. Ionic elimination. Intra molecular rearrangement, Neighbouring group participation. Elimination. Pyrolysis of acetate, Xanthates and amine oxide. Relation of conformation to reactivity.

Optical Isomerism due to restricted rotation in biphenyls allenes, Alkylidenes and spiranes.

11. Systems

Conformational studies in Cycloalkanes; mono and disubstituted Cycloalkanes. Its stability and reactivity. Energy determination in chair and boat form. Studies in fused systems. Decalins and Perhydrophenanthrenes.

12. Geometrical Isomerism

Nomenclature (E & Z) Nature of geometrical isomerism and determination of Configuration Curtin - Hammet Principle Study of Physical properties of the isomers, Relative stability and interconversion of Geometrical isomers.

13. Pi Bonding Ligand Complexes

Pi Acid Ligands CO as prototype, other pi acid ligands-isocyanide ligands, dinitrogen, the CS ligands, the NO ligands, pi acid ligands trivalent phosphorus compound, multiple bonds from ligands to metal, pi complexes of unsaturated organic molecules: alkene & alkyne, enyl ligands, aromatic ring systems.

Theories of Bonding in Transition Metal complexes - Qualitative Approach: Qualitative introduction to the molecular orbital theory, complexes with no pi bonding, complexes with pi-bonding, the crystal field & ligand field theories, orbital splitting and magnetic properties, the angular overlap model.

14. Structural and Thermodynamic Consequences of Partly Filled-shells

Ionic radii, Jahn-Teller effects, thermodynamic effects of d-orbital splitting, magnetic properties of chemical compounds, origin of magnetic behavior, magnetic susceptibility and types of magnetic behavior: diamagnetism, paramagnetism, ferromagnetism: types of paramagnetic behavior: Large multiplet separation, small multiplet separations, spin only, heavy atoms, high spin-low spin cross overs, coordination chemistry and its importance.

15. Spectral Properties

Russel - Saunder's term, selection rules, break down of selection rules, band widths & shapes, energy level diagrams and dd complex spectra, Orgel diagrams - weak fields, charge-transfer spectra. photochemical reactions of chromium & ruthenium complexes.

16. Bioinorganic Chemistry

Introduction, the biochemistry of Iron: iron storage and transport ferritin, transferrin, bacterial iron transport, hemoglobin and myoglobin, nature of the heme-dioxygen binding, model systems, cooperativity in hemoglobin cytochromes, other iron-porphyrin bimolecule peroxidases & catalases, cytochrome P₄₅₀ enzymes, other natural oxygen carriers hemerythrins, iron sulfur proteins. The biochemistry of other, metals: zinc, carboxypeptidase A, carbonic anhydrase, metallothioneins, copper, superoxide dismutase (CuZn SOD) hemocyanins, oxidases, cobalt, molybdenum & tungsten. nitrogenases, miscellaneous other elements: vanadium, chromium & nickel metal ions and chelates in chemotherapy, synthetic metal chelates as antimicrobial agents, lithium and mental health, gold and its compounds, metal complexes as antitumour agents, chelation therapy,

17. Chemistry of Main Group Elements

Hydrogen; transition metal hydrides, the group I- elements - organometallic compounds of alkali-metals, the group II-organo-beryllium and organo-magnesium compounds, the group, XIII-elements -structure and bonding of polyhedral boranes, structural study by NMR, Wade's rules, carboranes and other hetro-boranes, organoboron compounds, organoaluminium compounds, the group XIV-elements

compounds with C-N bonds, thiocarbonates, dithiocarbamates, zeolites, clays. The group XV elements-types of Covalence in nitrogen, stereochemistry, dinitrogen and nitrogen compounds as ligands, ammonia and amines phosphorus-nitrogen, compounds, group XVI elements- chemical properties of dioxygen, singlet oxygen, dioxygen superoxo and peroxo ligands peroxy compounds of boron, carbon, sulphur and sulphur- nitrogen compounds, sulphur- sulphur compounds as ligands, iso & heteropoly acids & anions of Mo and W. The group XVII elements the charge-transfer complexes of halogens, polyiodide anions, pseudohalogens, the group XVIII-elements-the chemistry of xenon, krypton and radon.

18. Electronic Structure of Atom

Electronic states of complex atoms, anti-symmetry and Pauli's exclusion principle, Hartree method, Russel Saunder's terms and coupling schemes, term separation energies for p^2 and d^2 configurations.

19. Molecular Orbital Theory

Huckel Theory of conjugated systems, bond order and charge density calculation, applications of Huckel molecular orbital theory to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene systems. Introduction to extended Huckel theory.

PART-B

General Knowledge, Logical Reasoning & Mental Ability

(a) General Knowledge & Current affairs

General Knowledge and Current affairs of National and International importance including:

- (i) Economic issues.
- (ii) Polity issues.
- (iii) Environment issues.
- (iv) Geography.
- (v) Science and Technology.
- (vi) Any other current issues.
- (vii) (a) History of India with special reference to Indian freedom struggle movement.
- (b) History of Punjab- 14th century onwards.

(b) Logical Reasoning, Mental Ability & Quantitative Aptitude.

- (i) Logical reasoning, analytical and mental ability.
- (ii) Basic numerical skills, numbers, magnitudes, percentage, numerical relation appreciation.
- (iii) Data analysis, Graphic presentation charts, tables, spreadsheets.