

**Detailed Syllabus for the post of LECTURER IN CHEMISTRY (Kerala
General Education (DIET)) - Direct Recruitment and By Transfer
Recruitment**

(Cat.Nos: 382/2022, 383/2022)

PART I - General Subject (50 Marks)

Module 1 : Community Engagement – Resources & Practices

Total: 10 Marks

Unit 1: Community Resources

Resources that enhance or facilitate the lives of people in a community - examples of community resources are factories, educational institutions, cinema halls, libraries, religious places, hospitals, community centers, parks, etc - make use of these resources in education as it develops a sense of value and belonging among students.

Unit 2: Community Engagement

Community Engagement in Education - and symbiotic relationship that exists between communities and Education Institutions - sustainable networks, partnerships, communication media, and activities - Linking formal learning and the local community

Unit 3: Forms of community engagement

Community-student engagement -Researching with the community, sharing knowledge with the community, Designing new curriculum and courses, Involving local practitioners as trainers, Social Innovation by students and the like

Unit 4: Practices for Community engagement

Engagement practices and activities - formal or informal - include building relationships through collaboration initiatives, community campaigns, [Community Survey](#), [Community services](#), [Excursions](#), cooperatives, small businesses, consultation meetings & conferences, sports events, cultural events, community development and community research projects.

Unit 5: Rural Community Development

Social, economic, political and cultural framework of the rural society - Rural Resilience -

Rural Institutions Close to Community, Participatory Learning - Approaches and Methods, Community Project Proposals and Project Management, Community living camps, Engagement with - School, Street Committee, Health Centre, Panchayat, SHGs - Programmes

Module II : Syllabus for General Subject - ICT in Education

Total: 10 Marks

Unit 1: Potentials of ICT in Education

ICT as a means to connect with the world – Pedagogy and ICT – Potentials and Advantages of Approaches to ICT

Unit 2: ICT integration in Curriculum transaction

Computer based Curricular planning- ICT Based Model of Curriculum Transaction - Considerations for integrating ICT – Innovations in Curriculum Transaction

Unit 3: ICT and Internet Resources for Teaching and Learning

Resources – Access and Creation, resource mobilization – Web-based learning, Social Networking –Virtual learning Environment - Designing e-initiatives

Unit 4: ICT in Classrooms

Creating Personal learning environments - ICT integrated Inclusive education - Assistive and Adaptive technologies

Unit 5: ICT for Assessment and Evaluation

Purposes and Techniques of Evaluation, Scope of ICT for evaluation- Innovative Practices in Assessment & Evaluation

Module 3 : PERSPECTIVES OF EDUCATION (10 Marks)

PHILOSOPHICAL PSYCHOLOGICAL AND SOCIOLOGICAL PERSPECTIVES OF EDUCATION

Philosophical perspectives of Education

Role of education in philosophizing the issues of life –Metaphysics, Epistemology, Logic, Phenomenology, Aesthetics and Axiology. Critical appraisal of schools of

philosophy in the context of Twenty First Century – aims, content, methods and ongoing changes.

Focus of education in the 21st century. Building perspectives on educational philosophies, Modern schools of Philosophy-Empiricism, Positivism, Relativism.- Post -structuralist views and eclectic views. Comparative study of philosophies and educational contributions of Indian and western thinkers

Psychological perspectives of education

Learning and development- Learner Characteristics and Learning styles with special reference to pre- primary, primary, secondary, higher secondary and adult learners Learning in twenty first century classrooms., Characteristics And types, Development – language development, emotional, moral, motor and identity development. Cognitive Functions- Thinking, Reasoning, Problem Solving and Meta-cognition, Personality- types characteristics and development

Intelligence-different types~ Multiple, Cultural, social and emotional, impact on learners. Mental Health-, Factors affecting Mental Health (parents, family environment, society, school practices) - Strategies for enhancing Mental health

Sociological perspectives of education

Education for social security, wellness and progress, sustenance and transformation in society. Determinants of social change in the context of globalization.-Constraints on social change in India with respect to caste, ethnicity, class, language, religion, gender, regionalism, political interest

Education and Secularism - Role of teacher in inculcating democracy and international values.- Pluralism – Role of education in creating unity in diversity- Nationalism and education.-Role of Education in addressing cultural lag, privatization, globalization and partnership in social progress – Current trends in social development and transformation of values in society.

Module 4 : Teaching aptitude (10 Marks)

Teaching aptitude.

- Teaching -characteristics, levels, phases and maxims
- teaching methods, techniques and strategies
- modern trends in professional development and ethics

- technology integration in education
- Research, evaluation and innovations in classroom teaching, -

Module 5 : Research Aptitude (10 Marks)

- Research Meaning, Characteristics and Types
- Steps to Research
- Methods of Research
- Aims of Educational Research
- Research Ethics
- Research paper, Article, Workshop, Seminar, Conference and Symposium
- **Thesis writings – its characteristics and Format**

PART II

MODULE - I

Inorganic Chemistry-1

Marks 7

- **Atomic Structure-** Dual nature of electron-de Broglie equation- Wave mechanical concept of the atom-Schrodinger- Chemical periodicity- Chemistry of Hydrogen and s block elements- Chemistry of p block elements and d block elements. Structure and bonding in boranes, carboranes, silicones, silicates, boron nitride, Borazines and Phosphazenes. Allotropes of Carbon, Phosphorous and Sulphur. Acid-base concepts and principles (Lewis, Brønsted, HSAB and acid-base catalysis).
- **Solid State Chemistry:** Crystal symmetry- Point groups and space groups. Miller indices and Bravais Lattices- Close packed structures: BCC, FCC and HCP. Voids. Coordination number. -X-ray diffraction by crystals: Applications and calculations using Bragg's equation and indexing methods. Defects in stoichiometric and non-stoichiometric defects and consequences, Electronic structure of solids. Different theories about conductors, insulators and semiconductors and their applications. Structures of AX, AX, ABX₃, Spinel and Inverse spinel structures. Structure and theories of Liquids- Liquid crystals and their applications.
- **Chemical Bonding-** VSEPR theory and its applications-valence bond theory-MO theory-Metallic bonding- free energy theory, VB theory and band theory- Theories of

metal complexes- Werner's theory - Crystal field theory –Ligand field theory – Molecular orbital theory- Stereochemistry of coordination compounds-Jahn Teller distortion- Detailed study of Stability and reactions of metal complexes- Electron transfer, Substitution and Photochemical reactions and their kinetics. Spectral and magnetic properties of complexes

- **Coordination Chemistry-** Structure and isomerism, Theories of bonding- VBT, CFT and MOT, Energy level diagrams in various crystal fields, CFSE, Applications of CFT, Jahn- Teller distortion, Electronic spectra of transition metal complexes- Spectroscopic term symbols, selection rules, Orgel diagram and Tanabe- Sugano diagrams, Racah parameters and Nephelauxetic effect, charge transfer spectra, Magnetic properties of transition metal complexes.

MODULE –II

Inorganic Chemistry- 2

Marks 8

- **Organometallics-** 18- Electron rule, Metal alkyl, metal carbonyl, metal olefin and metal carbene complexes and metallocenes, Fischer carbene/ Schrock carbene, Clusters, Organometallic complexes as main group compounds, Reaction mechanisms of organometallic compounds (Oxidative addition, Reductive elimination, Migratory Insertion, Beta Hydride elimination, Agostic Interaction), Coupling reactions- Heck, Negishi, Sonagashira, Kumada, Stille coupling and Suzuki coupling- Use of various organic, inorganic and organometallic reagents in organic synthesis- Grignard reagents, Alkyl lithiums, Lithium Dialkylcuprates, Alkynyl copper reagents, Tebbe reagent etc. Homogeneous catalysis- Hydrogenation, Hydroformylation, acetic acid synthesis, metathesis and olefin oxidation. Heterogeneous catalysis- Fischer Tropsch reaction, Ziegler Natta polymerization.
- **Spectroscopic Methods in Inorganic Chemistry-** Structural elucidation of coordination compounds containing the following molecules/ ions as ligands- N, H₂O, CO, NO, OH⁻, SO₄²⁻, CN⁻, SCN⁻, NO⁺, CH₃COO⁻ and X⁻ (X=halogen), changes in ligand vibration on coordination with metal ions.- CD and ORD spectra of metal complexes- NMR of metal nuclides with emphasis on ¹¹B, ³¹P and ¹⁹F NMR.- ESR spectra: Application to Cu(II) complexes and inorganic free radicals such as PH₄, F⁻ and [BH]⁻.

- **Analytical Chemistry:** Chromatography, HPLC principle and applications, Thermal analysis – different thermal analysis (DTA), Thermo Gravimetric Analysis (TGA) and DSC Principle and application. Chemical crystallography – Diffraction methods – X ray Neutron, electron diffraction methods. Principle and applications, Polarimetry – Circular dichroism – Optical Rotatory dispersion (ORD) Principle and applications.

MODULE III

Organic Chemistry 1

Marks 7

- Nomenclature of organic compounds, Basic concepts of Organic reactions - Electron displacement effects (Inductive, Electromeric, Mesomeric and Hyper conjugative effects) – Aromaticity and antiaromaticity, Aromaticity of annulenes, mesoionic compounds, metallocenes, cyclic carbocations and carbanions. Mechanism and applications of common substitution, addition, elimination and rearrangement reactions.
- Stereochemistry and factors affecting Aliphatic and Aromatic SN1 and SN2 reactions. SN1', SN2', SNi, SNAr and benzyne mechanisms – NGP and Non-classical carbocations- Generation and reactions of Nitrenes, Carbenes and free radicals like Triphenyl methyl, TEMPO, Dibenzoyl peroxide, NBS , Tributyl Tinhydride and AIBN. - Chlorination of alkane, addition of HX, SRN1 mechanism- Acyloin condensation, Alkyne coupling reactions- Reimer-Tiemann, Vilsmeier-Haack reactions. Mitsunobu reaction and Chichibabin reactions.
- Mechanism of Addition of H₂O, X₂, HX, and boranes to C=C systems- Cis and trans hydroxylation of cycloalkenes- Mechanism and applications of Michael addition and Robinson Annulation- Aldol condensation- Stork enamine, Cannizzaro, Perkin, Ritter, Stobbe, Knoevenagel, Darzen, Reformatsky and benzoin condensations- Grignard, Mannich, Thorpe reactions and Dieckmann condensation
- Oxidation and Reduction reactions in organic synthesis- Reduction using boranes, hindered boranes and derivatives- NaBH₄, and LiAlH₄, DIBAL-H, tri-n-butyltin hydride, diimide, and aluminium alkoxide. Birch reduction, Clemmensen reduction and Wolff - Kishner reduction, Huang - Minlon modification, Rosenmund reduction - allylic and benzylic oxidation, Sharpless epoxidation, oxidation using SeO₂, manganese (IV) oxide, lead tetraacetate, ozone, peracids, DDQ, silver carbonate and

Cr(VI) reagents. Jones oxidation, Swern oxidation, Moffatt oxidation, Sommelet reaction. Applications of HIO_4 , OsO_4 and mCPBA

MODULE IV

Organic Chemistry 2

Marks 8

- **Stereochemistry**- Chirality and symmetry of organic molecules with or without chiral centres and determination of their absolute configurations. Relative stereochemistry in compounds having more than one stereogenic centre. Homotopic, enantiotopic and diastereotopic atoms, groups and faces. Stereoselective and stereospecific synthesis. Conformational analysis of acyclic and cyclic compounds. Geometrical isomerism and optical isomerism. Configurational and conformational effects, atropisomerism, and neighbouring group participation on reactivity and selectivity/specificity.
- **Organic synthesis**- Retrosynthesis, disconnection, synthons, linear and convergent synthesis, Atom economy and green chemistry, Umpolung of reactivity, protection and deprotection of functional groups.
- **Heterocyclic Compounds**: Structure, preparation, properties and reactions of furan, pyrrole, thiophene, pyridine, indole, quinoline and isoquinoline.
- **Pericyclic Reactions and Photochemistry**: Electrocyclic, cycloaddition and sigmatropic reactions. Orbital correlations – FMO and PMO treatments, Woodward-Hoffmann rule. Photochemistry of alkenes, arenes and carbonyl compounds. Photo oxidation and photoreduction. Di- π -methane rearrangement, Barton-McCombie reaction, Norrish type-I and II cleavage reaction.
- **Spectroscopic methods in Organic chemistry**- Applications of UV, IR, $^1\text{H-NMR}$, $^{13}\text{C-NMR}$ and Mass Spectroscopy - 2D NMR techniques - NOE, DEPT, and 2D techniques such as COSY-HSQC, HMQC and HMBC. Spectral interpretation and structural elucidation. Solving of structural problems on the basis of numerical and spectrum based data. ORD and CD - theory and applications.

MODULE V

Physical Chemistry 1

Marks 7

- **Electrochemistry**- Redox potential, electrochemical series, redox indicators. Kohlrausch's law of independent migration of ions. Transport number and its determination, Hydrolysis of salts, pH and buffer solutions, type of single electrodes

and electrode potentials, concentration cell with and without transference, liquid junction potential, Corrosion, Anodic and Cathodic protection, H₂- O₂ fuel cell.

- **Chemical Kinetics and Catalysis** : Differential and integral rate equations for zero, first, second and third order reactions, Half-life period, Kinetics of first order opposing, consecutive and parallel reactions, Effects of temperature on reaction rate, energy of activation and collision theory of bimolecular gaseous reactions. Steady-State approximation, Lindemann's theory of reaction rates. Thermodynamic formulation of rate constant, comparison of collision and absolute reaction rate theory, calculation of transmission co-efficient, Primary and Secondary salt effects, kinetics of homogeneous, acid -base and enzyme catalysis, heterogeneous catalysis.
- **Surface chemistry**- Physisorption and chemisorption. Langmuir, Freundlich and Brunauer–Emmett–Teller (BET) isotherms. Surface catalysis: Langmuir-Hinshelwood mechanism. Surface tension, viscosity, Self-assembly, Physical chemistry of colloids, micelles and macromolecules.

MODULE VI

Physical Chemistry 2

Marks 8

- **Thermodynamics:** Laws of Thermodynamics - Entropy and its dependence on variables of a system-Equation of state- Euler's relation, Gibbs and Helmholtz equations and energies. Maxwell's relations- Gibbs Duhem equation- Partial Molar Quantities- Chemical potential- Fugacity- Activity coefficients. Thermodynamics of Solutions – Duhem Marghules equation- Vant Hoff's equations, isochore and isotherm. Chemical Equilibrium- Le Chatlier principle, Homogeneous and Heterogeneous systems. Spontaneity of reactions. Free energy functions.
- Ideal and Non-ideal solutions, Raoult's Law and Henry's Law, Colligative properties, Chemical equilibria. Dependence of equilibrium constant on temperature and pressure, Ionic mobility and conductivity. Debye-Hückel limiting law, Debye-Hückel-Onsager equation, Potentiometric and conductometric titrations. Phase rule, Clausius-Clapeyron equation. Phase diagram of one component systems: CO₂, H₂O, S; two component systems: liquid- vapour, liquid-liquid and solid-liquid systems. Fractional distillation, Azeotropes and eutectics.
- Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.

Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.

- **Computational Chemistry** - Computational methods : ab initio, Semi Empirical methods - Molecular Mechanics Quantum statistics- Bose-Einstein statistics, Thermodynamic probability- Maxwell Boltzmann, Bose Einstein and Fermi-Dirac statistics- Quantum theory of heat capacity - calculation of heat capacity of gases- Dulong and Petit's law, Kopp's law; limitations.- Einstein theory and Debye theory of heat capacity Symmetry elements and symmetry operation.

MODULE VII

Advanced Chemistry

Marks 5

- **Green Chemistry & Environmental Chemistry:** Twelve principles of green chemistry and issues in sustainable chemistry, Green reagents and solvents, Green reactions, Biocatalysis. Chemistry of Atmosphere, Hydrosphere and Lithosphere, Chemical processes in atmosphere, Acid- base properties, BOD and COD.
- **Nanostructures** - 1D, 2D and 3D structures - Synthesis and applications of nanomaterials.
- **Polymers-** Types of polymerisation, Change in physical and chemical properties, Synthetic polymers- Polyethylene, Polypropylene, PVC, Teflon, Bakelite, Nylon 6 and Nylon 66, High temperature polymers and degradation of polymers.
- **Supramolecular chemistry** - Molecular recognition: Synthetic Receptors, Cyclodextrin, Calixiranes, Cyclophanes, Crown Ethers- Drug design and Drug action.
- **Medicinal Chemistry:** Introduction to drug discovery and design, drug administration, LD 50 and IC50 values, Drug action – pharmacokinetic and pharmacodynamics phases, Classification of drugs, Antibiotics and analgesics with examples. Drug stability, Composition and structural features of lipids, Introduction to enzyme and coenzyme chemistry.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.