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UNIVERSITY OF LADAKH

OFFICE OF THE REGISTRAR, LEH

(Administrative Building, Melongthang, Leh)

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Syllabus/ Scheme of Examination for direct Recruitment for Technical Assistant (Geology/Chemistry) (Non-Gazetted posts).

There will be OMR based written examination consisting of objective type multiple choice questions, for the posts with minimum educational qualification, PG Level. The details of subjects, marks, and number of questions subject-wise will be as given below: -

Sr.No.	Subject	No. of Questions/ Maximum Marks	Total Duration
1.	Geology	100	1 hour & 30 Minutes (1 hour & 50 minutes for candidates eligible for scribes)
2.	Chemistry	100	1 hour & 30 Minutes (1 hour & 50 minutes for candidates eligible for scribes)

Important Notes: -

I. There will be negative marking of 0.25 marks (out of Maximum 1 mark per question) for each wrong answer.

II. The medium for examination will be English.

III. The competent authority shall have the discretion to fix minimum qualifying score taking into consideration, category-wise vacancies, and category-wise number of candidates.

IV. Tentative Answer keys will be placed on the University of Ladakh website after the examination.

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Syllabus for Technical Assistant (Geology) (PG Level):

Origin and abundance of elements

Origin and abundance of elements in the solar system and in the Earth Geochemistry of atmosphere, hydrosphere and lithosphere. Geochemical classification of elements. Properties of LILE, HFSE and Rare Earth Elements. Types of bonding of atoms of elements in minerals. Chemical composition and unit cell content.

Mineralogy

Principles of ionic substitution in minerals. Isomorphism.Solid solution and different types of polymorphic transformations. Silicate structure. Phase diagram. Development of intergrowths, zoning and twinning. Crystallography and elements of symmetry. Mineral Optics: Behaviour of light in isotropic, uniaxial and biaxial crystals, study of crystal under parallel and convergent polarised light, Interference figures. Universal stage. Introduction to spectroscopic study of minerals.Application of X-ray, Diffraction, EPMA and SEM-EDX.Calculation of mineral formula from chemical analysis.

Nature, Origin, and Classification of Igneous Rock

Classification Schemes: Irvine- Baragar Classification, QAPF Classification for volcanic and plutonic rocks, Concept of Norm and Mode in Igneous rocks. Granites, Pegmatites, Alkaline rocks, Anorthosites, Lamprophyres, Ultramafic and layered rocks, Carbonatites, Kimberlites, and Lunar rocks.

Igneous Processes

Crystallization of magma and their evolution through phase diagrams (binary and ternary system)

Partial melting, fractional crystallization, contamination and assimilation. Geochemical characteristics of igneous rocks as Petrogenetic indicators. Isotope systematic of K-Ar, Rb-Sr, Sm-Nd, U-Th-Pb in igneous rocks Geological controls and application of major, trace and rare earth elements in petrogenesis. Quantitative approach to partial melting and fractional crystallization using different types of trace elements. Concept of mantle metasomatism and role of fluids in magma generation. Magmatism in Global Tectonic Scenario.Magmatism in (a) Constructive Plate Margins, (b) Destructive Plate Margins, (c) Within Plate Magmatism. Archaean& Proterozoic Crustal Evolution. TTG Suites and their significance.

Sedimentary Rocks: Texture, composition and structure

Nature and origin of sedimentary rocks composition and classification Earth surface processes.

Sedimentary structures and their genetic significance. Biogenic structures. Diagenesis. Palaeocurrent analysis.

Classification of siliciclastic rocks

Classification of conglomerates, sandstones and shales. Texture of sediments, provenance and their deductions from composition of sedimentary rocks, Sediment transport in different systems.

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Non Marine Sedimentary Environment

Concepts of sedimentary environment Environmental parameters and controls. Classification of environments, Glacial environment, Alluvial environment (Braided, Meandering), Aeolian Environment. Deltaic models (Fluvial, wave), coastal (interdeltaic) model – barrier islands and lagoons, tidal channels, tidal deltas and Estuaries.

Marine Sedimentary Environment

Marginal marine and neritic environment.

Deep marine sedimentation: Slope and Basin-floor fans (Point and Line source). Carbonate sedimentation model. Geometry of carbonate platforms; ramp, rimmed shelves, isolated platform, reefs.Cyclic sediments: allokinetic and autokinetic controls, turbidites and Bouma sequence

facies model and environmental reconstruction. Role of environmental analysis in petroleum exploration.

Introduction to Rock Mechanics

Stress at a point in a solid body: 3-D stress tensor; Homogeneous and heterogeneous stress: stress functions. Mohr diagrams for stress and strain and their use. Behaviour of rocks under stress: elastic, plastic, viscous and visco-elastic responses and their geological significance. Mechanics of rock fracturing: fracture initiation and propagation. Coulomb's criterion and Griffith's theory; Crack linkage and their importance. Effect of strength anisotropy on fracturing; Role of fluid in rock fracturing.

Deformational Structures

Concept of deformation: distortion, rotation, dilatation etc. Analysis of homogeneous deformation: strain ellipses of different types and their geological significance. Petrofabric analysis and diagrams. Concept of stress-strain compatibility.

Geological structures

Folds, fold interference and superposed folds. Strain distribution in a folded layer and its significance. Evolution of axial planar and transacted cleavages with folds, fold-related lineations, Constructions of folds. Faults and Joints: Mechanics of faulting: Anderson's theory and its limitations. Complex geometry of normal, strike slip and thrust faults with natural examples. Palaeostress analysis using fault-slip data.

Shear zone and Structural analysis

Ductile Shear Zones & their significance in continental crustal evolution and metallogeny Shear/fault zone rocks: mylonite, cataclasite and pseudotachylyte. Kinematics of flow in a shear zone. Microstructures associated with Shear zones. Dislocation and diffusion creep, strain hardening and softening mechanisms, lattice preferred orientation and superplasticity. Crustal deformation: Deformation behaviour of quartzo-feldspathic rocks. Brittle-plastic transition and seismic behaviour of the upper crust.

Fundamentals of Metamorphic Processes

Nature and scope of metamorphism. Types of metamorphism. Metamorphic textures. Fundamentals of thermodynamics. Nucleation and crystal growth in metamorphism. Metamorphic paragenesis.

Compositional Plots and Projective analysis

Construction and interpretation of ACF, AKF and AFM diagrams. Schrienmaker's rule and construction of petrogenetic grid. Compositional Space, P-T diagrams, Psuedosections.

Concept of Facies

Advantages and limitations of Metamorphicfacies classification. Mineralogical changes during progressive metamorphism of pelitic, calcareous and mafic rocks Control of bulk composition on metamorphic assemblages. Role of fluids in metamorphism. Metasomatism, Granitization, Migmatities, Paired Metamorphic zones,Inverted Metamorphic sequences.

Tectonics and Metamorphism

Orogenic processes and metamorphism. Relationship between deformation and metamorphism. Global Tectonic Context of Metamorphism Ultra-high temperature and Ultra-high pressure metamorphism. Time-scales of metamorphism and implications on thermal history of the crust. Metamorphic differentiation, geothermobarometery, compositional zoning and P-T-t paths, and their tectonic significance.

Principles of Remote Sensing and GIS

Introduction, Energy Sources and Radiation Principles, Energy Interactions in the Atmosphere , Energy Interactions with Earth Surface Features, Data Acquisition and Digital Image Concepts, The Global Positioning System and Other Global Navigation Satellite Systems, Characteristics of Remote Sensing. Geographical Information System (GIS): Introduction and Definitions Technology and concepts; Components of GIS; Developments in GIS

Elements Basic Principles of Photogrammetry

Development in aerial photography. Geometry and types of aerial photographs. Scale of photographs. Types of aerial cameras, films, and filters. Panchromatic, colour and infra-red films. Multiband photography. Tilt and height displacement. Vertical exaggeration, Elements of photo interpretation: tone, texture, pattern, drainage and lineaments. Spectral signatures. Land forms. Structural and lithological interpretation.

Digital Image Analysis

Pre-processing of Images, Image Enhancement, Contrast Manipulation, Spatial Feature Manipulation and Multi-Image Manipulation, Image Classification: Supervised Classification, Unsupervised Classification and Hybrid Classification

Applications of Remote Sensing

Land Use/Land Cover Mapping, Geologic and Soil Mapping, Agricultural Applications, Forestry Applications, Rangeland Applications Water, Resource Applications, Snow and Ice Applications, Environmental Assessment and Protection, Natural Disaster Assessment, Principles of Landform Identification and Evaluation.

Fundamentals of Ore Geology

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Ore Minerals: Development of ore minerals in open space and polycrystalline aggregates. Endogenous, Exogenous processes and Transformation Processes of Ore formation. Crustal evolution and metallogenesis. Metallogenic epochs and provinces.

Ore microscopy

Introduction to ore microscopy. Optical properties of ore minerals. Ore texture and structure. Fluid inclusions and their applications.

Petrological Ore Association

Petrological ore association-consideration with reference to distinct ore types,Ore associated with ultramafic and related mafic plutonic rocks: Sudbury-type Fe-Ni-Cu sulphides, apatite rich and Ti-V bearing migmatites, Fe-Ti oxides and anorthosites. Ores associated with felsic plutonic rock: porphyry deposit of Cu, Mo, Greisen &Skarn deposit of W and Sn, Various Pegmatoiddeposit,IOCG deposits. Ores associated with acid/mafic volcanic rocks, including those in greenstone belts: Kambalda type, Kuroko type and Cyprus Types of ores. Stratabound ore deposit associated with nonvolcanic, Meta Sedimentary rocks, Kupferschiefer, Rhodesia Katanga, Broken Hill. McArthur, Mississippi valley type, Witwatersrand type, Bog iron manganese ores ironstone, Banded iron formation. Manganeseores: Orthoquartzite-clay association, Jaspillite and volcanic association, metamorphosed manganese ores. Colorado Plateau type U-V ores,Surficial deposits.

Lateritoid and Karst deposit of Fe, Mn, Al, and Ni. Placer deposit of Gold, Tin, Tungsten, monazite. Oxidation and supergene enrichment, sulphide enrichment. Ocean floor deposit of Mn, Ni-Cu-Co.

Indian Mineral Deposits: Occurrence and Distribution.

Coal Geology

Coal and its properties Different varieties and ranks of coal. Origin of coal. Type of depositional processes. Coalification process and its causes. Sediments closely associated with coal (coal balls, tonsteins, seat-earths, under-clays, fire-clays and soils). Coal Petrography: Lithotypes, microlithotypes and macerals: their physical, chemical and optical properties. Applications of coal petrography. Maceral analysis of coal: Mineral and organic matter in coal. Proximate and ultimate analyses. Industrial evaluation of coal characteristics with reference to coal classification. Methods of coal prospecting and estimation of coal reserves. Geology and coal petrography of different coalfields of India. Uses of coal for various industries e.g. carbonization, liquefaction, power generation, gasification and coal-bed methane production.

Petroleum Geology

Origin of petroleum. Petroleum: its different states of natural occurrence. Basic concepts of petroleum geochemistry.Maturation of kerogen; Biogenic and Thermal effect. Distribution of Petroleum in space and time. Introduction to migration of oil and gas: geologic framework of migration, short and long distance migration, primary and secondary migration, geologic factors controlling hydrocarbon migration, forces responsible for migration, migration routes and barriers.

Reservoir Studies

Reservoir rocks: general attributes and petrophysical properties. Classification & Characterization of reservoir rocks - Clastic and Carbonate reservoirs. Hydrocarbon traps:

definition, classification of hydrocarbon traps - structural, stratigraphic and combination, time of trap formation and time of hydrocarbon accumulation. Cap rocks - definition and general properties. Oil field water- characters and classifications. Petroleum Geology of important Indian basins. Introduction to oil and gas exploration.

Coal Bed Methane and Gas Hydrates

Coal bed methane: Biogenic and thermogenic methane, Coal bed methane generation and accumulation. Geological and petrographic influences on coal, Pore geometry, Micropore, Mesopore and macropore and cleat system. Sorption – principles, sorption isotherms – types and interpretation. CO_2, CH_4 and N_2 adsorption – desorption, hysteresis, Langmuir isotherm. Carbon dioxide sequestration. Swelling of coal matrix isotherm construction. CH_4 content determination in coal seams. Potential coal bed basins and production, hydraulic fracturing of coal seams. CBM exploration. Non-conventional fossil fuels: Underground Coal gasification, shale gas, Gas Hydrates.

Fundamentals of Hydrogeology

Origin of Water, Hydrologic cycle and its components. Surface water and groundwater interaction.

Classification of aquifers. Hydrological properties of rocks - specific yield, specific retention, porosity, hydraulic conductivity, transmissivity, storage coefficient.Darcy's law and flow in continuous media, Dupuit's equation. Unconfined, confined, steady, unsteady and radial flow conditions. Pumping tests. Flow nets. Water table fluctuations - causative factors, concept of barometric and tidal efficiencies.Evaluation of aquifer parameters using Thiem, Thesis, Jacob and Walton methods. Theory of groundwater flow, Bernoulli's equation and its applications. Hydraulic head.Potentiometric surface and potential surface.

Groundwater Exploration

Geological, Meterological and Geophysical methods. Application of remote sensing in ground water exploration. Hydrogeomorphic mapping. Types of wells. Well development and design.

Groundwater quality: physical and chemical properties of water, Hill and Piper and Durov diagrams and Chebotareb sequence.

Application of Hydrology

Rain water harvesting and Artificial recharge methods. Groundwater contamination and saline water intrusion (Ghyben-Herzberg Principle) in coastal and other aquifers and its prevention. Ground water problems and management related to mining, foundation work of canals, tunnels. Problems of over-exploitation. Conjunctive use of ground water and surface water. Hydrogeology of arid Zones of India. Ground water provinces of India - their aquifer characteristics.

Applications

Deciphering of hydro-geological boundaries on water table contour maps. Groundwater quality study using Trilinear (Hill-Piper), C-S diagrams etc. Problems on radial flow to a well in confined and unconfined aquifers. Exercises on step drawdown test. Determination of aquifer parameters using Theis and Jacob's methods. Calculation of salt water encroachment in coastal aquifers.

Electrical resistivity surveys for aquifer delineation.Analysis of Hydrographs.

Introduction to Geophysical Methods

Geophysical Properties of Earth and its layers. Gravity method: Basis for gravity exploration,

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concept of geoid, international gravity formula, unit of gravity. Gravimeters: Spring-mass system as basic gravimeters, principles of working of unstable gravimeters, zero length spring, La-Coste-Romberg and Worden gravimeters. Corrections of Gravity anomaly. Gravity effect due to buried sphere, use of gravity survey in buried high density mineral deposits. Seismic Method:Generation and propagation of seismic waves, seismic energy sources, geometry of refraction and reflection, interpretation of travel time curves for two layered earth,horizontal and dipping interface, field procedure-profile and broad side shooting, fan shooting, end on and split spread arrangements. Principles of Seismometry, Seismograms as signals, Earthquakes and source theory: Green's function and the moment tensor, Earthquake faults, radiation pattern and beach balls, Stress drop, earthquake b-value, Finite slip model, the heat flow paradox, Seismology and Tectonics. Continental tectonics and intraplate earthquakes. Magnetic method: Magnetic susceptibility of rocks and their ranges, elements of earth magnetic field; Magnetometers: Fluxgate and Proton Precession Magnetometers Diurnal Correction; Magnetic effect due to isolated pole.
Resistivity Method: Resistivities of common rocks and minerals, True and apparent resistivity, Electrode configurations-Schlumberger and Wenner, Electrical profiling and Vertical Electrical Sounding,Interpretation of two layered VES curves.

Geodynamics and strain in Rocks

Strain analysis: Kinematics, Pure and Simple Shear deformation. Kinematic vorticity. Strain distributions in the crust: Strain associated with folds, thrust, cleavage and shear zones. Strain ellipse and its classification. Geological structures in $\lambda 1$- $\lambda 2$-$\lambda 3$ space. Deformation of the crust in tectonic and strain domains. Lithosphere and asthenosphere. Detailed structures of core, mantle and crust, including their geophysical properties and composition. Isostasy and gravity anomalies.

Plate Tectonics

Introduction to plate tectonics and earlier hypotheses of orogenesis, continental drift, Palaeomagnetic evidences and sea-floor spreading. Diastrophism: Epeiorogeny and Orogeny. Stages in the evolution of ocean basins. Wilson Cycle. Plate geometry and Triple junctions. Different types of continental margins and their characters. Plates in velocity space. Spherical coordinates and reference frame. Cartesian coordinates. Finding Euler's pole. Velocity due to rotation about an Euler's pole. Angular velocity vectors. Mechanisms of plate motion: mantle plume model, convection model, viscous drag and buoyancy model. Different types of tectonic settings: extensional, compressional and strike-slip. Transpressional and Transtensional tectonics: Indian and global examples. Configuration of the Indian plate and origin of the Himalayas. Orogeny through time: Global orogeny and their origin. How correct is the theory of plate tectonics? Introduction to Neotectonics and active tectonics.

Basic stream hydrology

Physical properties of water, sediment and channel flow, River discharge, River hydrographs (UH, IUH, SUH, GIUH) and its application in hydrological analysis, Flood frequency analysis.

River Basin Analysis

River basin: Sediment source and catchment erosion processes, Sediment load and sediment yield, Sediment transport process in rivers, Erosion and sedimentation processes in channel. Drainage network, Quantitative analysis of network organization – Slope analysis, morphometry, Random Topology (RT) model and fractal analysis, Role of drainage network in flux transfer, Evolution of drainage network in geological time scale.

River Diversity

River diversity in space patterns of alluvial rivers - braided, meandering and branching channels.

Dynamics of alluvial rivers, Channel patterns in stratigraphic sequences. Different classification approaches in fluvial geomorphology and its applications. River linking projects case studies.

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Neotectonics and Stream Flow

Bedrock channels, Bedrock incision process, River response to climate, tectonics and human disturbance, Bedrock channel processes and evolution of fluvial landscapes. Fluvial hazards, integrated approach to stream management, Introduction to river ecology.Techniques of artificial stream modification for the control of water flow, mitigation of floods and erosion.

Fundamentals of Isotope Geology

Fundamentals of radioactivity, Stable and radiogenic isotopes. Nuclear structure, atomic weights, nuclear stability and abundance. Theory and mechanism of decay. Abundances of unstable nuclides in earth, core, mantle, crust, oceans and different rock types and their decay schemes. Radioactive elements as major elements, minor elements and trace elements and their geochemical behaviour.

Isotopic Analysis

Mass spectrometer: Instrumentation, chemical separation, isotope dilution and ratio analysis. Methods of dating: Isochron method, model/mineral ages, concordia–discordia method. Fission track, ^{40}Ar-^{39}Ar, U and Th disequilibrium. Application of ^{14}C, Be and Al isotopes. Isotope systematics of K-Ar, Rb-Sr, Sm-Nd, U-Th-Pb in petrological applications. Interpretation and geological significance of ages.

Stable Isotopes

Stable isotopes of oxygen and hydrogen, carbon, nitrogen and sulphur. Fractionation of stable isotopes in lithosphere, hydrosphere and atmosphere. Stable isotope geothermometry and geobarometry. Environmental, sedimentological and chemostratigraphic studies using stable isotopes systematics.

Applied Isotope Geology

Isotopes in mineral exploration. Petroleum exploration, Paleo-climate evaluation, health and environmental aspects. Introduction to software: ISOPLOT etc. Case study, data analysis and interpretation.

Geological Prospecting and Exploration

Introduction and methods of prospecting and exploration.

Sampling: theory and methods; Geological plans and sections for ore body evaluation; Exploration drilling, drill core logging and sampling. Cut-off grade concepts and applications; Resources and Reserves. Estimation of reserves – methods and practice.

Geochemical Exploration

Geochemical cycle, geochemical mobility and association of elements. Pathfinder and target elements for geochemical exploration. Primary and secondary dispersions of elements.Determination of background, and geochemical anomalies. Application of Geomorphological, remote sensing techniques, Geobotanical and Geophysical methods. Geostatistical techniques in Mineral Exploration. Indian case studies.

Introduction to mining

Elements of mining, definitions and explanation of different mining terms. Introduction and classification of opencast mining, stripping ratio, bench heights and haulway design. Introduction to underground mining, room and pillar method, Longwall method, cut and fill method.

Mineral Economics

Classifications of mineral resources– UNFC,JORC, IMM, SAMERC and ISP schemes.National Mineral Policy and National Mineral exploration Policy.NELP. World resources of minerals and production of important mineral. Concepts of Strategic Minerals. Monopolies and Cartel, Trade restriction and production incentives. Basic pattern of Mineral economy and changing mineral requirements. Marine mineral resources and Law of Sea. Exclusive economic Zones.

Unit I: Introduction to Environmental Geology

Changes in the environment caused by geological activities of man. Inorganic and organic contaminants. Drinking water standards. Surface and ground water pollution. Acid rain Geochemistry of toxic elements in natural waters. Environmental problems connected with exploitation of minerals and energy resources. Acid mine drainage. Land use and land degradation due to mining. Study of surface geological processes, earthquakes and volcanism and GLOF with reference to their impact on environment. Soils, erosion and conservation. Geological solutions to environmental problems. Role of geology in nuclear waste disposal, Global warming, Climate change and Mitigation. Environmental planning, management and economics (EMP and EIA).

Rock Mechanics

Engineering classification of geological materials. Introduction to rock mechanics: Rock properties:density, hardness, abrasion, slake durability, permeability. Strength of rocks: tensile, compressive and shear strength, determination of elastic moduli, Physico-mechanical properties of building stones and aggregate, alkali aggregate reaction. Rock mass classification systems – RQD, Q system, RMR and SMR classification. Laboratory measurements of rock strength, Uniaxial and triaxial tests, Stress-strain relationships. Determination of principal stresses.

Soil Mechanics

Engineering classification of Soils, Particle size analysis. Atterberg limits (plastic and liquid limits) Consolidation parameters, Swelling/Shrinking Index, Void Ratio, Effective stress concepts in soil: Total, neutral and effective stress distribution in soil, Permeability, Darcy's Law, Permeability measurement in the laboratory – quick sand condition, Seepage, Laplace Equation, Liquifaction and Condensation. Measurement of shear strength, direct shear, Triaxial compression, UCC and Vane shear tests. Types of shear tests, Drained and undrained behaviour of clay and sand. Stress path for conventional triaxial test, cyclic shear test.

Geotechnical site Investigations

Geotechnical investigation for dam site, reservoir site; geotechnical study for road alignment, geotechnical evaluation of tunnel alignment, methods of tunnelling. Geotechnical investigations for bridge foundation and building foundation. Mass movements, slope stability problems, their predictions and optimum design of slope (natural slope, benches in mines, mine dumps). Earthquakes and seismicity, seismic zones of India, soil liquefaction, and earthquake resistance design of building. Influence of geological condition of foundation and design of buildings. Shoreline engineering geology.

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Syllabus for Technical Assistant (Chemistry) (PG Level):

1. Periodic table and periodicity in properties, atomic structure, structure and chemical bonding in molecules, concepts of acids and bases.

2. Compounds of main group elements: synthesis, properties, structure, and importance.

3. Coordination compounds of transition elements: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.

4. Organometallic compounds: synthesis, bonding and structure, reactions, uses.

5. Chromatography techniques (HPLC, GC, GC-MS, TLC, Column chromatography), spectroscopic techniques (IR, Raman, NMR, EPR, Mössbauer, UV-vis, Mass, XPS, etc.) and microscopic techniques.

6. Chemical kinetics, rate laws and temperature dependence, complex reactions, steady state approximation, determination of reaction mechanisms, collision and transition state theories of rate constants, unimolecular reactions, enzyme kinetics, salt effects, homogeneous catalysis, photochemical reactions.

7. Chemical thermodynamics: Fundamental Laws, key functions and properties, thermodynamic processes, spontaneity, thermodynamic equilibrium, Heat and work, Le Chatelier principle, phase transitions, phase equilibria and phase rule, thermodynamics of ideal and non-ideal gases, and solutions, Boltzmann distribution, kinetic theory of gases, partition functions and their relation to thermodynamic quantities.

8. Electrochemistry: Nernst equation, redox reactions, electrochemical cells, Debye-Huckel theory, Kohlrausch's law, ionic equilibria, conductometric and potentiometric titrations.

9. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis, Polymer chemistry.

10. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

11. IUPAC nomenclature, isomerism, stereochemistry, aromaticity.

12. Organic reactive intermediates and organic reaction mechanisms.

13. Organic transformations, named reactions, functional group interconversion, common reagents and their applications in organic synthesis.

14. Pericyclic reactions, principles and applications.

15. Heterocyclic compounds: Synthesis, properties and uses.

16. Natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids.

Nawang Tundup, 25/11/25
Registrar,
University of Ladakh