ANNEXURE-III

SCHEME AND SYLLABUS FOR VARIOUS GAZETTED CATEGORIES OF POSTS IN GROUND WATER DEPARTMENT

FOR PC. NO. 01:- SCHEME AND SYLLABUS FOR THE POST OF ASSISTANT HYDROMETEOROLOGIST IN GROUND WATER DEPARTMENT

SCHEME OF EXAMINATION

Written Examination (Objective Type)	**No.of Questions**	**Duration (Minutes)**	**Maximum Marks**
Paper-I: General Studies And General Abilities	150	150	150
Paper-II: CONCERNED SUBJECT	150	150	300
		Total	**450**

Name of the Papers	**Language of Examination**
Paper-I: General Studies and General Abilities	Bilingual i.e.,English and Telugu
Paper-II: CONCERNED SUBJECT	English Only

SYLLABUS

Paper-I: GENERAL STUDIES AND GENERAL ABILITIES

1. Current affairs – Regional, National and International.
2. International Relations and Events.
3. General Science; India's Achievements in Science and Technology.
4. Environmental issues; Disaster Management- Prevention and Mitigation Strategies.
5. Economic and Social Development of India and Telangana.
6. Physical, Social and Economic Geography of India.
7. Physical, Social and Economic Geography and Demography of Telangana.
8. Socio-economic, Political and Cultural History of Modern India with special emphasis on Indian National Movement.
9. Socio-economic, Political and Cultural History of Telangana with special emphasis on Telangana Statehood Movement and formation of Telangana state.
10. Indian Constitution; Indian Political System; Governance and Public Policy.
11. Social Exclusion; Rights issues such as Gender, Caste, Tribe, Disability etc. and inclusive policies.
12. Society, Culture, Heritage, Arts and Literature of Telangana.
13. Policies of Telangana State.
14. Logical Reasoning; Analytical Ability and Data Interpretation.
15. Basic English. (10^{th} Class Standard)

PAPER-II COCERNED SUBJECT

Atmospheric Physics and Thermo Dynamics

The atmosphere- Composition of the atmosphere- major components- carbon dioxide, water vapour, aerosols, ozone and ozone depletion. Vertical thermal structure of the atmosphere- Scale height, Troposphere, Stratosphere, Mesosphere, Ionosphere, Thermosphere and Exosphere.

Thermodynamics: Gas laws, Virtual temperature, the Hydrostatic equation, Geopotential, Hypsometric equation. The first law of Thermodynamics- joules law, Specific heat enthalpy. Adiabatic processes –concept of an air parcel, the dry adiabatic lapse rate, potential temperature, thermodynamic diagrams. Water vapour in air – moisture parameters, latent heat, saturated adiabatic and pseudo adiabatic processes, saturated adiabatic lapse rate. Static stability- unsaturated air, saturated air, conditional and convective instability. The second law of thermodynamics – entropy, the Clausius and Clapeyron equation

Weather and climate concepts-World climate system - climate of the hemispheres. Global distribution of temperature, precipitation, pressure and winds - Circulation pattern during winter and summer seasons. Jet streams. Monsoons: Asia, Australia, E. Africa and North America; Systems of climatic classification - Koppen - Thornthwaite. Climate change on different time scales-decadal centuries and millennia.Climate change Extreme weather events, The Measurement of Climate Change, Global warming. Natural Disaster events in India

Radiation: The spectrum of radiation – Black body radiation- Planck function, Wien's displacement law, Stefan Boltzmann law, radiative properties of nonblack bodies, Kirchhoff's law, greenhouse effect. Scattering and absorption by air molecules and particles, Atmospheric windows and radiative transfer in atmosphere.
Clouds and precipitation: Cloud classification, cloud condensation nuclei, curvature and solute effects, and growth of cloud droplets by condensation, collision – coalescence.
Principles of Solar Radiation and Collection: Non-renewable energy resources – Principles of power generation and transmission. A model of conventional thermal power plant. Advantages and disadvantages of conventional power plants. Role and potential of new and renewable sources, the solar energy option, environmental impact of solar power, physics of the sun, the solar constant, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data

Dynamics of the Atmosphere

Introduction to Partial differential equations – Definitions; Examples – Linear equations, Nonlinear equations, Linear systems, Nonlinear systems; Strategies for studying PDE – well posed problems, classical solutions, weak solutions and regularity, Typical difficulties Transport equation – Initial value problem, Nonhomogeneous problem Laplace 's equation – Physical interpretation.

Inertial and Non Inertial frames- Fundamental Forces-Pressure Gradient Force, Gravitational Force, Friction or Viscous Force. Apparent forces- Centrifugal Force, Coriolis force, Effective Gravity. Momentum Equations-Cartesian Coordinate System, Spherical–Polar coordinate system. Scale analysis of momentum equations. Hydrostatic approximation. Balanced motion-Geostropic Wind, Gradient wind, Thermal Wind. Continuity equation – Horizontal divergence, Vertical motion. Isobaric coordinate system – Transformation of momentum & continuity equations. Rossby, Richardson, Reynolds and Froude numbers
Kinematics of the pressure and Wind fields: Characteristic curves - General expressions for their velocity and acceleration – Movement of troughs, ridges and pressure centres, Intensification and Weakening, deepening and Filling of surface pressure systems, Relation between streamlines and trajectories. Isotachs and contour analysis; tilt & slope of pressure/weather systems with height. Trajectories in moving cyclones and anticyclones.

Waves

Fundamentals of Waves -Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones, energy transport, transverse impedance. Longitudinal vibrations in bars- wave equation and its general solution.

Wave motion in the Atmosphere: Linearized equations, vertical sound waves, horizontal sound waves and internal gravity waves, surface gravity waves, inertial gravity waves, inertial oscillations, Rossby Waves, Gravity waves, the geostrophic adjustment process.Geostrophic

Scaling, The Planetary, Geostrophic Equations, The Shallow Water Quasi Geotropic Equations, The Continuously Stratified Quasi Geostrophic System, Quasi geostrophy and Ertel potential vorticity, Energetics of Quasi Geostrophy, Rossby Waves, Rossby Waves in Stratified Quasi Geostrophic Flow,Barotropic and Baroclinic Instability, Kelvin Helmholtz Instability.

Hydrometeorology

Hydrological cycle: Understanding the importance of Water and as the subject ofObservation, Hydrological information systems and its components. Uses of water resourcesInformation and types of water resources.

Observations: Rainfall observations and units. Design of Network. Framework for networkanalysis and redesign. Optimum Density of stations for a network. Different types of Rain gauge:Manual/non recording, recording.

Rainfall analysis: Point rainfall, Concept of basin and catchment, major river basins in India.Estimation of point rainfall at ungauged point, generation of grid point data from point rainfall. Estimation of average rainfall over basin/geographical areas.

Hydro meteorological disasters: Definition of flood, Types of floods (seasonal, flash, urban). Causes of flood. Droughts, types of drought. Various indices for monitoring drought. Drought monitoring and prediction practices at India Meteorological Department., GLOF, cloudburst, landslides etc.
Rainfall monitoring: Rainfall Normal, Rainfall monitoring and Operational RainfallStatistics.

Statistics

Introduction - The purpose of statistics, Population and sample, Censuses and surveys, Descriptive statistics and inductive statistics, applications. Statistical variables - qualitative and quantitative, discrete and continuous variables.
Description of data patterns – centre, spread, shape, and gaps & outliers, Histograms and bar charts, difference between bar charts and Histograms, various plots (Dot plots, Stem plots, Box plots, Cumulative plots, Scatterplots), Tabular displays (one -way and two-way tables).
Measures of central tendency – Mean, median, mode quartile, decile, and percentile, Standard Score (z-Score).
Variability - Range, Interquartile Range (IQR), mean deviation, quartile deviation, Sums of squares, Variance, Standard Deviation.
Basic probability concepts – events and event space, random variables, definition of probability, joint and conditional probabilities, odds, expectation, Bayesian theorem. Estimation and Hypothesis Testing, Statistical Significance and Confidence Interval.
Time series analysis – basic concepts linear and non-linear trend, Principles of stochastic processes, Auto-correlation theory, Application of Auto-correlation and auto regressive processes, Spectral analysis, Co-spectral methods, Analysis of variance ANOVA/ MANOVA

FOR PC. NO. 02:- SCHEME AND SYLLABUS FOR RECRUITMENT TO THE POST OF ASSISTANT CHEMIST IN GROUND WATER DEPARTMENT

SCHEME OF EXAMINATION

Written Examination (Objective Type)	No.of Questions	Duration (Minutes)	Maximum Marks
Paper-I: General Studies And General Abilities	150	150	150
Paper-II: Concerned Subject	150	150	300
		Total	**450**

Name of the Papers	Language of Examination
Paper-I: General Studies and General Abilities	Bilingual i.e.,English and Telugu
Paper-II: Concerned Subject	English Only

SYLLABUS

Paper-I: GENERAL STUDIES AND GENERAL ABILITIES

1. Current affairs – Regional, National and International.
2. International Relations and Events.
3. General Science; India's Achievements in Science and Technology.
4. Environmental issues; Disaster Management- Prevention and Mitigation Strategies.
5. Economic and Social Development of India and Telangana.
6. Physical, Social and Economic Geography of India.
7. Physical, Social and Economic Geography and Demography of Telangana.
8. Socio-economic, Political and Cultural History of Modern India with special emphasis on Indian National Movement.
9. Socio-economic, Political and Cultural History of Telangana with special emphasis on Telangana Statehood Movement and formation of Telangana state.
10. Indian Constitution; Indian Political System; Governance and Public Policy.
11. Social Exclusion; Rights issues such as Gender, Caste, Tribe, Disability etc. and inclusive policies.
12. Society, Culture, Heritage, Arts and Literature of Telangana.
13. Policies of Telangana State.
14. Logical Reasoning; Analytical Ability and Data Interpretation.
15. Basic English. (10^{th} Class Standard)

PAPER-II CONCERNED SUBJECT

Unit-I Inorganic Chemistry:

1. **Atomic structure & Chemical Bonding**: Quantum theory Schrodinger, wave equation, Electronic configuration, Ionic bond, covalent bond, coordinate covalent bond, valence bond theory ,molecular orbital theory.

2. **Periodic classification:** (Classical and modern) periodic functions of elements, atomic volume, atomic radius, electronegativity, oxidation states, lattice energy and their applications, General characteristic properties of **S and P block elements**.

3 **Chemistry of 'd & f' block elements:** General characters based on electronic configuration size, Oxidation states, Colour, Magnetic properties, Abilities to form complexes. Comparison of 'd ' block elements with 'f' block elements with respect to colour and magnetic properties. Chemistry of **complex compounds, isomerism in complexes.**

4 **General Principles of Metallurgy:** Properties of Metals, Theories of Metallic bond, Manufacture of Pig iron, Methods of steel making, Extraction of Aluminium , Copper, Composition of iron, steel and alloys.

Unit – II Physical Chemistry:

1. **Chemical Kinetics & Chemical Equilibrium:** Concept of reaction rate, Variables affecting. The rat**es** reaction, Units of rate constant, order and molecularity of reaction, Theories of reaction rates i.e., collision theory and Activated Complex theory, integrated rate equations and half lives for Zero, First, second and Third order reactions, Equilibrium,Factors affecting equilibrium, Relation between Kp & Kc, Kinetic theory of gases.

2. **Thermodynamics :** Concept of system surroundings work , Heat, Energy, First law of thermodynamics ,Internal energy, Enthalpy, heat capacity, first law for open systems. Second law of thermodynamics ,statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application, Gibbs free energy, Gibbs free energy change for spontaneous, non-spontaneous and equilibrium process.

3. Electro-Chemistry: Equivalent conductance and its measurement.The independent migration of ions, kholraush's Law, Applications and calculations of Equivalent conductance of weak and strong electrolytes. Inter-ionic attraction theor, Theories of acids and bases, Hydrogen ion concentration and its measurements from E.M.F. Buffer solutions, potentiometric, conductometric & colorimetric titrations.

4. Solids & Solutions : Classification of solids based on different binding forces as molecular, ionic, covalent solids and metallic solids, Amorphous and crystalline solids, Electrical and magnetic properties of solids, Classification of solutions, Concentration units, dilute solutions, Colligative Properties.

Unit –III Organic Chemistry:

1. **Organic reaction mechanism**: Introduction of Organic Chemistry, Nomenclature, Structure and reactivity of organic molecules, Factors affecting Electron density in a band-inductive, mesomeric (reasonance) and electromeric effects, hyper conjugation, Dipole moments, acidic and basic strength of organic Compounds.

   Modern concepts of organic reaction mechanisms: Addition, substitution and elimination reactions – simple examples and their mechanism. The intermediate carbonium ion formation and its participation in organic reactions.

   Stereo Chemistry: Optical and geometric isomerism configuration of saturated molecules, DL and RS configuration of optically active compounds, racemic-mixtures.

2. **Heterocyclic compounds**: Importance of heterocyclic compounds, classification based on the nature of hetero atom.A general and comparative study of Furan pyrole and thiophene Ring transformations. General comparison with benzenoid compounds, Furan, thiophine, pyridine, quinoline, Isoquinoline.

3. **Amines, Amino acids and Proteins:** Classification, Nomenclature, Isolation and their synthesis, Structure and Functions and uses.

   Alcohols, Aldehydes, Ketones and carboxylic acids: Classifications, basic structures, Properties and Uses.

   Vitamins and hormones: Classification, Functions and their effects**.**

4. **Chemistry of natural products:**
   Alkaloids: Classification, reactions and degradations. Chemical and Physico-Chemical methods for the elucidation of structures-synthesis and structural elucidation of the following alakaloids, atropine , cocaine, quinine, Narcotine, papaverine.

   Carbohydrates: Classification, General reactions of monosaccha rides configurational studies of glucose, fructose, sucrose and cellulose, Chemistry of carbonyl compounds.

Unit –IV Industrial Chemistry

1. **Separation Methods (Unit Operations):** Basic Concepts of Separation Methods Screening Filtration, Sedimentation, Froth Flotation Distillation, Extraction, Evaporation, absorption and adsorption, Boiling and Condensation. Conveying and Storage of Solids, Liquids & Gases.

   Stoichiometry: Introduction, percentage composition, empirical formula and molecular Formula, mole concept, Stoichiometric approach to chemical reactions, significance of Chemical Equation, balancing methods and problems.
2. **Fuels:** Classifications, Advantages, Sources and uses of fuels with examples.

   Petroleum processing: Crude oil composition, cracking and refining, petrochemical products.
   Coal and Coal Chemicals: Formation, Types & Ranks of Coals, Carbonisation. Composition, properties and applications of Coal Products.
   Oils, Soaps and Detergents: Definition, Classification and Composition.
   Acid - Alkali Industries: Manufacture of common salt, Soda ash, Caustic soda, Chlorine, Sodium bicarbonate and their Industrial applications. Manufacture of sulphuric acid, Hydrochloric and Nitric acid.
   Pulp and Paper Industry: Manufacture of Pulp**,** pulping methods, types of pulps, effluents from pulp Mills, paper industry, Processing, effluents, environmental concerns and applications.
   Polymer Industry: Introduction, nomenclature, classification of polymers**,** composition, synthesis properties and applications of plastics and rubbers.
   Surface Coating Industries: Paints & varnishes and their applications.
3. **Ceramic Industries:** Types of Ceramic products, Chemical conversions, Manufacture of white waves,Manufacturing of Refractories and their properties, Vitreous Enamels and their applications.

   Cement Industries: Raw Materials, Types of cements, Manufacture of Portland cement.
   Glass Industries: Raw Materials, Special glasses, Composition and their uses, methods of Manufacture of glass.
4. **Fertilizers:** Synthesis of ammonia, Urea, Calcium ammonium nitrate (CAN), Phosphate rock, Phosphoric acid, Super phosphate, Triple super phosphate, Diammonium phosphate (DAM), Potassium Fertilizers, Mixed fertilizers, Bio fertilizers.

Unit – V Chemistry of Water

1. **Sources of water & Quality:** Sources of contamination of water, Chemical, Physical and Biological characteristics of water, Drinking water standards, standards and effects of contaminated water , water born diseases & problems.

2. **General purification Methods of water:** Sedimentation, Filtration, Coagulation, Distillation & reverse osmosis and **Disinfection**, Types of Disinfection, ideal Disinfectant, Mechanism of Disinfection, Efficiency of Disinfection, **Chlorination**, Types of Chlorination. **Coagulation**: Types of Coagulation, Mechanism, Efficiency of Coagulation.

3. **Water Softening Method:** Heating, Lime-Soda Process, Caustic- Soda Process, Softening with Calgon, Zeolite process, Ion-Exchange process. Municipal Water Conditioning and Industrial effluent Treatment.

4. **Qualitative & Quantitative analysis:**

   Qualitative analysis: Classification of anions and cations. Reactions involved in the Separation and identification of anions and cations. Qualitative analysis of Organic compounds.
   Quantitative analysis: Volumetric analysis and Gravimetric Analysis

a. **Volumetric analysis:** Theory of Volumetric analysis Types of reactions, Titration curves w.r.t neutralization, redox, precipitation & Complexometric titrations. Theory of Indicators.

b. **Gravimetric Analysis:** Theory of gravimetric analysis, Formation of precipitate, conditions or precipitation, Impurities in precipitate. Washing, drying & ignition of precipitates.

Principles and applications of **Chromatographic techniques, UV,IR and NMR.**

FOR PC. NO. 03 to 05:- SCHEME AND SYLLABUS FOR RECRUITMENT TO THE POSTS OF ASSISTANT GEOPHYSICIST, ASSISTANT HYDROGEOLOGIST AND ASSISTANT HYDROLOGIST IN GROUND WATER DEPARTMENT

SCHEME OF EXAMINATION

Written Examination (Objective Type)	No.of Questions	Duration (Minutes)	Maximum Marks
Paper-I: General Studies And General Abilities	150	150	150
Paper-II: Water Resources	150	150	300
		Total	**450**

Name of the Papers	Language of Examination
Paper-I: General Studies and General Abilities	Bilingual i.e.,English and Telugu
Paper-II: Water Resources	English Only

SYLLABUS

Paper-I: GENERAL STUDIES AND GENERAL ABILITIES

1. Current affairs – Regional, National and International.
2. International Relations and Events.
3. General Science; India's Achievements in Science and Technology.
4. Environmental issues; Disaster Management- Prevention and Mitigation Strategies.
5. Economic and Social Development of India and Telangana.
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8. Socio-economic, Political and Cultural History of Modern India with special emphasis on Indian National Movement.
9. Socio-economic, Political and Cultural History of Telangana with special emphasis on Telangana Statehood Movement and formation of Telangana state.
10. Indian Constitution; Indian Political System; Governance and Public Policy.
11. Social Exclusion; Rights issues such as Gender, Caste, Tribe, Disability etc. and inclusive policies.
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15. Basic English. (10^{th} Class Standard)

PAPER-II WATER RESOURCES

Unit-1 General Geology and Mineralogy

Origin, age and interior of earth, earthquakes, volcanoes and mountains, weathering, geological work of rivers, wind, groundwater, glaciers, seas and oceans.

Definition of mineral, Classification of mineral into rock forming and ore forming minerals. Physical and optical properties of minerals, silicate structures, olivine family, feldspars, pyroxenes, amphiboles, micas, chlorides, garnets and quartz family.

Unit-2 Petrology, Structural Geology and Indian Geology

Definition of rock, rock cycle, igneous rocks-forms, textures, structures, origin, classification and types. Sedimentary rocks- mode of formation, structures and textures, classification. Metamorphic rocks- Types and agents of metamorphism, structure and textures of metamorphic rocks – grades and zones of metamorphism.

Structural geology- strike and dip, folds, faults, joints and unconformities, recognition of folds in the field and recognition of faults in the field

Indian geology-Standard Geological time scale, Principles of correlation, Physiographical sub-divisions of India. Achaeans, cuddapahs, vindyans, gondwanas, Deccan traps, siwalliks and recent formations.

Unit-3 Groundwater Geophysics

Gravity methods: principles, instruments-survey techniques, Magnetic methods: principles, instruments, and survey techniques, Seismic method; principles, instruments, survey techniques.

Electrical methods: Wenner, Schlumberger, Lee, Dipole-Dipole configurations. Resistivity profiling and instruments. Resistivity sounding, Interpretation techniques. Geoelectrical parameters corresponding to hydrological zones, Application of resistivity in groundwater studies.

Electromagnetic methods: principles, instruments, survey techniques. Induced polarisation methods: principles, relationship between apparent chargeability and apparent resistivity.

EM sounding - profiling-dipole and VLF techniques. Bore hole geophysics: Well logging, basic concepts of logging.

Unit-4 Hydrochemistry

The water molecule, isotopic composition of waters-physical and chemical properties of water, geochemical processes, geochemical classification of waters, Mechanisms controlling the groundwater chemistry.

Chemical dissolved constituents. Sampling of water from rivers, lakes, ponds, open wells, bore wells. Standard laboratory techniques for the analysis. Bacteriological studies. Interpretation of physical and chemical data of water, plotting on maps, Statistical techniques in presenting hydrochemical data.

Unit-5 Environmental Hydrology

Ground water pollution- its sources and classification, Water sanitation- water borne diseases, Groundwater quality problems that originate above and below water table. Utility of water, for drinking, agriculture, industry and recreation. Standards of water-Indian, World Health Organisation,

Control measures of groundwater contamination, prediction of contaminants migration and travel times, problem of fluoride and arsenic. Defluorination-Nalgonda method, Activated carbon method of treatment.

Global threat-EInino effect -Green House Effect-Ozone layer depletion and its impact on hydrological environment-Global Warming- acid rain- its cause and impact on water environment.

Unit-6 Surface Hydrology
Hydrologic Cycle, Precipitation, Infiltration, run-off, Evaporation & Evapotranspiration, Water Balance Studies, Forecast of climatic Parameters.

The significance of water, Water resources of the earth. Global water budget. Formation of surface water resources; streams, rivers, lakes, swamps, caves, seas and oceans.

Runoff, groundwater runoff, direct runoff, factors affecting runoff. Discharge and discharge measurement, hydrographs: components of hydrograph, base flow separation methods. Unit hydrograph to design flood computation and of inflow to major rivers.

Unit-7 Groundwater Hydrology
Groundwater in Hydrologic cycle, Occurrence of Groundwater: Aquifer, Aquiclude, Aquifuge and Aquitard, Porosity, Effective porosity, Vertical distribution of Groundwater; Zone of aeration, zone of saturation, Division of subsurface water. Specific retention, specific yield, Storage coefficient. Water movement in saturated soils, Darcy's law. Permeability, Intrinsic permeability. Hydraulic conductivity, Transmissivity, Determination of Hydraulic conductivity.

Groundwater fluctuations: Secular, Seasonal and Short-term fluctuations, Artificial Recharge of Groundwater, salt water intrusion of coastal aquifers, Development of Groundwater in intrusion areas.

Water wells: Dug wells, Bored wells, Driven wells, Jetted wells, Methods for drilling deep wells, Well design, Well completion, Well development, pumping equipment, Protection of wells, Well rehabilitation and Horizontal well.

Unit-8 Hydrologic Modeling
Concepts of modelling, Process of model development, types of Hydrological models: Physical models and Mathematical models. Introduction to Continuous and Discrete models, Dynamic and Static, Lumped parameter and Distributed parameter models, Block-Box model, Conceptual model, Stochastic and Deterministic models

Unit-9 Watershed Management
Watershed: Concept, Characteristics, Size, Shape, Physiography, Climate, Drainage, Land-use, Hydrological parameters. Basic data collection, Integrated Study of Watershed Management. Conditions to develop watershed, types of Watersheds, Integrated studies to develop watersheds. Rain water structures, design and Economic aspects. .
Floods: flood elevation, Flood discharge, flood volume and duration of floods, Flood estimation, causes of flood, factors affecting flood flow, flood flow determination flood control methods, limitations of flood control measures, Flood routing. Watershed and Agricultural Practices, National projects, Appropriate Technology and action plans, Post-operative problems of watersheds.

Unit-10 Remote Sensing and Geographical Information System
Electromagnetic Energy: Laws, Distribution and Interaction, concept of incoming short wave and outgoing long wave radiation: passive and active remote sensing, electromagnetic radiation, spectral reflectance curves. Imaging and non-imaging sensors, resolution. Satellite remote sensing, geo-synchronous and sun-synchronous orbits, IRS-satellites and high resolution satellites. Supervised and unsupervised image classifications. Remote sensing applications for meteorological, hydrological, geological studies and urban planning and management.

Basic concepts of geographical information systems, map projections, geographic coordinate system, transformations, map analysis. Data Acquisition and Data Management, Data Processing, Data Modeling, GIS Analysis and Functions. GIS applications to Environmental and natural resource management, software scenario, functions, standard GIS packages.