Syllabus for the Post of Scientific Assistant
Department of Ecology, Environment and Remote Sensing, J&K

Pattern: Objective Type

Max. Marks 70

REMOTE SENSING (Marks 4)
Overview of Remote sensing: Definition of Remote sensing Principles of Remote Sensing, Electromagnetic Radiation, Radiometric terms and definitions, Radiation Laws, EM spectrum, Sources of EM, Interaction of EM Radiation with atmosphere, and target, Atmospheric Widows, imaging spectrometry, Spectral signature of various land cove features

PLATFORMS AND SENSORS (Marks 5)
Platforms: Types of platforms, ground, airborne, and space born platforms, Orbit of satellites, Kepler's Law, satellite characteristics, satellites for Earth observations studies, and planetary missions (Chandrayana) • Sensors: Types and classification of sensors, imaging modes, Characteristics of optical sensors, sensor resolution-spectral, radiometric and temporal, Characteristics of detectors. **Thermal Imaging system • Thermal Imaging System:** IR - radiometers, Airborne and Satellite TTR scanner system Interpretation of thermal imagery • Advantages of Thermal imagery
Microwave Remote Sensing • Introduction Microwave sensors and Image characteristics, Microwave image interpretation of LiDAR (Topographic, Bathymetric) platforms of LiDAR, components of LiDAR.

GPS (Marks 3)
Principle used, Segments of GPS, Components of GNSS, Data collection methods, DGPS, Errors in observations and corrections. GPS and Total Station surveying). Data integration from different sources (GPS, Total Station, High resolution satellites) for large scale mapping and cadastral surveys. Unit-II GNNS: Carrier phase measurements, Signal structure, GNNS Errors and biases, Differential Positioning –concepts and principles, IGS station-final ephemeris, differential corrections, accuracy in differential satellite positioning system PS, local area DGPS, wide area DGPS, LAAS, WAAS, GAGAN, Mapping methods with GPS – rapid static method, semi-kinematic method, kinematic method. Real time DGPS. GNSS, GLONASS, IRNSS, GALILEO, Beidou, and future prospects of navigational satellites

DATA RECEPTION, DATA PROCESSING & DATA GENERATION (Marks 3)
Ground station, Data generation, Data processing Ground Investigation in support of Remote sensing • Uses of ground data, calibration correction, Interpretation of properties, Training sets, Accuracy evaluation, test sites • Ground truth Instruments and spectral signature, • Sources of RS data: Global and Indian data products. Processing of IRS IC/ID, CARTOSAT, ASTER, ALOS PRISM, SPOT, IKONOS, Quick Bird, WorldView, GeoEye, Pleadies, etc

IMAGE PROCESSING (Marks 5)
Introduction to digital image processing- concept of digital image, steps in DIP. Image processing systems –hardware and software considerations. Digitization of photographic image, converting digital image to visual form image. Digital image data formats, Image data storage and retrieval. Image registration – definition principle and procedure. Fundamental of image recertification, interpolation, intensity interpolation. Radiometric & geometric correction of remotely sensed data. Basic statistical concept in DIP and use of probability methods in DIP. Image enhancement techniques, Contrast enhancement - linear and nonlinear,

histogram equalisation and density slicing. Spatial filtering and edge enhancement. Multi image manipulation – addition, subtraction and band rationing. Principal Component Analysis (PCA). Enhancement by using colours – advantages, types of colour enhancements. BGR – coding and generation of FCC's. Image transformation – Intensity Hue Saturation (IHS). Pattern recognition and image classification, unsupervised classification – advantage, disadvantage and limitations, supervised classification - training site selection, classifiers used in supervised. Fuzzy classifier, hybrid classifier, decision tree classification and data mining classification – minimum distance to mean, parallelepiped maximum likelihood. Classification accuracy assessment (error matrix and kappa coefficient). High resolution and hyperspectral image analysis

VISUAL IMAGE INTERPRETATION (Marks 5)

Introduction to Visual Interpretation, Basic principles of Visual Interpretation • Elements of Visual Interpretation, Techniques of Visual Interpretation. Interpretation Keys, Methods of searching and sequence of Interpretation • Methods of analysis and Reference levels • Computer compatible tapes – Band sequential format, Band interleaved by Line format, Run-length encoding format. • Hardcopy outputs – Generation of B/W and False Color Composites. Generally supported scales of the data products, Information about annotation of the products.

MAPS (Marks 4)

Importance of maps to engineering projects, Types of maps, Scales and uses, Plotting accuracy, Map sheet numbering, Coordinate systems- Cartesian and geographical, map projections, map datum – MSL, Geoid, spheroid, WGS-84

FUNDAMENTALS OF PHOTOGRAMMETRY AND PHOTO INTERPRETATION (Marks 3)

Fundamentals of Photogrammetry and Photo interpretation – types of photographs; Vertical photographs – principal point; scale; Stereoscopy; Vertical exaggeration – factors involved and determination; Overlap, side lap and flight planning. Geometric elements of vertical aerial photographs; Relief Displacement on vertical aerial photographs; Parallax and parallax measurement – monoscopic and stereoscopic methods; Determination of horizontal ground length, direction and angles from photo coordinates; Aerial mosaics: comparison with maps; Elements of aerial photo interpretation – (a) landforms; (b) surface drainage patterns; (c) erosion features, (d) gray tones; (e) miscellaneous elements. Digital Photogrammetry: definition and scope; Photographs and images; Geo-referencing – Interior orientation, exterior orientation; aero-triangulation – single frame and block triangulation - pass points, tie points; ground control points; Satellite photogrammetry. 3-D surface modelling – DEMs, DSMs and DTMs; Triangulated irregular networks; Gridded surfaces; interpolation methods; Contour representation; Terrain visualization; DEM user applications. Digital earth models and data dissemination services: contemporary approaches (Bhuvan and Google Earth) and future prospects.

GEOGRAPHIC INFORMATION SYSTEM (Marks 5)

Introduction to GIS, Understand the difference between GIS and information system in general, GIS components and function of GIS: hardware software requirement of GIS, data types and spatial data models, idea of conceptual, logical and physical models, RDBMS, data base normalization Representation of real world via vector and raster representation model. Definition of a map Geographic data in the computer. File and data processing, data base structures, perceived structures and computer representation and geographical data. Raster data structure, Vector data structures for geographical entities.

Data input and Quality verification Data Quality, Errors and Natural Variation: Sources of error, Errors resulting from natural variation of from original measurements. Errors arising through processing, problem; and errors arising from overlay and boundary intersections. Errors resulting room rasterizing a vector map. Errors associated with overlaying two or more polygon networks. The nature of boundaries. The statistical nature of boundaries. Combining attributes from overlaid maps.

DEM & Map Projections: Digital Elevation Models: The need of DEMs, methods of representing DEMs. Image methods, data sources and sampling methods for DEMs. Products that can be derived from a DEM. Automated landform delineation from DEMs. Digital Terrain Modeling and other raster analysis, Vector overlay analysis, TIN. View shed analysis and its application. Watershed analysis and its application

Vector & Raster based analysis: Attribute data analysis, integrated spatial and attribute data analysis: Single and multi-layer raster and vector analysis, map overlay, spatial join, buffering analysis, network analysis, that is optimum path, (cost/time/distance, Travelling sales man problem, Dijkstras's algorithm, geometric networks) Raster data analysis: Local, Neighbourhood and regional operations. Methods of Data Analysis and Spatial Modelling: Introduction, definition of the database. Simple data retrieval. A general approach to map overlay, Cartographic modelling using natural language commands. Linking command sequences into cartographic models, advantages and disadvantages of cartographic modelling in land evaluation and planning.

Methods of Spatial interpolation. The available methods for interpolation, global methods of interpolation, location interpolators, optimal interpolation methods using spatial auto covariance. Extensions of kriging to large areas. Comparing kriging with other interpolation techniques. Choosing a Geographic Information System. Designing the needs for GIS. Technological trends in GIS. Tools for Map analysis: Single maps, Map reclassification, operations and attribute tables, spatial topological and geometric modelling and operations on spatial Neighbourhood. Tools for map Analysis: Map pairs, map overlay and map modelling correlation between two maps. Tools for map analysis: Multiple maps, types of models, Boolean logic models, Index overlay models, Fuzzy logic methods. GIS customization, Data warehousing, cloud GIS, data mining, OLAP, SDSS, distributed, parallel and GPU, spatial data infrastructure, (i.e. integration and standards etc.,) Free and open source tools and web resources, Introduction to spatial decision problems, GIS and decision support system, over view of Internet GIS, Location based services.

HYPERSPECTRAL AND LIDAR REMOTE SENSING (Marks 3)

Introduction to Hyperspectral Remote Sensing. Spectral consideration. High resolution spectral features. Hyperspectral sensors. Airborne hyperspectral sensors. Space borne hyperspectral sensors. Processing of hyperspectral data. Procedures of data analysis. Principles of LIDAR. Laser and scanning system. Extraction of DSM. Analysis of LIDAR data.

SPATIAL DATABASE HANDLING MODELLING & GIS IMPLEMENTATING ARCHITECTURES (Marks 5)

Spatial Database Management System: Database overview, attribute data model, Spatial Data base, spatial Data Type and structures. Spatial Database Design: Conceptual data modelling, Concepts of UML, UML use case, Spatial data topological relationship. Spatial Database: Storage and Retrieval Concepts of spatial data storage, spatial Indexing, Basics of relational algebra, Data normalization, Spatial Query languages using extended SQL, spatial query processing and optimization. GIS Implementing Architectures: GIS Implementation architectures (desktop, client server, enterprise, mobile, web/cloud, web services from mobile platforms, spatial data acquisition / supply in distributed environment and security issues.

Spatial data modelling and its classification, spatial decision support system, spatial decision modelling concepts, AHP based modelling with case study, Agent based modelling with case study. Spatial Data Mining: Overview of data mining, Concepts of Decision tree-based approach with case study, Content based image retrieval concept with case study.
Data analysis and modelling in GIS– types of GIS modelling, Open sources software, free software and cloud computing, Decision support systems, Overview of image processing & GIS Packages – ARC GIS, ERDAS, MAP INFO, ILWIS, GEOMEDIA, IDRISI, GRASS, SAGA, QGIS. Recent trends in GIS – AM/FM, Virtual 3D GIS, Mobile GIS, OLAP, Internet GIS, Open.

AGRICULTURE (Marks 3)

Soil and Water Conservation: Scope of soil and water conservation. Mechanics and types of erosion, their causes. Rainfall, runoff and sedimentation relationships and their measurement. Soil erosion control measures – biological and engineering including stream bank protection-vegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterways. Gully control structures – temporary and permanent – design of permanent soil conservation structures such as chute, drop and drop inlet spillways. Watershed Management – investigation, planning and implementation – selection of priority areas and water shed work plan, water harvesting and moisture conservation. Land development – levelling, estimation of earth volumes and costing. Wind Erosion process – design to shelter belts and wind brakes and their management.

SOIL (Marks 3)

Processes and factors of soil formation, classification of Indian soils including modern concepts, Mineral and organic constituents of soils and their role in maintaining soil productivity. Problem soils, extent and distribution in India and their reclamation. Essential plant nutrients and other beneficial elements in soils and plants; their occurrence, factors affecting their distribution, functions and cycling in soils. Symbiotic and non-symbiotic nitrogen fixation, Principles of soil fertility and its evaluation for judicious fertilizer use. Soil conservation planning on water shed basis, Erosion and run off management in hilly, foot hills and valley lands; processes and factors affecting them. Dryland agriculture and its problems. Technology for stabilizing agriculture production in rainfed agriculture area. Water use efficiency in relation to crop production criteria for scheduling irrigations, ways and means of reducing run off losses of irrigation water; Drainage of water-logged soils.

FORESTRY (Marks 3)

Forest Mensuration and Remote Sensing: Methods of measuring diameter, girth, height and volume of trees; form-factor; volume estimation of stand, current annual increment; mean and annual increment. Sampling methods and sample plots. Yield calculation; yield and stand tables, forest cover monitoring through remote sensing; Geographic Information Systems for management and modelling. Surveying and Forest Engineering: Forest surveying: Fundamental definitions and concepts of surveying; linear measurements; different methods of surveying; levelling and contouring; maps and map reading. Forest Engineering: Basic principles; building materials and construction; roads and bridges; general principles, objects, types, simple design and construction of timber bridges; estimates.

GEOLOGY (Marks 3)

Essentials of prospecting and exploration techniques. Principal methods of mining, sampling, ore-dressing and beneficiation. Application of Geology in Engineering works. Elements of soil and ground water geology and geochemistry. Use of aerial photographs in geological

investigations. Distribution of water in earth, hydrology and hydrogeology, major basins and groundwater provinces of India,

ZOOLOGY (Marks 3)

Ecology and Environment, Abiotic factors and their role; Biotic factors- Inter and inter-specific relations. Animal Organisation at population and community levels, ecological successions. Ecosystem: Concept, components, fundamental operation, energy flow, biogeochemical cycles, food chain and trophic levels. Adaptation in fresh water, marine and terrestrial habitats. Pollution in air, water and land. Wild life in India and its conservation.

Ecology and its relevance to man, natural resources, their management and conservation. Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth, impact of changing environments on cropping pattern as indicators of environments. Environmental pollution and associated hazards to crops, animals and humans. Cropping patterns in different agroclimatic zones of the country-impact of high yielding and short duration varieties on shifts in cropping patterns. Concepts of multiple cropping, multi-storey, relay and inter-cropping and their importance in relation to food production, package of practices for production of important cereals, pulses, oilseed fibre, sugar and commercial crops grown during Kharif and Rabi seasons in different regions of the country.

ENVIRONMENTAL SCIENCE (Marks 5)

Definition, Principles and Scope of Environmental Science. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Interaction between Earth, Man and Environment. Biogeographic provinces of the world and agro-climatic zones of India. Concept of sustainable development. Natural resources and their assessment.

Ecology as an inter-disciplinary science. Origin of life and speciation. Human Ecology and Settlement. Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow models, food chains and food webs. Biogeochemical cycles, Ecological succession. Species diversity, Concept of ecotone, edge effects, ecological habitats and niche. Ecosystem stability and factors affecting stability. Ecosystem services.

Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity. Concept and basis of identification of 'Hotspots'; hotspots in India. Measures of biodiversity. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. National parks, Sanctuaries, Protected areas and Sacred groves in India. Concepts of gene pool, biopiracy and bio-prospecting. Concept of restoration ecology. Extinct, Rare, Endangered and Threatened flora and fauna of India.

Environmental implications of energy use; energy use pattern in India and the world, emissions of CO_2 in developed and developing countries 6 including India, radiative forcing and global warming. Impacts of large-scale exploitation of solar, wind, hydro and nuclear energy sources.

Air Pollution: Sources and types of Pollutants - Natural and anthropogenic sources, primary and secondary pollutants. Criteria air pollutants. Sampling and monitoring of air pollutants (gaseous and particulates); period, frequency and duration of sampling. Green-house effect, ozone layer depletion, acid rain.

Noise Pollution: Sources, weighting networks, measurement of noise indices (Leq, L10, L90, L50, LDN, TNI). Noise dose and Noise Pollution standards. Noise control and abatement measures: Active and Passive methods. Vibrations and their measurements. Impact of noise and vibrations on human health.

Water Pollution: Types and sources of water pollution. Impact on humans, plants and animals. Measurement of water quality parameters: sampling and analysis for pH, EC, turbidity, TDS,

hardness, chlorides, salinity, DO, BOD, COD, nitrates, phosphates, sulphates, heavy metals and organic contaminants.

Soil Pollution: Physico-chemical and biological properties of soil (texture, structure, inorganic and organic components). Analysis of soil quality. Soil Pollution control.

Solid Waste - types and sources. Solid waste characteristics, generation rates, solid waste components, proximate and ultimate analyses of solid wastes.

Environmental Assessment, Management and Legislation Aims and objectives of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). EIA Guidelines. Impact Assessment Methodologies. Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost benefit analysis. Guidelines for Environmental Audit. Environmental Planning as a part of EIA and Environmental Audit. Environmental Management System Standards (ISO14000 series). EIA Notification, 2006 and amendments from time to time. Eco-labelling schemes.

Overview of Environmental Laws in India, Environment, Air, Water, etc Acts and Rules.

Contemporary Environmental Issues in India. Natural and energy resources: Solar, Wind, Soil, Hydro, Geothermal, Biomass, Nuclear and Forests, Natural hazards and disasters: Mitigation strategies. National Action Plan on Climate Change, International agreements/efforts - Montreal Protocol, Rio Summit, Convention on Biodiversity, Kyoto Protocol, Paris Agreement, International Solar Alliance.

COMPUTER SCIENCE and WEBGIS (Marks 5)

Introduction to computers: Characteristics and history. Classification of computers, hardware: Input/ output devices, Secondary storage devices, Software: types, translators, interpreters, compilers and editors. Introduction to operating systems: DOS, WINDOWS, and UNIX. Introduction to number system. Flowcharts and Algorithms with examples. Mobile operating systems: android. Introduction to Computer Programming; Development of algorithms and flow chart; Introduction to C language; C++ language - Introduction, Objects, Decisions, Loops, Functions, Structs, References, Classes, Pointers. Introduction to Client-server systems, Internet and Web GIS technology Introduction to HTML and Javascript Introduction of Database Management System- SQL Queries and Data visualization including PostgreSQL and POSTGIS Introduction to publicly available webGIS platform for Geodata Processing OGC We Services and Data publishing using Geoserver SLD, WMS, WFS, WCS and other Geo-web services. Web Mapping APIs – OpenLayers Web Mapping APIs – Leaflet Development of Web GIS applications using Mashup architecture, Web GIS applications for Governance