

DETAILED SYLLABI

SEMESTER I

PAPER 1. INTRODUCTION TO EARTH SYSTEM SCIENCES

The Earth – dimensions and structure - continents and oceans. Spatial distribution. Mass movements. Spatial attributes - latitude and longitude. Maps - scale - projections. Topographical maps and geological maps and their preparation, conventional symbols. Reading a topographic map, symbols used in the topographic maps.

Earth processes – agents - the rock cycle. Overview of rocks - Igneous, sedimentary and metamorphic rocks. Weathering – Physical weathering and chemical weathering. Soils – their formation, classification, types in India, a typical tropical soil profile.

Water resources - Surface water and ground water - Streams, rivers and lakes – Types of streams. Drainage basins, patterns, morphometry. Geological work of streams – erosion, transportation, deposition – long profile of stream.

Groundwater and its sources. Hydrologic cycle. Subsurface occurrence of groundwater–springs– different types of wells. Groundwater potential zones, artificial recharging of groundwater.

Landforms and landscapes - Fluvial landforms. glacial landforms, aeolian landforms, coral reefs, coastal landforms. Overview of structural features – Fold, fault, Joints, fractures.

Natural Resources and Bioresources. Fundamental concepts of Environment management. Natural Hazards – Earthquakes, Volcanoes, Floods, Tsunamis, coastal erosion, land subsidence, landslides. Disaster Management and mitigation plans.

PAPER 2. DATA MANAGEMENT AND STATISTICAL ANALYSIS

Spatial data concept- data types- database and data management – Hardwares and softwares – Computer programming - Geoportals - Spatial Data Infrastructure - national and state SDIs.

Open Source Concepts and Specifications: - Introduction to open source - Installation of Open source Software -. Spatial data and markup languages-XML and GML.

Database management systems - Data – Information – Database – models – database management systems –types of DBMS – hierarchical, network, relational data model – classification of database based on modeling capability, based on tools/usage, based on server configuration, Knowledge based systems – File organization – Sequential – Index sequential –

random – multikey file organization – Concepts of Active database, temporal database, spatial database and multimedia database – object oriented database.

Geo-statistics for spatial analysis and modeling: Mean, median and mode. Standard deviation, Moments, Probability analysis. Continuous random variable and discrete random variable. Neighborhood, Zonal and Distance measure operations; Spatial pattern analysis-concepts and techniques, Spatial autocorrelation, Multivariate Correlation, Linear regression, Multiple regression. Statistical Surfaces- Interpolation, Variogram, Krigging. Basic introduction to geostatistical models.

PAPER 3. FUNDAMENTALS OF REMOTE SENSING

Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology, stages in remote sensing technology, spatial data acquisition, interdisciplinary nature and relation with other disciplines, applications of remote sensing, advantages of RS over conventional methods of survey and inventorying.

Basic Principles of Remote Sensing - Electromagnetic spectrum: Characteristics of electro-magnetic radiation; Interactions between matter and electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Definition of radiometry; Black body radiation; Spectral characteristics of solar radiation; EMR Interaction with Earth materials; Spectral signature concepts– spectral reflectance and emittance – specular reflection and non-specular reflectance – Albedo of materials – EMR interaction with rocks, minerals, vegetation and water -Factors affecting spectral reflectance of materials. Instruments used to study the spectral reflectance – spectrophotometer – spectro-radiometer.

Sensors - Types of sensors- passive sensors and active sensors; imaging systems, photographic sensors; Sensor resolution- spectral, spatial, radiometric and temporal; Imaging sensors and non-imaging radiometers; photograph v/s image, Panchromatic, Multispectral, hyperspectral, stereo images, Optical mechanical line scanner; Pushbroom scanner; Imaging spectrometer; spaceborne imaging sensors, active and passive microwave sensors; Thermal sensors; Atmospheric sensors; Sonar; Laser, Radar, hyperspectral sensors.

Platforms - Principles of satellite Missions; Types of platforms- airborne remote sensing, space borne remote sensing; Orbital elements of satellite; satellites for Land, Ocean, and atmospheric studies – IRS, Landsat, SPOT, Radarsat, quick bird, Ikonos and ESA satellite series.

Image Interpretation and Analysis - Fundamentals of satellite image interpretation; Types of imaging, elements of interpretation; Techniques of visual interpretation; Generation of Thematic maps.

Introduction to advanced Remote Sensing Technologies: Synthetic Aperture Radar; Side Looking Airborne Radar; Hyper spectral Imaging Spectrometer; Lidar; Thermal Imaging System; Advanced Laser Terrain Mapping.

PAPER 4. DIGITAL IMAGE INTERPRETATION

Introduction- Satellite data acquisition –Storage and retrieval – Data Formats – Compression – Satellite System – Data products – Image display system.

Geometric correction- Radiometric correction – Noise removal. Image Enhancement- Contrast Manipulation –Gray-Level Thresholding-Level Slicing-Contrast Stretching – Convolution – Edge Enhancement – Spatial feature manipulation –Fourier Analysis.

Multi Image Manipulation- Spectral Ratioing –Principal and Canonical Components–Vegetative Components – Intensity – Hue – Saturation – Colour Space Transformation.

Information Extraction - Principal -Component Analysis- Ratio Images- Multispectral Classification – Supervised Classification Stage- Minimum distance to means classifier, parallelepiped classifier, Gaussian maximum likelihood classifier – Training Stage: Graphical representation of the spectral response patterns, unsupervised classification- Hybrid – Classification – Classification of Mixed Pixels. Data output -Graphic Products – tabular data, Digital Information files – Post Classification Smoothing – Classification Accuracy Assessment. Classification error matrix, sampling consideration, evaluating classification error matrix.

Data Merging and GIS Integration - Multitemporal Data merging – Pattern recognition - Change detection procedures- Multisensor image merging – Merging of image data with Ancillary data- Incorporating GIS Data in automated land cover classification.

PAPER 5. AERIAL PHOTOGRAPHY AND DIGITAL PHOTOGRAMMETRY

Historical development of Aerial Photography; Definition and terms, concepts, principles and types of photogrammetry, types of aerial photographs, vertical photographs, tilted photographs, orthophotographs, aerial cameras, geometry and scale orientation and measurements, distortions, displacements and their corrections, photographic bands, principles of photography.

Planimetric Information from aerial photographs - Overlapping of vertical photographs, determination of scale and flying height. Stereoscopy and Parallax, Stereoscopic viewing, Stereoscopes, Orientation for viewing, Vertical exaggeration, Floating mark. Triangulation, aerial mosaics.

Theory and techniques of Orientation – Interior orientation, Exterior orientation, Relative orientation, Absolute orientation. Orthophotography – Classifications of orthophoto system, Strip rectification, orthophoto stereomate.

Photogrammetric Project Planning – Flight Planning, Photographic scale, Relief displacement, Tilt, Crab and drift, Flying height, Ground control. Principles of aerial photo interpretation.

Digital Photogrammetry: Digital photogrammetric systems, Digital photogrammetric work station and its configuration, photogrammetric scanners; various formats of data inputs; 3D visualization in digital environment, anaglyph, polarization, digital image matching, line interleaved, quad buffer; Interior, relative, absolute and exterior orientation parameters and process; automatic tie point generation; automatic production of digital elevation models, , accuracy assessment of block, feature extraction by 2D and 3D; Feature collection, feature classification, coding and annotation; database attachments, interactive editing, and layer concepts. Advantages of digital photogrammetry and introduction to digital photogrammetric softwares.

PAPER 6. DIGITAL IMAGE PROCESSING PRACTICAL

Satellite image processing using various softwares.

PAPER 7. AIRPHOTO INTERPRETATION PRACTICAL

Visual and digital interpretation of aerial photographs using mirror stereoscope; introduction and hands-on in LPS

SEMESTER II

PAPER 1. GEOGRAPHIC INFORMATION SYSTEM

Fundamentals of GIS : Basic concepts, Principles, Techniques, Procedures, Terminology, etc. Overview of GIS. Data in GIS : Temporal, thematic and spatial data. Main characteristics of spatial data. Basic spatial entity types. Attribute data. Various file formats.

Introduction, characteristics of database approach, intended uses of DBMS and RDBMS, implications of database approach. Database System Concepts and Architecture; classification of database management systems. Database design: Functional dependencies and normalization for relational databases, Normal forms based on primary keys, general definition of second and third normal forms.

The interface of remote sensing and geographic information systems – data encoding-datamanagement, data manipulation, data output. Data Input and Editing : Map Projections. Coordinate Conversion. Data Sources, Digitizing, data encoding, re-projection and transformation.

Data Structures in GIS : Various Raster and Vector data structures. Attribute data management. Data modelling : Points, lines, areas, networks and surfaces. Raster and Vector Spatial data models. Modelling of three and four dimensional spatial data.

Data Analysis : Proximity, neighbourhood and reclassification functions. Vector and Raster data analysis. Interpolation and overlay techniques. Display of images, Colour look up tables, Query analysis.

Global Positioning System : Overview of GPS and its applications. Cartographic communication process, including commercial and management aspects - map type, symbol and typographic design and use of colour - cartographic generalisation and map projection - concepts and technical constraints of the cartographic production line.

PAPER 2 APPLICATIONS OF GEOMATICS

Topographic mapping, and production of large-scale maps and photo and image maps - thematic mapping, including socio-economic and physical environment mapping, tourist maps, - data classification - visualisation of multimedia and web mapping.

Remote sensing based mapping – application of remote sensing for water resources management – application of thermal and RADAR remote sensing

Applications of GIS: Natural resource management, mapping and decision making; Urban planning and management; Water resources management; Disaster management; Environmental management; Demography, health, business and humanities.

Introduction to Web GIS: Definition, concept of Web GIS, History of Web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Fundamentals of computer networking – network environment – network communication models –protocols – TCP/IP. Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS, overview of Web GIS- Geoportals and data aquisition.

Basic introduction to GIS project management; Definition of plan, project, program and scheme. Functions of planning and management. Components of Geoinformatics project. Overview of Geoinformatics projects and types.

PAPER 3 GIS PRACTICAL

Introduction to softwares and production of various thematic maps

PAPER 4 PROJECT

The final part of the course is devoted to a production-oriented project in which, participants apply the knowledge and skills acquired during the course,

References

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