

M.Sc. Remote Sensing and Geographic Information System (GIS) Applications

SYLLABUS FOR SEMESTER – I

Paper 1: Aerial Remote Sensing (SOES/RS/C001)

- I- Introduction of Aerial Photography, Basic Principles of Aerial Photos (Photo flight planning, Types of Aerial Photos, Scale, Ground Coverage, Season of photography, Photographic Resolution) Spectral Sensitivity and Filters, Acquisition of Aerial Photographs, Production of aerial photographs, Procurement, and security of Aerial photos,
- II- Introduction to Photogrammetry, Fundamentals of Photogrammetry: Geometry of Aerial photos, Relief and Tilt Displacements, Stereoscopy, Parallax equation.
- III- Concepts of Stereo-photogrammetry, Sterovision, Measurement of Height, Aerial Triangulation and orthophotography, Principles and fundamentals of Aerial photo interpretation and Digital Photogrammetry.
- IV- Introduction to Cartography, Classification of maps, Visual variables, Generalization, Symbolization, Map design, Map layout and Map projection.

Paper 2: Satellite Remote Sensing (SOES/RS/C002)

- I- Principles and Basic Concepts of Remote Sensing, Physics of Remote Sensing, Effects of Atmosphere, Principles and Geometry of Sensors and CCD arrays, Spectral Reflectance of Earth Surface, different wavelength regions of electromagnetic spectrum, Thermal and microwave sensing.
- II- History of Space Imaging: Landsat, Spot, SEASAT, HCMM, SIR A&B, ERS, MOS, RADARSAT, NOAA and IRS Series, Meteorological Satellites, Sensors- Geometry and Radiometry, Orbit characteristics and Data Products.
- III- Principles and basic concepts of Multi spectral, Thermal and hyperspectral Scanning: Across-track and Along Track multispectral Scanning, Principles of Thermal Sensing, Geometric and Radiometric Corrections, Temperature Mapping.
- IV- Fundamentals of Image Interpretation, Type of Imagery, elements of Interpretation, Techniques of Visual Interpretation, Principles of Multispectral data analysis.

Paper 3: Digital Image Processing and Microwave Remote Sensing (SOES/RS/C003)

- I- Introduction to digital image processing, Image rectification, Restoration and Enhancement, Contrast, Spatial feature and multi-Image manipulation
- II- Image classification: Supervised classification, Unsupervised classification, Hybrid classification, Output stage, Post-classification smoothing and Classification accuracy assessment.
- III- Principles and basic concepts of microwave remote sensing, SLAR and SAR, Geometric characteristics, Spatial resolution and Interpretation of data.
- IV- Spaceborne Radar System: SEASAT, ERS, Radarsat, RISAT, Applications of RADAR remote sensing, Application of RADAR remote sensing.

Paper 4: Geographic Information System and Global Navigation Satellite System

(SOES/RS/C004)

- I- Introduction to Computer
- II- Principles and basics of Geographic Information System, Raster and Vector GIS, Database creation, Database models, database Management.
- III- Linking of spatial and non-spatial data, Network Analysis, Spatial data integration and modeling, Concept and application of DEM, Concept of Web GIS.
- IV- Basics of Global Navigation Satellite System (GNSS), GNSS constellation, IRNSS, GAGAN and applications of GNSS.

Laboratory Course I (SOES/RS/C005):

- i. Stereo test and study of different types of aerial photos, Orientation of Stereomodel. Visual interpretation of different types of satellite data
- ii. Study of Multispectral data, Study of Image Processing Systems, Display of raw data, Histogram analysis.
- iii. Digital classification and Enhancement of satellite data, Information extraction (Thematic) through digital image processing techniques.

Laboratory Course II (SOES/RS/C006):

- i. Study of Geographic Information System, Geo-referencing, designing GIS database, Editing spatial and attribute data, output generation.
- ii. Hands on training and geographical positioning study of GNSS system. Experiment on Bhuwan Geoportal.

SYLLABUS FOR SEMESTER – II

Paper 1: Environmental Management (SOES/RS/C007)

- I. Introduction; History of Environment, Major Environmental Problems, Concepts of Environmental Management, Environmental ethics, Resource and conflicts.
- II. Introduction to Environmental Laws; Stockholm Conference, The Earth summit, Environmental Protection and Fundamental rights, Environmental Governance in India, Man and Environment, Environment Concerns and WTO.
- III. Environmental Risk Communication, Approaches; Laws and Principles of Risk Communication and Organizational Ethics.

Paper 2: Environmental Impact Assessment (SOES/RS/C008):

- I. Introduction to the Environmental Impact Assessment, Planning and Significance, EIA practices and future trends in India, Legal frame work for EIA.
- II. Impact of Thermal power stations, River valley projects, Urbanization and Industrialization, Mining activities.
- III. Forest Fire Assessment and Risk Zonation, Flood monitoring, Snow melt and Glaciers, Ozone Layer Depletion, Acid rain and Toxicity of water.
- IV. Principles of Environmental Analysis, Project identification and proposal, Project appraisal, Project implementation, Project monitoring, Completion of report and Evaluation.

Paper 3: Disaster Management (SOES/RS/C009)

- I. Introduction to Natural Disasters (Hydro-meteorological, Geological and Environmental) and Technical Disasters (Industrial, Transport and miscellaneous accidents). Introduction to disaster management cycle; India's and International initiatives for disaster management.
- II. Concepts and Overview of agriculture drought, Flood mapping and monitoring, Forest fire mapping and assessment.
- III. Potential of RS, GIS and GNSS technology, Geo-spatial data requirement, Existing methodologies and tools with reference to disaster management, Potential of GIS based decision support system in management of emergencies.

Paper 4: Climate Change (SOES/RS/C010)

- I. Introduction to climate systems, Climatic summaries, Classifications, Climate and distribution of vegetation, weather and weather modification, Role of RS in monitoring climate change.
- II. Global warming and climate change, Effects of climate change on agriculture, water resources and sea level, Shift of plant range, Exotic species invasion, Loss of biodiversity, Ecosystem vulnerability, Droughts, Extinction of species, Habitat loss, Shifting of timberline, Forest cover change, Retreating of Glaciers, Coral reef bleaching and its assessment, Biotic indicators of climate change, Other disastrous and irreversible consequences of climate change.
- III. Renewable and non-renewable energy sources, Alternate source of energy, Fuel briquetting, Biomass estimation, Bio-diesel and methanol production, Biodegradable wastes, Carbon sequestration and carbon pools.

- IV. Policies for climate change at global level, International laws on climate change, economic review of carbon taxes, effect of climate change on global politics and developing countries.

Laboratory Course I (SOES/RS/C011):

- i. Preparation of base map and thematic maps for disaster management.
- ii. Designing GIS database for management of disaster prone area and output data generation.

Laboratory Course II (SOES/RS/C012):

- i. Preparation of base map and thematic maps for different risk zones.
- ii. Designing GIS database for disaster different risk zones output data generation.

SYLLABUS FOR SEMESTER – III

Specialization-I Forestry and Ecology

Paper 1: Forest Classification and Mapping (SOES/RS/C013FE)

- I. Natural vegetation of India and its classification, History of vegetation mapping in India, Basics of ecology and Forest ecology.
- II. Application of remote sensing in vegetation mapping, Spectral properties of vegetation and other features, Visual interpretation from satellite imagery.
- III. Digital image processing, Mapping and change detection, Microwave remote sensing and its applications in forestry, Monitoring forest changes and damages, Forest disease detection and monitoring.

Paper 2: Forest Inventory and Management (SOES/RS/C014FE)

- I. Principles of forest inventory, Forest sampling techniques, Planning forest inventory, Assessment of growing stock, Modern data processing techniques.
- II. Estimation and measurement of tree and stand height, crown diameter, crown count, crown density, volume and area.
- III. Geospatial data bases, Stock maps, their revision and updating, Forest Resources Information System, Land evaluation for forestry, Mapping for afforestation and social forestry sites, Biodiversity conservation planning.

Paper 3: Ecosystem Analysis (SOES/RS/E001FE)

- I. Ecological principles and concepts, structural and functional analysis of vegetation, Biomass estimation, landscape ecology.
- II. Concepts of ecosystem stability, Levels and role of biodiversity in ecosystem function and stability.
- III. IUCN categories of threat and terrestrial biodiversity hot spots, Ecosystem restoration, Wildlife habitat evaluation.

Paper 4: Eco-Development (SOES/RS/E002FE)

- I. Eco-development; Concepts and rationale, Eco-development planning in India, People participation in eco-development.
- II. Sustainability concepts, indicators and livelihood issues, Land use planning and eco-development monitoring, Need of Information for eco-development.
- III. Decision support system/Semi expert system for eco development planning, Industrialization and eco-development, Mapping of various sites, Expert opinion and report preparation.

Laboratory Course I (SOES/RS/C017FE)

- i. Study of the composition and structure and Forest regeneration study of different forest types at various altitudes using different sampling methods.
- ii. Preparation of forest/vegetation map on GIS

Laboratory Course II (SOES/RS/E003FE)

- i. Digital data analysis for vegetation, land cover and land use mapping for ecological purposes.
- ii. Measurements of spectral properties of different features in visible, NIR and Thermal IR portions of EM spectrum.

Specialization-II Agriculture and Soils

Paper 1: Crop Inventory and Agricultural Water management (SOES/RS/C013AS)

- I. Principles of Satellite imageries interpretation in Identification, Delineation and Classification of Agricultural crops, Landuse/landcover analysis, Crop inventory, Agro-ecosystem characterization, Agriculture water, Management.
- II. Principles of remote sensing in crop identification, discrimination and mapping, Spectral responses of different crops.
- III. Principles of remote sensing in landuse mapping and planning, Course spatial resolution data use in district level statistical information extraction.

Paper 2: Crop Inventory and Management (SOES/RS/C014AS)

- I. Principles of remote sensing in crop inventory; Identification and Classification, Crop acreage estimation, Crop suitability and Crop production forecasting.
- II. Crop condition and damage assessment; Crop stress, Crop diseases, Insect damage, Effect of crop condition on the spectral response.
- III. Crop Monitoring; Spectral response in different growth periods, Selection of optimum growth period for discrimination of crop from other crops and vegetation features, Integrated crop-weather-soil technology modelling.

Paper 3: Soil Mapping and land Evaluation (SOES/RS/E001AS)

- I. Principles of Air photos and satellite data Interpretation in soil survey and mapping, Factors affecting reflection and response of soils.
- II. Procedures of Soil surveys, Scale and Accuracy of mapping, Recognition and Identification of soils, Soil characteristics, Land suitability and capability classification, Methodology for soil mapping and land evaluation.
- III. Application of remote sensing in soil conservation and Watershed management, Watershed analysis for soil conservation, Identification and mapping of degraded lands, Sediment yield, soil loss estimation, Identification of priority areas.

Paper 4: Soil Resource Management (SOES/RS/E002AS)

- I. Introduction to soil resource, Physiographic and soil Geomorphology, Soil mapping and classification, Image enhancements and classification techniques in soil mapping.
- II. Advances in soil mapping and erosion modelling, Agents and kinds of erosion and their identification, Characteristics of eroded and non-eroded soils, Sustainable land management.
- III. Mapping of soil salinity and waterlogged areas, Water management practices and soil moisture studies.

Laboratory Course I (SOES/RS/C015AS):

- i. Visual interpretation of satellite data for identification and mapping of different crops.
- ii. Digital analysis of satellite data for landuse mapping, crop identification, crop acreage estimation and crop yield forecasting.
- iii. Comparative study of B/W, IR and colour photographs for soil mapping.

Laboratory Course II (SOES/RS/E003AS):

- i. Identification and mapping of drainage patterns, landforms, analysis of relief and slope on aerial photos at different scales.

- ii. Use of satellite imagery for preparation of soil maps, Delineation of waterlogged areas, Identification of saline and sodic soils.
- iii. Classification of soils up to family level using soil profile data and preparation of land capability maps.

Specialization-III Geosciences

Paper 1: Remote Sensing in Geology (SOES/RS/C013GS)

- I. General principles of Aerial/satellite data interpretation in geology,
- II. Principles of aerial/satellite data interpretation in lithological identification and structural analysis, Identification and mapping of structural features (faults, fractures, folds, joints, etc.).
- III. Geological interpretation on thermal and microwave remote sensing data, Remote sensing in oil/mineral exploration.

Paper 2: Applied Geomorphology (SOES/RS/C014GS)

- I. Fundamentals of geomorphology, Environmental geomorphology
- II. Principles of geomorphic analysis, genesis of landforms, Terrain evaluation and classification.
- III. Relief lowering and principles of planar surface, Influence of various geomorphic agents and processes, Role of climate and time in geomorphic evolution.
- IV. Applied geomorphology- application in groundwater, Water resources conservation,

Paper 3: Engineering Geology and Ground Water (SOES/RS/E001GS)

- I. Principles of engineering geology, Construction material survey, Mass movement processes.
- II. Route alignment studies, Dam and reservoir site locations, Significance of geological mapping of rock structure and landforms and their hydrological properties in ground water exploration.
- III. Remote sensing and GIS applications in ground water in rocks. Consolidated, semi-consolidated and unconsolidated material.

Paper 4: Glaciers Monitoring (SOES/RS/E002GS)

- I. General glaciology: types of erosion, different deposits, Aeoline, Fluvial lacustrine, alluvial deposits.
- II. Morains and their forms, Glaciers formation, retreating and sliding.
- III. Mapping of retreating of glaciers.

Laboratory Course I (SOES/RS/C015GS):

- i. Basic Geomorphic mapping using aerial photos and satellite imageries.
- ii. Mapping of igneous, sedimentary and metamorphic rocks using aerial and satellite data.
- iii. Preparation of geological maps using GIS techniques

Laboratory Course II (SOES/RS/E003GS):

- i. Drainage mapping and analysis using multi spectral satellite data.
- ii. Mapping of intrusive bodies and volcanoes using aerial/satellite data (including thermal and microwave).
- iii. Application of digital image processing techniques in geological studies.

Specialization-IV Human Settlement and Analysis**Paper 1: Urban Area Analysis (SOES/RS/C013HS)**

- I. Spectral characteristics of different surface features, Urban area interpretation, Space use, landuse planning.
- II. Principles of aerial photography and remote sensing in land evaluation and suitability for settlements.
- III. Principles of aerial photo interpretation and satellite data in classification of residential area and estimation of population settlement.
- IV. Aerial photos and census operation, Traffic and parking survey.

Paper 2: Physical Planning and Statistical Methods (SOES/RS/C014HS)

- I. Fundamental aspects of physical planning, Statistical methods.
- II. Urban development planning, management planning, settlement geography, Regional planning.
- III. Small format aerial photography for updating base maps and monitoring urban growth.

Paper 3: DIP and GIS for urban studies (SOES/RS/E001HS)

- I. Digital image processing and analysis for urban area development, growth monitoring and change detection.
- II. Geo-information system and analysis for improving existing and development new urban areas for human settlement.
- III. Grid cell data processing and urban management modeling.

Paper 4: Urban Facility Planning (SOES/RS/E002HS)

- I. Preparation of photomaps for base mapping and cadastral mapping for urban area development.
- II. Urban and regional mapping using various remote sensing data products, Updating, monitoring, using high resolution data products.
- III. Thematic cartography, thematic hazard and risk management.

Laboratory Course I (SOES/RS/C015HS)

- i. Recognition and detection of different settlements on satellite imageries/aerial photo.
Preparation of urban land use maps using SOI toposheets.
- ii. Digital image processing techniques for urban planning and development.

Laboratory Course II (SOES/RS/E003HS):

- i. Preparation and updating of base maps on geographical information system.
- ii. Urban Management Modeling, Planning for establishment of habitation under various land forms.

Specialization-V Water Resources

Paper 1: Water Resources Assessment (SOES/RS/C013WR)

- I. Hydrologic elements, Hydrological cycle and general principles of remote sensing for evaluation of hydrologic elements.
- II. Application of geology and geomorphology in hydrology, Rock type and structural interpretation, Drainage characterization, Morphometry, River morphology, landform analysis, slope analysis.
- III. Landuse/landcover features in hydrology- type to landuse, landcover classification, Hydrologic soil grouping.
- IV. Rainfall-runoff modeling, water quality, water balance, Evapo-transpiration.

Paper 2: Watershed Characterization (SOES/RS/C014WR)

- I. Watershed hydrology and physical processes in the watersheds, Watershed characterization, drainage analysis, Erosion assessment.
- II. Spectral response of water in different parts of electro magnetic spectrum, Characteristics of water in multispectral imagery.
- III. River hydraulics; types of rivers, river behaviour, Migration and silt discharge, Irrigation and drainage engineering.
- IV. Digital Elevation Model; Application in water resources, Soil erosion, watershed prioritization, management and conservation planning.

Paper 3: Water Resources Management (SOES/RS/E001WR)

- I. Flood risk zone mapping and damage assessment, Drought monitoring and management.
- II. Irrigation water management, Water harvesting structures, Ground water modeling.
- III. Hydrometeorology; Analysis of weather system, cyclone and depressions based precipitation (including storm-runoff modeling) estimation.
- IV. Flood plain zoning and management.

Paper 4: Water Resources Development (SOES/RS/E002WR)

- I. Reservoir sedimentation, Water logging and salinity, Water quality assessment.
- II. Planning, Investigation and Feasibility study of multipurpose water resources projects.
- III. Environment Impact Assessment of multipurpose water resources projects.
- IV. Flood estimation, forecasting, warning and damage assessment.

Laboratory Course I (SOES/RS/C015WR):

- i. Hydrologic soil grouping, Irrigability classification.
- ii. Flood plain mapping, flood forecasting and damage assessment
- iii. Erosive impacts by channels, streams and rivers.
- iv. Impacts of dams on the down stream conditions.

Laboratory Course II (SOES/RS/E003WR):

- i. Study of aerial photographs/satellite data for evaluation of hydrologic elements.
- ii. Snow covers mapping and accuracy estimation from multi-date data.
- iii. Flood plain mapping and erosion prone areas.
- iv. Visual interpretation of aerial/satellite data for watershed characterization and damage assessment.

SEMESTER-IV

Experimental Designing (SOES/RS/C016):

- i. Population and sample, presentation of data- tabulation, Frequency distribution, Measure of central tendency and coefficient of variation.
- ii. Correlation and regression, examples of linear regression and its fitting by least square method, probability, basic laws of probability.
- iii. Principal steps in sample surveys, population, sampling unit, size of sample (sample intensity) bias, accuracy and precision, simple random sampling, stratified random sampling, Systematic sampling and point sampling.
- iv. Principles of experimental design, Randomization, layout and analysis of data of Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split Plot and Strip plot design.

Research Methodology (SOES/RS/C017)

- i. Selection of research problem and Writing of project proposals.
- ii. Generation of research questions, objectives of research study, proposing hypothesis, planning of literature survey and use of computer based literature.
- iii. Planning for field work, Data collection and statistical analysis.
- iv. Interpretation and deriving inferences and conclusions, preparation of dissertation and development of scientific articles for publication.

Laboratory Course I (SOES/RS/C018)

- i. Laying out of designs in the field (Latin Square Design, Replicated and Randomized designs, Split Plot and scattered Block Designs).
- ii. Laying out of sample plots in different Forest types, estimation of the volume in natural and plantation forests
- iii. Moisture percentage and water holding capacity of various soils.
- iv. Land use/land cover map preparation.

Project Work and Dissertation (SOES/RS/E004)*

- I. Dissertation.
- II. Presentation of Dissertation work