M.Phil Syllabus on Earth System Sciences

Department of Geography & EM and Department of Remote Sensing & GIS

Semester	Course No	Course Name	Lecture (Hours)	Credit
Semester – I (50 x 4 = 200)	ESS-111	Research Methodology	10	4
	ESS -112	Advance Statistics and Geo-spatial Techniques	10	4
	ESS -113	Advance Learning of Earth system Sciences	10	4
	ESS -114	Concept and Techniques in Social Sciences	10	4
Semester – II (50 x 4 = 200)	ESS -121	Software and Laboratory	10	4
	ESS -122	Field Techniques	10	4
	ESS -123	Elective Courses (Theory)	10	4
	ESS -124	Elective Courses (Practical)	10	4
2nd Year	ESS -221	Project work, Final Report and Defense in presentation	30	8

Total Marks – 500
Total Lecture (Hours) – 120
Total Credit – 12

Semester - I (Course work) **Credit-4**

Course -1: ESS-111: Research Methodology:

1. Introduction to Research: Types, Objectives and Methods
2. Review of literature and bibliography
3. Research Design
4. Research report, Citation and Referencing
5. AssignmentWriting

Course-2: ESS-112: Advance Statistics for Geo-spatial Analysis

1. Concept of variables, vectors, probability and sampling / sampling design and applications
2. Hypotheses and their testing.
3. Bivariate correlation and linear regression: problem of estimation and problem of inferences.
4. Principal component analysis.
5. Multiple linear regression: problem of estimation and inferences.Multicollinearity and heteroscadascity, problem of autocorrelation,Model Selection procedure: information criterion, variable inflation factor.
6. Bivariate nonlinear regression: problem of estimation and inferences, Logistic regression
7. Path modelling, Regression tree
8. Concept of autocorrelation and variogram, techniques and methods of interpolation, role of interpolation for surface modeling.
9. Time series analysis: linier trend analysis, MK Test, Sen's slope estimation
10. Geospatial Techniques: applications of RS & GIS in Geoscience research
11. Instigation and analysis of spatial and non-spatial data using RS & GIS techniques: spatial data generation using various types of aerospace data; merging of image data with ancillary data; real world cases studies link to competency based domains and problem base learning (e.g. Urban, LULC, Geomorphology, Geology etc.)
12. Assignment Writing

Course-3: ESS-113: Advance Learning of Earth system Sciences

1. Geological time scale, Dating techniques; Fundamental concepts, Geomorphic agents, Drainage patterns, Soils, Classification of Landforms, Inage characteristics of major Landforms.
2. Quaternary Geology and applied Geomorphology
3. Remote sensing techniques in quaternary geological and applied geomorphological mapping: Hyperspectral, Thermal, Micro wave – Concept and applications
4. GNSS (viz. GPS, GLONASS, GALLELIO and Indian Navigation System) Application in Geological / Geomorphological and Societal survey
5. Concept and application of Geosciences in Natural Hazards and Disaster Management.

Course-4 (ESS-114): Concept and Techniques in Social Sciences (FM-50 X 4) = 200

1. Economic and Environmental issues related to Tourism and Travel Management.
2. Research Design under Realism and Structuralism.
3. Social Indicators of Development with Special Reference to Health and Education
4. Gender and Development: Regional Dimensions with Special Reference to India
5. Environmental hazard and mitigation strategies
6. The ecology of cities: Approaches to sustainability and management
7. Human dynamics: social–ecological–technical/built system (SETS) interaction.

Semester –II (Elective Papers and Practical Papers)

Course-5: ESS 121 : Software and Laboratory Courses Credit-4

1. Computer programming, use of RS and GIS software and Digital techniques and Cartography
2. Laboratory Methods in Geo-Sciences: Sediment, Soil, Water, Air, and Geo-Chemical Analysis
3. Multivariate data analysis:Applied Geo-statistics using R, Principal component regression, Partial least square regression, canonical correlation, linear discriminant analysis.
4. Spatial regression; Krigging, linear modeling and Random forest
5. Multi-criteria decision making; V/F testing: multi-collinearity AHP
6. Practical Notebook and Viva Voice

Course-6: ESS-122: Field Techniques (Any two applications)

1. Geomorphological mapping techniques in the field
2. Identification of Sedimentary structures in the field
3. Assessment of disaster in the field
4. Identification of Planation surfaces in the field
5. Total station survey for micro contour plan
6. Use of GPR in the field research
7. Respondent Survey Techniques
8. Use of Current Doppler
9. In-Situ surveying for field validation techniques
10. Practical Notebook and Viva Voice

Course -7: ESS-123: Elective Courses

(A) Fluvial Landscape: System, Processes and Forms (Theory)

1. Fluvial landscape and River System: Spatial and temporal considerations
2. Concept of Catchment Connectivity
3. Landscape sensitivity and resilience. Boundary conditions and controls: Imposed and flux boundary
4. Impelling and Resisting forces in river system
5. Human Impacts on River System: Forms of disturbances, responses and recovery

(B) Theories in Landscape Ecology

1. Landscape Perception ; Introduction to Landscape Ecology
2. Drivers of Landscape Patterns
3. Land System Modelling; Landscape Modelling , Landscape Metrics
4. Ecosystem Services and Valuation ; Land Ethics
5. Landscape and Society; Urban Ecology

(C) **Coastal Geomorphological and Environmental research**

1. Geomorphological features developed by coastal processes
2. Genetic classification of coasts and environmental issues
3. Modern approaches in coastal studies with special reference to India
4. Coastal habitats and costal wetland geomorphology
5. Field Techniques in coastal geomorphological research

(D) Atmosphere and Aerosol Climatology

In this course we would like to learn some of the basic concepts of aerosol physics and chemistry, and also try to understand the basic idea of aerosol remote sensing. The course would also focus on the interaction of aerosol with other meteorological parameters.

1. Atmospheric particle size distribution, types and sources of aerosols in the atmosphere.
2. Formation of secondary aerosol particles; photochemical reactions under the presence of gaseous precursor.
3. Scattering of light based on the size and chemistry of the aerosol particles.
4. Remote sensing of atmospheric aerosols; available in-situ and satellite remote sensing methods.
5. Spatio-temporal variation of atmospheric aerosols; distribution and causes of temporal variation. Interaction with the relative humidity, precipitation, wind speed. Altitude effect of the spatial distribution aerosols.
6. Possible climate effects.

(E) Applications of Thermal and Microwave Remote Sensing

1. Concept of thermal conductivity, thermal capacity, thermal inertia, thermal diffusivity, emissivity, sensing radiant temperatures, radiant versus kinetic temperatures, blackbody radiation, atmospheric effects, interaction of thermal radiation with terrain elements.
2. Thermal sensors and scanners, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery.
3. RadarSystems: airborne and space borne SLRs and their components, imaging systems, radar wavelengths, scattering theory, spatial resolution and theoretical limits, azimuth resolution, real aperture and synthetic aperture RADAR systems.

(F) Sedimentology: Focus on Fluvial Depositional System

1. Depositional systems, Source to sink relation from sediments
2. Sedimentary Facies and Walther's law
3. Depositional and erosional structures
4. Fluvial facies and architectural elements
5. Interpretation of different fluvial depositional system

(G) Urban Development and Planning (Theory)

1. Rural urban fringe and dynamics of peri urban development
2. Urban land economics and urban sprawling
3. Urban explosion in developing countries: problems of poverty and slum
4. Problems of civic amenities and facilities
5. Emerging urban problems: urban hydrology, solid waste management and urban heat island

(H) Geospatial Survey and Geodesy

1. Fundamentals of Geodesy
2. Coordinate system and Map projections
3. Aerial Survey and Digital Photogrammetry
4. Satellite and areal altimetry, interferometry GNSS
5. Gravity field analysis

(I) Advance land system studies

1. Land system studies: Theory / Empirical and Process based models
2. Use of Remote Sensing techniques for deriving bio physical parameter and empirical models and bio-diversity characterization

Course -8: ESS-108: Elective Courses

(A) Fluvial Landscape: System, Processes and Forms

1. Analysis of Stream Network and Hydraulic Character
2. Estimation of Sediment Flux
3. Calculation of Critical Shear stress for Entrainment
4. Reading a fluvial landscape: Practical Approach
5. Case Study of Human Impacts on River System: Forms of disturbances, responses and recovery

(B) Applications in Landscape Ecology

2.1 Biomonitoring and Bioindicator measuring field techniques
2.2 Habitat suitability mapping
2.3 Application of GIS techniques formeasuring patterns and Structures on landscapes;Fractal Geometry of Landscapes
2.4 Case Study: Anthropogenic Impact on Wildlife Habitat in North Bengal and South Bengal forests
2.5Case Study: Urban Ecology of fragile environment

(C) Applied coastal research

1. Climate change and sea level rising process and their consequences
2. Research on mega deltas of the word
3. Coastal sensitivity and development activities
4. Coastal Zone Management, CRZ Rules, ICZM
5. Coastal Hazard Zonation Mapping and Environmental Zoning approach in sustainable management
6. Future of Coastal Society in India

(D) Physical basics of aerosol climatology (Practical applications)

1. Air sampling techniques using high volume sampler.
2. Gas and Particle analysis techniques.
3. Analysis of aerosol optical depth using MODIS, MISR, OMI and CALIPSO data
4. Aerosol source attribution using air mass trajectory analysis- HYSPLIT application.
5. Multivariate analysis to understand the interaction of aerosols on other meteorological parameters.
6. Weather data management from meteorological park (Station Data)

(E) Applications of Thermal and Microwave Remote Sensing (Practical works)

1. Concept of thermal conductivity, thermal capacity, thermal inertia, thermal diffusivity, emissivity, sensing radiant temperatures, radiant versus kinetic temperatures, blackbody radiation, atmospheric effects, interaction of thermal radiation with terrain elements.

2. Thermal sensors and scanners, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery.
3. RadarSystems: airborne and space borne SLRs and their components, imaging systems, radar wavelengths, scattering theory, spatial resolution and theoretical limits, azimuth resolution, real aperture and synthetic aperture RADAR systems.

(F) Sedimentology Practical:

1. Texture, shape, size, structures with granulometricstudies and composition of sedimentary rocks
2. Field based practical for sample/data collection
3. Sedimentary facies identification and correlation vertical as well as lateral
4. Palaeocurrent analysis in the filed
5. Preparation of vertical logs from field and drawing the logs in lab using software

(G) Urban Development and Planning (Practical applications)

1. Identification of rural urban fringe
2. Demand supply analysis of urban services
3. Urban ecological footprint measurement
4. GHG emission and global warming potential measurement
5. Identification of Urban Heat Island with space based and in situ observation

(H) Geospatial Survey and Geodesy (Practical applications)

1. Fundamentals of Geodesy
2. Coordinate system and Map projections
3. Aerial Survey and Digital Photogrammetry
4. Satellite and areal altimetry, interferometry GNSS
5. Gravity field analysis

(I) Advance land system studies (Practical applications)

1. Land system studies: Theory / Empirical and Process based models
2. Use of Remote Sensing techniques for deriving bio physical parameter and empirical models and bio-diversity characterization

2ND YEAR

Course -10: ESS-221: Project work, Final Report and Presentation Credit-8

Progress in Project work, Report Submission and Viva: