Interdisciplinary Department of Remote Sensing & GIS Applications
Aligarh Muslim University
Aligarh 2020001

Learning Outcome Based Syllabus

Under Choice Based Credit System (CBCS)

M. Sc. in Remote Sensing & GIS Applications

Session
2019-20

PROGRAM: M. Sc. in Remote Sensing & GIS Applications

Programme Educational Objectives (PEOs)

PEO 1: To prepare the students in identifying, analyzing and solving geospatial problems.
PEO 2: To train the students in developing practical and executable solutions to the challenges of growing field of Remote Sensing and GIS.
PEO 3: To impart the students with strong base of knowledge that makes them suitable both for industries as well as for teaching and research.
PEO 4: To inculcate the students with the sensitivity towards ethics, public policies and their responsibilities towards the society.

Programme Specific Objectives (PSOs)

PSO1: To impart theoretical and practical knowledge in both teaching and research as well as in industries.
PSO2: To obtain and apply professional ethics, accountability and equity
PSO3: To carry out geospatial research/investigation independently and development work to solve real life problems.
PSO4: To train students to join in various premier public & private institutions relevant to Geospatial technology like IIRS, IMD, NRSC, ICRISAT, DRDO, SAC, Rolta India, RMSI, ESRI and many more.

Programme Outcomes :(POs)

After the completion of this programme students should be able to:

PO1: To impart knowledge and differentiate GIS & Cartography, normal versus spatial data.
PO2: To enhance and equipped with concepts, methodologies and applications of Remote Sensing technology.
PO3: Apply spatial data analysis to solve natural, environmental and societal problems and challenges
PO4: Ability to write and present a substantial technical report/document and publish international level research articles.
PO5: Students should be able to demonstrate a degree of mastery over the areas of Remote Sensing and GIS technology. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

SEMESTER I | Paper 1. RSM 1001 (Core) |Credit (2) |Marks 100

Principles of Remote Sensing

Course Objective:

1. To impart understanding of basic and fundamentals of remote sensing components.
2. To gain knowledge about various remote sensing missions

Unit I. Definition; History of Remote Sensing; Physics of Remote Sensing: Electromagnetic Radiation (EMR), Characteristics; Electromagnetic Spectrum (EMS); Interactions Between Matter and Electro-Magnetic Radiation; Energy Interaction in The Atmosphere; Energy Interactions with The Earth's Surface. Radiation Laws. Atmospheric Windows; Types of Remote Sensing with Respect to Wavelength Regions.

Unit II. Sensor and Platforms. Sensor Technology; Historical Development; Types of Platforms and Sensors– Airborne Remote Sensing; Space Borne Remote Sensing; Orbital Elements of Satellite; Sensor Types Characteristics: Active and Passive Remote Sensing; Imaging Systems; Non-Imaging Sensors; Across Track and Along Track Scanners; Framing and Scanning Systems; Characteristics of Optical Sensors; Resolution.

Unit III. Remote Sensing Satellites and Data Products: Overview of Different Satellite and Sensors for Earth Observations– Coarse; Medium and High-Resolution Missions (Landsat Series; SPOT; Ikonos; Quickbird; ASTER; Sentinel; Aqua and Terra (MODIS); SAR and Future Missions.

Unit IV. IRS Missions: IRS 1A; IRS 1B; IRS-P2; IRS-1C; IRS-P3; IRS-1D; Oceansat (IRS-P4); IRS P6 / Resourcesat-1; Cartosat-1; Cartosat-2; Cartosat-2A; Chandrayan-1; RISAT-1; RISAT-2; Oceansat-2; Cartosat-2B; Resourcesat-2; Megha-Tropiques; SARAL; Resourcesat-2A; Mars Orbiter Mission Spacecraft.

Course Outcome:

1. Understanding basic components of remote Sensing
2. Students may able to obtain knowledge of the sensor characteristics of various RS Systems
3. Acquire knowledge of different missions & their utility
4. Students may able to understand functioning, data acquisition and orbit operations of missions.

Recommended Books and Suggested Readings

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.

Rees, W. G. (2012). Physical Principles of Remote Sensing. Cambridge University Press.

Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.

Sabins, F. F. (2007). Remote Sensing: Principles and Applications. Waveland Press.

SEMESTER I | Paper 2.RSM 1002 (Core) | Credit (2) | Marks 100

Applied Cartography

Course Objective:

1. To impart knowledge of cartography and its various components
2. To gain knowledge of various surveying methods and their data generation and output
3. To understand the working of Total Station and GPS equipment and solve the surveying problems.

Unit I. Cartography - Meaning and Scope; Nature of Cartography; Historical Development; Cartography for Visual Communication; Maps - Classification of Maps; Map Scale; Conventional Symbols; Topographic Maps; Map Layout; Labeling Techniques, Color Choice and Symbolization; Post-Processing of Maps in Raster and Vector Graphic Editing Environments.

Unit II. Map Projection: Map Projection and Co-Ordinate System; Datums; Ellipsoid and Geoid; Introduction to Various Spheroid / Ellipsoid Systems. Map Distortion and Types; Types of Map Projections - Conical; Cylindrical; And Azimuthal/Planar Projections. Recent Projections; Basics of 2D Transformations – Affine Transformation - Choice of Map Projection.

UnitIII. Surveying Techniques: Objectives and Importance of Surveying. Principles of Surveying. Surveying Instruments and Techniques. Errors; Types of Errors; Precision and Accuracy.

Unit IV. Collection of Ground Truth. Basic Principles of Total Station; Historical Development; Classifications; Applications and Comparison with Conventional Surveying. Applications of GPS and DGPS In Surveying; Data Processing and Accuracy; Factors Affecting Accuracy.

Course Outcome:

5. Understanding basic components of cartography
6. Acquiring knowledge about various map projections and their characteristics
7. Gaining knowledge about various surveying techniques
8. Understanding modern methods of surveying and data processing
9. Understand the working principle of GPS , it's components, signal structure, and error sources and to understand various GPS surveying methods and processing techniques used in GPS observations

Recommended Books and Suggested Readings

Peterson G. GIS Cartography: A Guide to Effective Map Design Boca Raton, FL: CRC Press. ISBN: 978-1-4200-8213-5.: 2015:

Brewer Cynthia A. Designed Maps: A Sourcebook for GIS Users 1st Ed.: Redlands, Calif.: ESRI Press: C2008: Xi, 170 P.: ISBN: 9781589481602 Search the University Library Catalogue

Peterson Gretchen N. Cartographer's Toolkit: Colors, Typography, Patterns Fort Collins, Colo.: Petersongis: C2012.: Xiv, 169 P.: ISBN: 9780615467948

Gill, S., & Aryan, A. (2016). To Experimental Study for Comparison Theodolite and Total Station. Total Station and Its Applications in SurveyingHttp://Www.Gisresources.Com/Total-Station-And-Its-Applications-In-Surveying/

SEMESTER I | Paper 3. RSM 1003(Core) | Credit (2) | Marks 100

Aerial Photography and Photogrammetry

Course Objective:

4. To impart understanding of the basics of aerial photography and phoogrammetry
5. To gain knowledge about methods of photogrammetry and air photo interpretation.

Unit I. Aerial Photographs: History of Aerial Photographs; Classification and Types; Characteristics of Aerial Photographs; Geometry of Aerial Photographs; Planning Aerial Photograph Missions; Types of Aerial Cameras; Elements of Aerial Photos; Scale of Aerial Photographs.

Unit II. Errors in Aerial Photographs and their Rectification: Roll, Pitch, Yaw; Stereoscopic Parallax; Measurement of Absolute and Differential Parallax; Height and Slope Measurements from Aerial Photos; Relief Displacement of Vertical Features and Its Determination; Vertical Exaggeration - Factor Affecting Vertical Exaggeration.

Unit III. Photogrammetry and Mapping: Photogrammetry – Definition; Fundamentals of Human Stereoscopy; Methods of Stereoscopic Viewing - Lens and Mirror Stereoscopes; Concepts of Interior, Relative and Absolute Orientation. Aerotriangulation; Introduction to Ortho Photos and Ortho Mosaic.

Unit IV. Digital Photogrammetry; concepts, types and characteristics; Unmanned Aerial Vehicle Systems: Planes, Helicopters, Drones; Sensors Onboard UAVs: Capabilities and Technologies; Data Processing from UAVs; Applications of Unmanned Aerial Vehicle (UAV) Based Remote Sensing; Structure from Motion (Sfm) Photogrammetry.

Outcome:

1. Understanding of various types of aerial photographs and their scale
2. Students may able to know errors in aerial photographs and their rectification
3. Handling and knowledge of mirror and pocket stereoscopes
4. Familiarize with concepts of choosing map projections, 2D transformation
5. Acquiring knowledge about recent advances in aerial surveying and mapping

Recommended Books and Suggested Readings

Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective. Pearson Education India.
Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.
Tator, B. A. (1951). Some Applications of Aerial Photo-Graphs to Geographic Studies in The Gulf Coast Re-Gion. Photogrammetric Engineering, 17(5), 716-725.
Gupta, R. P. (2017). Remote Sensing Geology. Springer.
Sabins, F. F. (2007). Remote Sensing: Principles and Applications. Waveland Press.
Wolf, P. R. (2000). Elements of Photogrammetry with Applications In GIS.
Colomina, I., & Molina, P. (2014). Unmanned Aerial Systems for Photogrammetry and Remote Sensing: A Review. ISPRS Journal of Photogrammetry and Remote Sensing, 92, 79-97.
Micheletti, N., Chandler, J. H., &Lane, S. N. (2015). Structure from Motion (SFM) Photogrammetry.

SEMESTER I | Paper 4. RSM 1004 (Core) | Credit (4) | Marks 100

Basic Statistics and Data Analysis

Course Objective:

1. To acquire understanding of the basic statistics for data analysis with reference to spatial data
2. To know different statistical methods for parameter estimation & inference
3. To acquire the skill of R programming

Unit I- Introduction: Descriptive Statistics: Measures of Location; Measures of Variability; Skewness and Kurtosis; Data Visualization: Histograms; Box Plots; Scatter Plots.

Unit II- Probability Theory: Probability Concepts; Probability Distributions, and Its Properties; Expected Value and Moments; Joint Distributions and Independence; Covariance and Correlation.

Unit III- Statistical Inference: Point Estimation of Parameters; Definition and Properties of Estimators; The Method of The Moments and Plug-In Principle; The Maximum Likelihood Estimation; Interval Estimation; Tests of Hypothesis: Samples from Two Populations; Probability Plots and Testing for Population Distributions; Probability Plots; Kolmogorov-Smimov Statistic; Chi-Squared Test.

Unit IV. R Programming; Vectors and Assignment; Vector Arithmetic; Arrays and Matrices; Lists and Data Frames. Import/Export of Data Objects; Defining New Functions; Elements of Graphics with R; Numeric and Graphic Summaries of Data.

Course Outcome:

1. Understanding of basic statistical methods for data analysis
2. Handling and knowledge of different probability methods for parameter estimation
3. Acquire skills R programming for computer based data analysis of data objects for different GIS functions

Recommended Books and Suggested Readings

Peter Bajorski (2012): Statistics for Imaging, Optics, and Photonics, John Wiley &Sons.

Gupta, S.C. And Kapoor, V.K. (2000): Fundamentals of Mathematical Statistics: A Modern.Approach, Sultan Chand.

Alfred Stein Freek Van Der Meer and Ben Gorte (2002): Spatial Statistics for Remote Sensing, Kluwer Academic Publisher

W. N. Venables, D. M. Smith and the R Core Team: An Introduction to R Notes on R:A Programming Environment for Data Analysis and Graphics

M.J. Crawley (2013): The R Book, John Wiley & Sons.

SEMESTER I | Paper 5, RSM 1005 (Core) | Credit (2) | Marks 100

Fundamentals of Data Structure and Computer Programming

Course Objective

1. To introduce the concept of data structures and apply these data structures in problem solving.
2. To learn the basic concept of database

Unit I. Basic Data Structure: Introduction to Linear and Non-Linear Data Structures; Arrays and Its Memory Representation; Two-Dimensional Arrays; Program on Matrices; Character of Array; Introduction to Linked List; Stack and Queues; Hierarchical form of data structure; Introduction to Trees and Graphs

Unit II. Introduction to Database: Database and its purpose, characteristics of database approach, database systems and their needs, components of database system, database System architecture, database administrator and his role, database management system and its components, types of data base management systems, RDBMS, OODBMS, ORDBMS etc.

Unit III. Introduction to Programming; Introduction To 'C'; Importance Of 'C' Language; Program Structure; Data Types; Variables; Expressions; Statements; Operators; Input-Output Functions; Some Basic Programs.

Unit IV. JUMPING; BRANCHING; LOOPING Decision Making Statements: IF; IF-ELSE; NESTED IF-ELSE; SWITCH-CASE; Repetitive Statements: FOR; WHILE; DO-WHILE; Structured Programming; Break and Continue Statements; Array Handling; Handling of Character Strings; Some Programs Practice.

Course Outcome:

1. Learn the fundamental concepts of data structures.
2. Analyze the importance and use of database.
3. Know the basis of C programming.
4. Understand some advanced concepts of C programming

Recommended Books and Suggested Readings

Data Structures by Lipschutz (Schaum's Outline Series)

Date, C. J. : "Introd. To Data Base Systems", Addison Wesley 6th Ed.

Elmasri & Navathe "Fundamentals of Database Systems" 5th Edition

Programming in C by Gotfried B. S. (Schaum's outline series)

Introduction to C by Yeshwant Kanitakr

Data Structures by Lipschutz S. (Schaum's outline series)

SEMESTER I | Paper 6. RSM 1011 (AE) | Credit (4) | Marks 100

Earth System Science

Course Objective:

1. To acquire and understand knowledge about basics of earth of and it various sub-system
2. To gain knowledge about various major feature of earth and their significance

Unit I. Lithosphere: Originand Evolution of The Earth; Interplay between the Lithosphere, Hydrosphere and Atmosphere; Continental Driftand Plate Tectonics; Interior of Earth; Weathering and Erosion; Rock Cycle; Mineral: Common Rock Forming Minerals.

Unit II. Atmosphere: Components and Structure; Weather and Climate Variability; Air Quality; Atmospheric Chemistry; Atmospheric Circulation (Regional and Global Patterns), Weather Patterns and Predictions, Climate Variability in The Past and Future; Greenhouse Gases.

Unit III. Hydrosphere: World's Ocean Basins, Their Formation, And Evolution Through Time; Water on The Earth, Physical, Biological, Chemical, And Geological Processes That Occur Within the Ocean and At Its Margins; Salinity and Temperature; Flora and Fauna.

Unit IV. Cryosphere: The Role of Ice Within the Earth System; Glaciers; Ice Sheets; Permafrost; Sea Ice; Cryosphere Metrology; Observing the Current Health of The Ice Sheets; Snow Cover Observation; Avalanches; Mapping Glacial Geomorphology.

Course Outcome:

1. After this course students may able to understand the lithosphere and its characteristics
2. Understanding of atmosphere, and its structure and components
3. Gaining knowledge about hydrosphere and its different pathways
4. Understanding Cryosphere, its methods and its various characteristics

Recommended Books and Suggested Readings

Thornbury, W.D., Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York. 1985.

Hengl, T., Reuter, H.I. (Eds) 2008. Geomorphometry: Concepts, Software, Applications. Developments in Soil Science, Vol. 33, Elsevier, 772 Pp.

Goudie, A. (2013). Encyclopedia of Geomorphology. Routledge

Pike, R.J., Evans, I.S., Hengl, T., 2008. Geomorphometry: A Brief Guide. In: Hengl, T. And Reuter, H.I. (Eds), Geomorphometry: Geomorphometry: Concepts, Software, Applications. Developments in Soil Science, Vol. 33, Elsevier, 1-28 Pp.

Rasemann, S., Schmidt, J., Schrott, L., & Dikau, R. (2004). Geomorphometry In Mountain Terrain. GIS & Mountain Geomorphology. Springer, Berlin, 101-145.

SEMESTER I | Paper 7. RSM 1012 (Elective) | Credit (4) | Marks 100

Groundwater Hydrology

Course Objective:

1. To impart knowledge about importance of ground water and the water cycle
2. To gain knowledge about occurrence, distribution and methods of ground water exploration

Unit-I. Groundwater and The Global Water Cycle; The Saturated Zone; Aquifers; Aquitards; Aquifer Properties; Hydrologic Properties: Porosity, Permeability, Specific Yield, Specific Retention, Hydraulic Conductivity, Transmissivity, Storage Coefficient; Hydrographs.

Unit-II. Sources of Ground Water: Provenance, Recharge Processes; Sub Surface Movement and Vertical Distribution of Groundwater; Well Hydraulics, Darcy's Law and Its Validity, Confined, Unconfined Steady, Unsteady and Radial Flow.

Unit-III. Ground Water Quality: Chemical Characteristics of Ground Water – Origin and Significance; Degradation of Groundwater Quality; Threats to Groundwater Systems; Problem of Over Exploitation; Preventing Contamination. Rain Water Harvesting.

Unit-IV. Surface and Subsurface Geophysical and Geological Methods of Ground Water Exploration. Hydro Geomorphic and Lineament Mapping Using Various Remote Sensing Techniques. Sub Surface Methods: Resistivity, Seismic, Gravity, Magnetic Methods, And Electrical Resistivity.

Course Outcome:

1. Understanding of groundwater occurrence and its behavior
2. Analyse physical behavior and laws of groundwater movement
3. Gaining knowledge on ground water quality and its deteriorations
4. Acquiring knowledge about various methods of groundwater exploration

Recommended Books and Suggested Readings

Todd, D.K., 1980: Groundwater Hydrology-John Wiley

Davies, S.N. & De Wiest, R.J.M., 1966: Hydrogeology-John Wiley

Freeze, R.A. & Cherry, J.A., 1979: Ground Water-Prentice Hall

Fetter, C.W., 1990: Applied Hydrogeology-Merill Publishing

Raghunath, N.M., 1982: Ground Water-Wiley Eastern

Karanth, K.R., 1987: Groundwater Assessment-Development And Management-Tata Mcgraw Hall

Alley, W.M., 1993: Regional Ground Water Quality-VNR, New York

Younger, P. L. (2009). Groundwater in The Environment: An Introduction. John Wiley & Sons.

SEMESTER I | Paper 8. RSM 1013(Elective) | Credit (4) | Marks 100

Global Climate Change

Course Objective:

1. To understand the theories and vital sign of Climate change
2. To gain knowledge about circulation of Climatic components and its impact measured by remotely sensed data

Unit I. Introduction - Climate in The Spotlight; Theories of Climate Change; Climate Change - Examine Drivers of Climate Change (Plate Tectonics; Earth's Orbital Variations; Long Lived Greenhouse Gases in The Atmosphere; Variations in Solar Luminosity; And Volcanic Eruptions). Climate Change Through Geological Time; Future Projection.

Unit II. Vital Signs – Global Temperature; Carbon Dioxide; Greenhouse Gases; Carbon Cycle; CO2 Emissions – Anthropogenic Emissions of CO2; Arctic Ice Minimum; Sea Level Rise-Causes; Impacts and Adaptation Measures; Different Concerns of Developed and Developing (Rich and Poor) Countries.

Unit III. Global Ocean Circulation - Introduction and Overview; El Niño And the Southern Oscillation, Its Effects; Upwelling and Climate. UNCCC-Role; Summits; Declarations; And Protocols on Climate Change and Its Mitigation. Role of IPCC in Policy Making.

Unit IV. Global Climate and Hazards - Risks and Uncertainties of Climate Change. Impact of Climate Change on Water Resources; Human Health, Agriculture; Forests Application of Remote Sensing in Identifying the Risk; And Mitigation Studies Related to Climate Problems.

Course Outcome:

1. Analyze the effect of various gases on global temp drivers and factors of climate change
2. Gain knowledge about impacts and adaptation measure of climatic conditions
3. Establish relationship between different impacts of climate change for satellite data analysis
4. Understand the role of different agencies in climate change

Recommended Books and Suggested Readings

IPCC(2014) -Fifth Assessment Report Https://Www.Ipcc.Ch/Report/Ar5/
UNFCCC - Https://Unfccc.Int/Topics
IPCC (2014). Climate Change 2014: Mitigation of Climate Change{Contributions of Working Group III. Edenholer, OEt Al (Eds), Cambridge University Press. Cambridge. And New York
Mackenzie, F. T., Lerman, A., & LM, B. V. (1980). Global Carbon Cycle. Carbon Dioxide Effects Research and Assessment Program, 360.
IPCC (2007) Contribution of Working Groups I, II and III to The Fourth Assessment Report of The Intergovernmental Panel on Climate Change, Fourth Assessment Report. Core Writing Team, Pachauri, R.K. And Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. Pp 104.
Nicholls, R. J., & Cazenave, A. (2010). Sea-Level Rise and Its Impact on Coastal Zones. Science, 328(5985), 1517-1520.
Yamasaki, K., Gozolchiani, A., & Havlin, S. (2008). Climate Networks Around the Globe Are Significantly Affected by El Nino. Physical Review Letters, 100(22), 228501.

SEMESTER I | Paper 9. RSM 1014 (Elective) | Credit (4) | Marks 100

Remote Sensing in Geosciences

Course Objective:

1. To impart basic understanding of the geosciences and various geologic structure
2. To gain knowledge about remote sensing application in geosciences field

Unit I. Nature and Scope of Geoscience; Origin, Internal Structure and Composition of the Earth; Plate Tectonics; Brief Idea of Structure of Earth – Shield, Craton, MoR; Minerals and Rocks; Mohs Scale.

Unit II. Nature and Importance of Rocks; Classification of Igneous, Sedimentary and Metamorphic Rocks. Forms and Structures of Igneous, Sedimentary and Metamorphic Rocks.

Unit III. Description and Nomenclature of Folds; Geometric Classification of Folds; Unconformities and Types; Description of Faults; Classification of Faults; Joints and their Classifications.

Unit IV. Geotechnical elements of Image Interpretations; Image characteristics of common rock types; landscapes; lineaments and lineament mapping; General idea on Image Processing for Lithological Studies.

Course Outcome:

1. Understanding of major structure and morphological features of the earth
2. Understanding of various rock types and their characteristics
3. Acquiring knowledge of interpretation of various rock types on satellite data/images.
4. Gaining knowledge of folds, faults and their characteristics for satellite data information extraction

Recommended Books and Suggested Readings

Physical Geology – Arthur Holmes

Structural geology – M.P Billings

A Text Book of Geology – P.K Mukherjee

Remote Sensing-Principles and Interpretation - Sabins.

Remote Sensing and image interpretation -Lillesand and Keifer

SEMESTER I | LAB-I: RSM 1071 (Core) | Credit (2) | Marks 100

LAB WORK-I: Principles of Remote Sensing 1001 | Applied Cartography 1002 | Aerial Photography and Photogrammetry 1003

Course Objective:

1. To provide exposure in handling equipment like Pocket and Mirror stereoscope, parallax bar, Height and slope measurement, Topomap reading, Air photo interpretation

2.Convert analog map in digital form

Exercises

1. Interpretation of Satellite Images
2. Interpretation of Satellite data products and generation of thematic maps
3. Stereo Vision Test and Anatomy of Pocket & Mirror Stereoscopes.
4. Decoding, Marking & Transfer of Principal Points, Base Line Drawing, Flight Line Marking, Transfer the Details to Base Map.
5. Determination of Scales of Aerial Photographs.
6. Height and Slope Measurements.
7. Interpretation of Aerial Photographs (Stereo Vision).
8. Decoding of different Satellite Data
9. Interpretation of Black & White and False Color Multi Band Imagery.
10. Transfer of Information from Imagery to Base Map
11. Toposheet Reading
12. Georeferencing of Satellite Images
13. Ground Truth Collection Using GPS
14. GPS Assisted Surveying
15. Total Station based survey & exercises

OUTCOMES:

On completion of this course, the student shall be able to

1 Understand the concept of stereoscopy and its use to determine height by parallax measurements

2 Perform the georeferencing and rectification of geospatial database

3 To obtain spectral signature of various objects

4 To visually interpret satellite imagery for generation of various thematic maps

SEMESTER I | LAB-II: RSM 1072 (Core) | Credit (2) | Marks 100

LAB WORK-II: Basic Statistics and Data Analysis1004 | Fundamentals of Data Structure & Computer Programming 1005 | Earth System Science 1011 | Electives (1012,1013,1014)

Course Objective:

1. To solve and understand the concepts of Statistical methods and its applications, programming languages at elementary level
2. Elucidate integrated geospatial techniques and apply them in solving real world problems.
3. The ways to handle the collected data through classification, tabulation and stigmatization. The data presentation using graphical and diagrammatic ways.
4. To calculate different averages on data and to identify the variations in data.

Exercises

1. Statistical Problems and Data Analysis
2. Exercises Related to Data Structure and Data Bases
3. R – Programming
4. C –Programming
5. Earth System Science / Ground Water hydrology/ Global Climate Change Problems/ Remote Sensing in Geoscience:
    a. Mapping Plate boundaries
    b. Mapping volcanic provinces
    c. Sea Level Rise Scenarios Using Remote Sensing – Introductory tutorials
    d. Glacial Geomorphic Feature Identification and Mapping
    e. Water Cycle
    f. Hydro-Geomorphic Mapping-Introductory tutorials
    g. Lineament mapping
    h. Water Quality Problems
    i. Air Quality Mapping Using Remote Sensing Data - Introductory tutorials
    j. Geomorphic mapping
    k. Atmospheric mapping

Course Outcome:

1. Carry out spatial data analysis to solve natural, environmental and societal problems and challenges in earth system sciences.
2. Know the nature of various data, different sources and methods of data collection and apply sampling methods for data collection.
3. Classify, summarize and produce various types of data tabulations.
4. Apply different forms of averages, their relevance on descriptive data and geographical descriptive data as well.
5. Analyze the variations in spatial and non-spatial data

SEMESTER II | Paper 1. RSM 2001 (Core) | Credit (4) | Marks 100

Digital Image Processing

Course Objective:

1. To impart understanding of basic elements in digital image processing
2. To learn and understand various techniques of image enhancement and classification

Unit-I. Introduction to Digital Image Processing (DIP); Digital Image Fundamentals; Brief Historical Context of Image Processing, Principles of Human Perception of Visual Information; Components of Image Processing System Basic Imaging Process; Formats of Digital Imagery. Data Analysis and Elements of Image Interpretations.

Unit II. Overview of Software Tools in Image Processing; Open Source Image Processing Software; Image Enhancements – Preprocessing: Basic Gray Level Transformations; Histogram Processing; Gaussian And Other Non-Linear Stretches. Image Registration - Definition; Principle and Procedure; Sources of Errors in Imageries- Atmospheric Errors and Removal; Geometric and Radiometric Distortions. Image Characteristics of Different Land Objects. Photographic and Geotechnical Elements of Image Interpretation.

Unit-III. Basics of Spatial Filtering; Convolutions and Morphology (High Pass; Low Pass; Laplacian; Gaussian; Sobel; Roberts; Erode; Dilate); Adaptive Filtering (Lee; Frost; Gamma; Kuan); Image Sharpening; Principal Component Analysis; The Fast Fourier Transform; Minimum Noise Fraction (MNF) Transformation; Color Representation: RGB, Hue Saturation Intensity Color Model.

Unit-IV. Pattern Recognition and Image Classification; Image Segmentation; Unsupervised Classification: K-Means Clustering, ISODATA. Supervised Classification – Training Site Selection; Different Classifiers - Minimum Distance to Mean; Parallelepiped; Maximum Likelihood; Classification Accuracy Assessment; Band Ratios; NDVI: Utility and Applications.

Course Outcome

1. Understanding the basic of digital images and its characteristics
2. Students may able to do geocoding and geometric corrections of satellite data
3. Understanding of image enhancement techniques
4. Learning and developing skills on image classification and statistical operations

Recommended Books and Suggested Readings

Digital Image Processing - R.C.Gonzalez & P.Wintz

Robot Vision - B.K.P.Horn

Computer Vision - D.H. Ballard & C.M. Brown

Syntactic Pattern Recognition: An Introduction -R.C. Gonzalezand M.G. Thomason

Pattern Recognition - A Statistical Approach - P.A. Devijver And J. Kittler

Digital Image Processing - W. K. Pratt

Fundamentals of Digital Image Processing - A.K. Jain

Digital Picture Processing - A. Rosenfeld And A.C. Kak

SEMESTER II | Paper 2. RSM 2002 (Core) | Credit (4) | Marks 100

Fundamentals of GIS & GPS

Course Objective:

1. To impart basic knowledge about GIS & GPS
2. To learn and understand the data generation, analysis and output in GIS & GPS.

UNIT I. Introduction To GIS: Definitions Of GIS; History and Evolution; Components Of GIS; Scope; Interdisciplinary Relations; Applications Areas Of GIS; GIS Data Types (Raster and Vector); Raster Vs; Vector Comparison; Spatial and Non-Spatial Data; Attributes; Spatial Data Input Processing System and Devices (Manual Input; Map Scanning and Digitization).

UNIT II. GIS And Spatial Data Analysis; Vector Data Analysis: Concept of Topology and Topological Analysis; Overlay Analysis; Network Analysis; Neighborhood; Interpolation; Data Integration; Spatial Join and Query; Connectivity; Proximity Analysis: Buffering; Thiessen Polygon; Multi-Criteria Analysis; Raster Data Analysis: Local; Neighborhood and Regional Operations – Map Algebra; View shed Analysis; Pattern Analysis; Trend Surface Analysis.

UNIT III. GIS Software and WEB GIS: Various Software In GIS; Introduction to Open Source GIS; Concept and History of Web GIS; Components of Web GIS; Citizen Science; Volunteered Geographic Information; Crowd sourcing.

UNIT IV. Introduction to Global Positioning System: Definition; History and Development; GPS Satellite Constellations; GPS Segments: Space; Control; User; Signals & Codes; GPS Receivers; Operating Principle and Sources of Errors In GPS; Modes of Measurements and Post Processing of Data; Accuracy of GPS Observation; GPS Applications in Various Fields; Concept of DGPS and WAAS; GNSS And Types (NAVSTAR; GLONASS; GALELIO); IRNSS.

Course Outcome:

1. Understanding fundamentals of GIS data types, structure and format
2. Analyse GIS data using various parameters
3. Acquiring knowledge on web based GIS software
4. Understanding of GPS components , operation, functioning and data capture

Recommended Books and Suggested Readings

Bolstad, P. (2005). GIS Fundamentals: A First Text On Geographic Information Systems. Eider Press.

Elangovan, K. (2006). GIS: Fundamentals, Applications and Implementations. New India Publishing.

Panigrahi, N. (2009). Geographical Information Science. Universities Press.

Fu, P., & Sun, J. (2010). Web GIS: Principles and Applications. Esri Press.

Demers, M. N. (2008). Fundamentals of Geographic Information Systems. John Wiley & Sons.

Hofmann-Wellenhof, B., Lichtenegger, H., & Wasle, E. (2007). GNSS–Global Navigation Satellite Systems: GPS, GLONASS, Galileo, And More. Springer Science & Business Media.

Misra, P., & Enge, P. (2006). Global Positioning System: Signals, Measurements and Performance Second Edition. Massachusetts: Ganga-Jamuna Press.

SEMESTER II | Paper 3. RSM 2003 (Core) | Credit (2) | Marks 100

Advanced Statistics and Multivariate Data Analysis

Course Objective:

1. To gain the knowledge of advanced tools of statistical analysis for image data
2. To learn the dimension reduction and predictive modeling techniques
3. To understand the basis of classification through multivariate analysis

Unit I. Regression Models: Review of Vector and Matrix Algebra; Simple and Multiple Linear Regression; Residual Analysis; Statistical Inference in Multiple Regression.

Unit II. Multivariate Statistics: Multivariate Random Sample; Multivariate Mean; Standard Deviation; And Sample Correlation Coefficient with Their; Geometric Interpretation; The Generalized Variance; Distances In P-Dimensional Space; Multivariate Normal Distribution; Mahalanobis Distance. Introduction to Spatial Variation.

Unit III. Multivariate Inference and Principal Component Analysis: Inference About Mean Vector; Testing the Multivariate Population Mean; Finding Principal Components; Interpretation of Principal Component Loadings; Scaling of Variables; Fair-Share Stopping Rules; Principal Component Score; Imaging Related Sampling Schemes.

Unit IV. Discrimination and Classification: Supervised Learning: Classification for Two Populations; Linear and Quadratic Discriminant Analyses; Unsupervised Learning: Similarity and Dissimilarity Measures for Observations and For Variables and Other Objects; Clustering Algorithm: Single Linkage Algorithm; Non-Hierarchal Clustering Method: K-Means Method.

Course Outcome:

On completion of this course the students will be able

1. Prepare some regression models.
2. To learn the dimension reduction and predictive modeling techniques
3. To classify an image using multivariate analyzing technique.

Recommended Books and Suggested Readings

Peter Bajorski (2012): Statistics for Imaging, Optics, and Photonics, John Wiley &Sons.

R.A. Johnson and D.W. Wichem (2013): Applied Multivariate Statistical Analysis, Pearson

Alfred Stein Freek Van Der Meer and Ben Gorte (2002): Spatial Statistics for Remote Sensing, Kluwer Academic Publisher

B. Everitt and T. Hothom (2011): An Introduction to Applied Multivariate Analysis with R, Springer

SEMESTER II | Paper 4. RSM 2004(Core) | Credit (2) | Marks 100

Thermal and Microwave Remote Sensing

Course Objective:

1. Enhance student's knowledge about optical, thermal and microwave based Remote Sensing and its Applications for solving real life problems
2. To provide exposure to students in gaining knowledge about concept & procedure of thermal and microwave sensors and data acquisition

Unit I. Fundamentals of Thermal Remote Sensing: Thermal Radiation Principles – Kinetic Heat; Temperature; Radiant Energy and Radiant Flux. Blackbody Radiation; Thermal Radiation Laws- Stephen Boltzmann Law; Wien's Displacement Law; Emissivity; Kirchhoff's Radiation Law. Thermal Infrared Atmospheric Windows. Thermal Interaction Behavior of Terrain Elements; Thermal Sensors and Specifications.

Unit II. Thermal Sensors and Specifications. Thermal Image Characters; Spatial and Radiometry; Sources of Image Degradation; Day Time and Night Time Thermal Data; Thermal Infrared Images and Applications in Vegetation/Forestry; Water Resources; Forest Fires; Volcanic Eruptions. Recent Advancement in Thermal Infrared Remote Sensing: Advantages and Limitations.

Unit III. Microwave Remote Sensing: Basics of Microwave Remote Sensing; Advantages; And Inconveniences; Wavelength and Frequencies; Passive and Active Systems. Active Microwave System Components. RADAR Image Geometry. Azimuth and Range Direction; Depression Angle; Look Angle; Incident Angle; And Polarization; Slant-Range Versus Ground-Range RADAR Image Geometry; Relief Displacement; Image Foreshortening; Layover; Shadows and Speckle. Synthetic Aperture Radar System.

Unit IV. Overview of RADAR Satellite and Sensors: (Seasat; SIR A And B; ERS Missions; JERS; ALOS PALSAR; RADARSAT; SRTM; Envisat; Sentinel-1) RADAR Environmental Considerations: Surface Roughness Characteristics. Penetration Capability; Assessing Soil Moisture Content. Radar Backscatter and Biomass; Water Response to Microwave Energy; RADAR Interferometry. Lidar Technology.

Course Outcome: On completion of this course, students should be able to:

1. Understand the basic difference between various kinds of satellites and sensors
2. Know the appropriate use of satellite data for different applications
3. Explain the principles of thermal and microwave satellites, sensors and their nature of the data and
4. Apply remote sensing in different thematic studies

Recommended Books and Suggested Readings

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.
Rees, W. G. (2012). Physical Principles of Remote Sensing. Cambridge University Press.
Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.
Woodhouse, I. H. (2017). Introduction to Microwave Remote Sensing. CRC Press.
Quattrochi, D. A., & Luvall, J. C. (Eds.). (2004). Thermal Remote Sensing in Land Surface Processing. CRC Press.

SEMESTER II | Paper 5. RSM 2005 (Core) | Credit (2) | Marks 100

Spatial Data Analysis and GIS Modeling

Course Objective:

1. To impart concept of Spatial data analysis and model building for GIS automation
2. To understand basic knowledge of different language for customization and spatial data linkage

Unit I. Introduction to Spatial Data Analysis; GIS Modeling: The Need for GIS Automation; Customization In GIS; Advantages; Geoprocessing and Model Builder Concepts; Tools for Customization. Introducing Rand Python Languages and Their Utility in GIS.

Unit II. Python: Working with Variables; Python Syntax; Modules and Packages; Iterators; Generators; Input and Output; File Management; Raspy: Controlling Arc GIS Using Python. Performing Map Algebra on A Raster; Creating Buffers; Printing the Spatial Reference of a Feature Class.

Unit III. GIS In R. Advantages; Packages of Spatial Data In R; Read Data; Making Maps With R; Magick: Image Processing and Analysis In R; Terrain Documentation In R; Classification of Raster Images in R.

Unit IV. Introduction to MATLAB, GIS Data Structure; Mapping Toolbox – Vector and Raster Data Import and Export; 2D and 3D Map Display, Customization, And Interaction; Image Processing (Supervised Classification) In MATLAB; Topo Toolbox; different toolboxes.

Course Outcome:

1. Students may able to do geoprocessing and model building for real world problem
2. May work with different variables of python & R language
3. Understand the customization and interaction of different GIS tools under Matlab

Recommended Books and Suggested Readings

Pimpler, E. (2015). Programming Arc GIS With Python Cookbook. Packt Publishing Ltd.

Beazley, D., & Jones, B. K. (2013). Python Cookbook: Recipes for Mastering Python 3. " O'Reilly Media, Inc.".

Allen, D. W. (2014). GIS Tutorial for Python Scripting (P. 265). Esri Press.

Trauth, M. H., Gebbers, R., Marwan, N., & Sillmann, E. (2006). MATLAB Recipes for Earth Sciences. Springer.

Middleton, G. V. (2000). Data Analysis in The Earth Sciences Using MATLAB® (Vol. 1). Prentice Hall.

Schwanghart, W., & Scherler, D. (2014). Topo toolbox 2-MATLAB-Based Software for Topographic Analysis and Modeling in Earth Surface Sciences. Earth Surface Dynamics, (1), 1.

W. N. Venables, D. M. Smith and The R Core Team: An Introduction to R Notes On R:A Programming Environment for Data Analysis and Graphics M.J. Crawley (2013): The R Book, John Wiley & Sons.

SEMESTER II | Paper 6. RSM 2011 (Elective) | Credit (6) | Marks 100

Fundamentals of Ecosystem

Course Objective

1. To impart understanding of basic principles of ecology, its chains and webs
2. To read the implications of ecosystem by remotely sensed data

Unit I. Principles of Ecology: Definition Principles and Scope of Ecology – Energy Flows, Ecological Pyramids, Typesand Diversity, Food Chains and Food Webs. Homeostasis – Theories of Limiting Factors; Ecological Succession – Population and Communities-Community Ecology- Structure, Species Diversity and Species Interaction.

Unit-lI: Ecosystem Ecology: Ecosystem- Structure- Components (Abiotic and biotic) and Functions of an Ecosystem. Ecosystem Types and Diversity- Terrestrial and Aquatic (Fresh water and Marine) Ecosystems. Ecotones – Concept of Edge Effect, Ecological Niche-Classification Biomes- General Relationships Landscapes and Biomes – Climatic factors – Bio-geographical Regions of the World and Modern Biogeography.

Unit-III: Ecological Applications I: Sustainable Development; Remote Sensing of Ecology, Biodiversity and Conservation – From space to species; Evaluation of suitable habitats using Remote Sensing techniques; Remote Sensing of Mangrove eco system.

Unit-IV: Ecological Applications II. Assessing species diversity; Mapping Encroaching Species; Quantification and interpretation of diversity patterns. Models for population growth; Remote sensing for restoration ecology

Course Outcome:

1. Students may able to know the ecological succession and its diversity
2. Understanding of ecosystem and its classifications
3. Students may able to establish relationship between different application of ecology by satellite data

Recommended Books and Suggested Readings

Turk J and Turk A. 1984 Environmental Sciences 3rd Edn. Saunders College Publications.

Odum E. P. 1971 Fundamentals of Ecology 3rd Edn. W. B. Saunders Company London.

Kendeigh S. G. 1961 Animal Ecology Prentice- Hall Inc. Englewood Cliffs, N. J, U.S.A.

Southwick C. H. 1972 Ecology and the Quality of environment D. Van Nostard Company, London.

Edmund Hillary 1984 Ecology 2000 The Changing Face of Earth, Michel Joseph Ltd. London.

Sharma P. D. 1994 Ecology and Environment Rastogi Publications. Meerut.

SantraS. C. 2001 Environmental Sciences New Central Book Agency (P) Ltd. Calcutta.

SEMESTER II | Paper 7. RSM 2012 (Elective) | Credit (6) | Marks 100

Coastal and Marine Environment

Course Objective:

1. This paper deals with the fundamental of physical, chemical and Biological oceanography and the various RS applications to coastal zone management.
2. To understand the sea temperature methods by remote sensing data.

Unit I. Coastal Processes; Estuaries and Related Environments Continental Shelf – Outer Continental Margin – Constructional and Destruction Landforms (In Emerging; Submerging; Neutral and Compound – Coasts)- Manifestations of Coastal Landforms (In Field; Aerial Photographs and Satellite Images). Shorelines – Erosion and Accretion.

Unit II. Principles of Integrated Coastal Zone Management: Basic Principle; The ICZM Development Process: Demonstration; Consolidation; Extension; Coastal Bio-Diversity; Coastal Environmental Impact Assessment; Socio; Economic and Legal Aspects of Coastal Zone Management: Protocols in Management of Ocean; Coastal Seas and Lands; Laws on Coastal Regulation Zone.

Unit III. Ocean Color: Measuring Chlorophyll and Suspended Sediment Concentration from Water Coloras Detected from Satellites; Studies of Phytoplankton Blooms. Sea Ice: Studying Arctic and Antarctic Ice by Synergy Between Different Types of Data. Oil Pollution.

Unit IV. Sea Surface Temperature: Method of Sea Surface Temperature Remote Sensing; Studies of Ocean Eddies and Fronts; Monitoring of Global Temperature Patterns. Imaging Radar: How Satellite Radars "See" The Ocean to Study Ocean Topography; Winds; Rain and Salinity Globally.

Course Outcome:

On completion of this course, the student shall be able to

1. Get exposed to the basics of marine and Coastal environment
2. Acquire knowledge about various satellites and sensors in the domain of Ocean and Coastal applications.

Recommended Books and Suggested Readings

Thornbury, W.D., Principles of Geomorphology, John Wiley and Sons, 2nd Edition, New York. 1985.

Goudie, A. (2013). Encyclopedia of Geomorphology. Routledge

Integrated Coastal Zone Management. Http://Projects.Worldbank.Org/P097985/Integrated-Coastal-Zone-Management?Lang=En

Http://Web.Unep.Org/Nairobiconvention/Feasibility-Assessment-Integrated-Coastal-Zone-Management-Iczm-Protocol-Nairobi-Convention-Parties

Ocean Circulation. Https://Ocean-Climate.Org/?Page_Id=3829&Lang=En

El Niño And La Niña. Https://Oceanservice.Noaa.Gov/Facts/Ninonina.Html

SEMESTER II | Paper 8. RSM 2013 (Elective) | Credit (6) | Marks 100

Environmental Impact Assessment

Course Objective:

1. To understand the various remote sensing and GIS technological applications in Environmental Impact Assessment
2. To gain knowledge about implication and constraints of EIA

Unit I: Environmental Impacts–Examples, Need for Assessment, Difficulties; The EIA Approach– Components & Techniques, Impact Prediction & Analysis, Treatment of Risk and Uncertainty, EIA Inputs to The Project Cycle and Development Planning; EIA In India–Legislative Aspects, Current Practices & Constraints, EIA Case Study.

Unit II. Air Quality Impact Assessment: Introduction; Air Quality Assessment Criteria; Primary Pollutants; Secondary Pollutants; Baseline Conditions; Vehicular Emission; Industrial Emission Impact Assessment. Effect of Air Pollution on Living Organisms.

Unit III. Water Quality Impact Assessment: Effluents Discharge; Assessment Methodology; Water Quality Monitoring; Standards (WHO, BIS, EPA); Case Studies.

Unit IV. Prediction and Methods: Prediction and Methods of Assessment of Impacts on Various Aspects of Environment; Application of Various Models for The Prediction of Impact on Air Environment, Water Environment, Noise Environment and Land Environment

Course Outcome:

On completion of this course, the student shall be able to

1. Understand the concepts of Environmental Impact Assessment
2. Understand the principles involved in EIA management
3. Get exposed to various methods of environmental assessment

Recommended Books and Suggested Readings

Bathwal R.R. (1988) Environmental Impact Assessment, New Age, International Publishers.
Canter L.W. (1996) Environmental Impact Assessment, 2ndedn. New York, Mcgraw Hill.
Dale R. (2004) Evaluating Development Programme and Project, Second Edition, Sage Publication.
Lee N. And Kirkpatrick C. (Eds) (2000) Integrated Appraisal and Sustainable Development in a Developing World, Cheltenham, Edward Elgar.
Vanclay F. And Bronstein D.A. (1995) Environmental and Social Impact Assessment, Wiley Publishers.
Asian Development Bank (1997) Environmental Impact Assessment for Developing Countries in Asia, Vol I & II, ADB Publication.
Briggs D., Corvalan C. and Nurminen M. (Edited) (1996) Linkage Methods for Environment and Health Analysis–General Guidelines, World Health Organization, Geneva

SEMESTER II | LAB-III: RSM 2071 (Core) | Credit (2) | Marks 100

LABWORK III – DIGITAL IMAGE PROCESSING 2001 | FUNDAMENTALS OF GIS AND GPS 2002 | SPATIAL DATA ANALYSIS AND GIS MODELING 2005

Course Objectives:

1. Lab aim is to give basic understanding of concept of GIS, its definitions and components;
2. To gain working experience geographical data collection using GPS
3. Knowledge and practical experience in handling satellite images focusing on hands-on experience of image pre processing, enhancement and classification;
4. Better understand the techniques for the study of land use land cover and urban study.
5. Basic understanding of GIS models with real world event and its relation with customize languages

Excercise

1. Geometric Correction
2. False Color Composite (FCC),
3. Contrast Enhancements,
4. Spatial Filtering
5. Edge Detection and Enhancement
6. Principal Component Analysis
7. Unsupervised Classification
8. Supervised Classification
9. Change Detection
10. Digitization
11. Georeferencing
12. Thematic Map Generation
13. Map Layout
14. Map Projections
15. Model Builder in ArcGIS
16. R programming and GIS
17. MATLAB For Image Processing
18. Multivariate Analysis
19. GIS Models
20. Python Programming

Course Outcome:

This is a practical, hands-on course; after completion of this lab exercise students may able to

1. Explain principles of remote sensing, different satellite systems and sensors;
2. Perform image pre processing, enhancement and classification and interpretation of satellite images;
3. Develop basic understanding and hands-on on GIS software and GPS ;
4. Understand GIS Data Structures and GIS Data Analysis ;
5. Apply GIS for natural resource management,

SEMESTER II | LAB-IV: RSM 2072 (Core) | Credit (2) | Marks 100 |

LABWORK IV –ADVANCED STATISTICS AND MULTIVARIATE DATA ANALYSIS 2003|THERMAL AND MICROWAVE REMOTE SENSING 2004 | ELECTIVES (2011, 12, 13)

Course Objective:

1. To provide the exposure for the students with hands on experience into the Microwave Image processing using software's
2. To gain the concept and knowledge of statistical operations solving geological problems
3. Thermal and microwave based Remote Sensing and its Applications for solving real life problems

Exercise

1. Geostatistical Problems
2. Python Programming
3. DN Conversion to Radiance
4. DN Conversion to Reflectance
5. DN To Brightness Temperature
6. Land Surface Temperature Estimation from Landsat Images
7. Land Surface Temperature Estimation from ASTER Images
8. Forest Fire Area Calculation Using Thermal Imagery
9. Speckle Removal in Microwave Imagery
10. Flood Mapping Using Microwave Imagery
11. Forest – Non-Forest Mapping Using Microwave Imagery
12. Introduction to Radar data processing

Course Outcome:

1. Understand the basic difference between various kinds of satellites and sensors.
2. Apply remote sensing tools in different thematic studies
3. Equipped students with basics of radar data acquisition and application

SEMESTER II | FIELD: RSM 2073 (AE) | Credit (2) | Marks 100 |

Field Work/Training

One Week Field Training/ Visit to Various GIS and Remote Sensing Agencies and Institutes in India | Ground Truth and Survey

- Image classification and ground truth verification of classified data.
- Capture geo tagged photographs during field visits.
- Prepare maps after collecting coordinates & primary field data.

SEMESTER III | Paper 1. RSM 3001 (Core) | Credit (2) | Marks 100

Hyperspectral Remote Sensing

Course Objective:

1. To make the post graduate students understand principles, processes and applications of hyper spectral remote sensing for earth resources.
2. To learn aim of hyperspectral mission and its data mapping techniques

Unit-I. Understanding Hyperspectral Imaging; Multispectral Vs Hyperspectral Remote Sensing – Advantages; History and Evolution of Hyperspectral Imaging; The Physical-Chemical Interactions of The Electromagnetic Radiation with The Atmosphere and The Geosphere. Spectral Radiometry: Principles – Radiance Vs Reflectance;

Unit-II. Review on the Past, Present and Future Hyperspectral Missions– AVIRIS; CASI; Hyperion; MODIS. Hyperspectral Imaging –Operational Considerations and Challenges. Spectral Reflectance Libraries. Software Tools; Information Extraction from Hyperspectral Data.

Unit-III. Hyperspectral Mapping – Spectral Angle Mapper; Spectral Feature Fitting; Sub-Pixel Analysis – Linear Spectral Unmixing; Matched Filtering. Information Contained in An Image; Concept of a Hyperspectral Cube; Pattern Recognition; Hyperspectral and Ultra spectral Information Extraction Approaches; The Importance of End members; Pixel Unmixing.

Unit-IV. Applications of Hyperspectral Remote Sensing in The Atmosphere, Biosphere, Lithosphere, Pedosphere, Hydrosphere and Cryosphere (Agriculture, Environment, Forestry Mineral and Rock Identification, Ocean Color).

Course Outcome:

On completion of this paper, the student shall be able to

1. Understand the Characteristics and properties of Hyperspectral Remote Sensing
2 Acquire skills in analyzing Hyperspectral Remote Sensing data for various thematic mapping and its applications.
3 To equipped students about hyperspectral data products for information extraction

Recommended Books and Suggested Readings

Thenkabail, P. S., & Lyon, J. G. (2016). Hyperspectral Remote Sensing of Vegetation. CRC Press.

Chang, C. I. (Ed.). (2007). Hyperspectral Data Exploitation: Theory and Applications. John Wiley & Sons.

Van Der Meer, F. D., Van Der Werff, H. M., Van Ruitenbeek, F. J., Hecker, C. A., Bakker, W. H., Noomen, M. F., ... & Woldai, T. (2012). Multi-and Hyperspectral Geologic Remote Sensing: A Review. International Journal of Applied Earth Observation and Geoinformation, 14(1), 112-128.

Borengasser, M., Hungate, W. S., & Watkins, R. (2007). Hyperspectral Remote Sensing: Principles and Applications. CRC Press.

Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.

SEMESTER III | Paper 2. RSM 3002 (Core) | Credit (2) | Marks 100

Application of Remote Sensing in Natural Resources

Course Objective:

1. To learn different of natural resources are available in earth systems, their mode of occurrence and processes involved
2. To measure natural resources by remote sensing data and to find out real world events/phenomenon

Unit-I. Natural Resources**;** Soil Classification; Soil Types and Spectral Signatures. Major Soil Types of India. Factors Affecting Soil Erosion; Degradation and Fertility. Application of Remote Sensing in Soil Type Mapping; Erosion Assessment – RUSLE.

Unit-II. Solar Energy Resources; Past, Current and Future Status; The Use of Remote Sensing and GIS In Solar Energy Potential Mapping; Wind Energy Resources; Wind Energy Potential Mapping Using Remote Sensing and GIS.

Unit III. Water Spectra; Surface Water Resources Mapping; Water Resources Depletion and Degradation; Application of Remote Sensing and GIS In Monitoring Degradation of Surface Water Resources. Forest Resources of India. Vegetation Spectra; Identification of Forest Categories on Satellite Data; Degraded and Non-Degraded Forests.

Unit IV. Geothermal Energy; Status; Remote Sensing and GIS For Geothermal Energy Exploration; Remote Sensing and GIS For Hydrocarbon Prospecting; Coal Exploration – Case Studies; Current and Future Trends in Mapping Natural Resources.

Course Outcomes:

1. Acquire the knowledge about soil, energy and water resources and its events
2. Get equipped to differentiate between remote sensing data application for mapping of different natural resources
3. Get exposure of geospatial technology and its data validation in real world problem

Recommended Books and Suggested Readings

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.

Jensen, J. R. (2009). Remote Sensing of The Environment: An Earth Resource Perspective 2/E. Pearson Education India.

Sabins, F. F. (2007). Remote Sensing: Principles and Applications. Waveland Press.

Keller, E. A., & Devecchio, D. E. (2016). Natural Hazards: Earth's Processes as Hazards, Disasters, And Catastrophes. Routledge.

SEMESTER III | Paper 3. RSM 3003 (Core) | Credit (2) | Marks 100

Digital Terrain Modeling

Course Objective:

1. To Understand the concepts for generating DEM from Digital Surface Model by filtering
2. To gain ability for correcting different errors in generation of DEM/DTM, and get familiar with different applications of DTM

Unit-I. Definition – Digital Terrain Model (DTM); Digital Elevation Model (DEM) And Digital Surface Model (DSM); Digital Elevation Data Sources and Structures; DTM/DEM Production Methods; DEM Interpolation Methods; Early DEMs; Availability of Global and Regional DEMS.

Unit-II. Error and Uncertainties In DEM/DTM – Typology of Error (Gross Errors or Blunders; Systematic Errors and Random Errors); Describing Errors (RMSE; ME And S); Sources of Error in Dems (Method of Source Data Generation; Processing and Interpolation and Terrain Representation); Error Models; Error Propagation; Visualization of Error; Error Correction and Fitness for Use; Optimization of DEM Resolution; DEM/DTM Interpretation

.**Unit-III.** Dems For Geomorpho-metric Analysis; Flow Direction Algorithms; Surface Derivatives (Slope; Aspect; Curvature; Hill Shade; Contours and Drainage); Basin Morphometry; Overview of Software Packages Used in Terrain Modeling – Terrain Modeling in ESRI Packages Terrain Modeling In SAGA; Terrain Modeling in Microdem; Terrain Modeling QGIS; Terrain Modeling In GRASS.

Unit-IV. Applications of DEMs: Terrain Analysis in Soil Mapping; Landslide and Slope Stability Analysis; Terrain Analysis in Hydrology; Landscape Studies; Land use Classification and Predictive Vegetation Mapping; Effect of Data Source; Grid Resolution and Flow Routing on Topographic Attributes; Future Directions for Terrain Analysis.

Course Outcomes:

1. Understand the concept and availability of global and regional DEMs
2. Get skilled to rectify the uncertainties /errors in generation of DEM using satellite information
3. Get to know the number of applications of DTM/DEM for solving problems

Recommended Books and Suggested Readings

Hengl, T., Reuter, H.!. (Eds) 2008. Geomorphometry: Concepts, Software, Applications. Developments in Soil Science, Vol. 33, Elsevier, 772 Pp

Li, Z., Zhu, Q. And Gold, C. (2005). Digital Terrain Modeling: Principles and Methodology. CRC Press.

Naser El-Sheimy, Caterina Valeo, And Ayman Habib (2005). Digital Terrain Modeling: Acquisition, Manipulation and Applications. Artech Publishers.

John P. Wilson & John C. Gallant (Eds) (2000). Terrain Analysis: Principles and Applications. New York: Wiley

Fisher, Peter F., And Nicholas J. Tate. "Causes and Consequences of Error in Digital Elevation Models. "Progressin Physical Geography 30, No. 4 (2006): 467-489. (Journal Article)

SEMESTER III | Paper 4. RSM 3004 (Core | Credit (2) | Marks 100

Data Mining and Cloud Computing

Course Objective:

Unit-I

Basic Concepts: Data Mining; Data and Patterns; Review of Statistical Techniques for Data Mining: Discriminant Analysis; Cluster Analysis; Outlier Analysis. Data Mining of Spatial Data: Geospatial Grids; Data Structures for Spatial Grids.

Unit-II

Introduction to Advanced Methods of Classification: Genetic Algorithms; Fuzzy Set Approach; Decision Trees; Neural Networks. Introduction to The Data Mining Software Packages; Data Mining Using R. Software.

Unit-III

Introduction to Cloud Computing including benefits, challenges, and risks; Cloud Computing Models including Infrastructure/Platform/Software; Types of cloud services: IaaS, PaaS, SaaS; Public cloud, private cloud and hybrid clouds. Cloud OS, federated clouds.

Unit-IV

Challenges in implementing clouds, data centers, memory management, cloud hosted applications. GIS Cloud; Real time Mapping; ESRI cloud ecosystem; Benefits of Cloud GIS; Applications of Cloud GIS.

Course Outcomes:

Recommended Books and Suggested Readings

Jiawei Han, Micheline Kamber, Jian Pei (2011): Data Mining: Concept and Techniques, Elesevier.

Valliappa Lakshmanan (2012): Automating the Analysis of Spatial Grids: A Practical Guideto Data Mining Geospatial Images for Human & Environmental Applications Springer Science & Business Media, 21012

Peter Bajorski (2011): Statistics for Imaging, Optics, and Photonics, Wiley Series in Probability and Statistics.

R. Software Manual.

https://www.gislounge.com/learn-about-gis-in-the-cloud/

https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/

SEMESTER III | Paper 5. RSM 3011 (AE) | Credit (2) | Marks 100

Technical Writing and Seminar Presentation

Course Objective:

1. An ability to independently carry out research /investigation and development work to solve real life geospatial problems.
2. An ability to write and present a substantial technical report/document and publish international level research articles, emails and communicates the reviwers.

Academic Writing: An Interdisciplinary Approach

- Thesis, Dissertation (Understanding the Difference in Science and Social Science Writing)
- Publications, Reports
- Blogs, Journals

Business Writing

- How to Develop A Good Research Proposal
- How to Develop A Project Proposal
- Report Writing
- Developing A Good Power Point Presentation
- Thinking About Communication
- Communication Skills

Professional Writing

- Email Writing
- CV And Cover Letters
- Letter and Memos

Course Outcome:

1. Students should be able to demonstrate a degree of mastery over the areas of Remote Sensing and GIS technology. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
2. An ability to apply professional ethics, accountability and equity

SEMESTER III | Paper 6. RSM 3012 (Elective) | Credit (6) | Marks 100

Integrated Watershed Management

Course Objective:

1. To understand basics of hydrology and also various remote sensing and GIS applications in the field of hydrology and water resources.
2. To know about automated drainage mapping and interlinking water projects using GIS techniques

Unit I. Global Water Resources. Surface Water Resources and Rainfall Run Off Relationship. Spectral Characteristics of Water; Mapping and Assessment of Surface Water Resources Using Satellite Data And GIS. Drainage Types; Drainage Pattern; Life History of Rivers (Youthful Stage; Dynamics and Landforms – Old Stage; Dynamics and Landforms).

Unit II. Automated Drainage Mapping Using GIS: Drainage Morphometric Analysis (Aerial; Linear and Relief). Strategies for Watershed Management. Watershed Management Practices. Application of Remote Sensing and GIS in Assessing Health of Watersheds. Application of Remote Sensing and GIS in Water Logged Areas.

Unit III. Application of Remote Sensing in Watershed Characterization and Prioritization Based on Morphometric Parameters. Shrinkage of Reservoirs and Sediment Yield Using Temporal Satellite Data; Sediment Yield Index. Case Studies and Examples. Remote Sensing Applications in River Valley Projects.

Unit-IV. Interlinking of River Projects; Location and Site Selection of Water Harvesting Structures in Basins Using Remote Sensing and GIS. Hydrogeo-morphic Mapping for Delineation of Groundwater Potential Zones in Different Terrains Using Remote Sensing and GIS.

Course Outcome:

1. Understand the assessment of Basin and its hydrology using Geospatial technology.
2. Get exposure to the Groundwater and Watershed Management aspects of GIS
3. Get skilled by GIS methods to interlink different water projects

Recommended Books and Suggested Readings

Sabins, F.F., 1985: Remote Sensing Principles and Interpretation. W.H. Freeman and Company
Todd, D.K., 1980: Groundwater Hydrology. John Wiley
Rajora, R., 2003: Integrated Watershed Management. Rawat Publication
Karanth, K.R., 1987: Groundwater Assessment-Development and Management. Tata Mc Graw Hill.
Bukata, R. P., Jerome, J. H., Kondratyev, A. S., & Pozdnyakov, D. V. (2018). Optical Properties and Remote Sensing of Inland and Coastal Waters. CRC Press.
Palmer, S. C., Kutser, T., & Hunter, P. D. (2015). Remote Sensing of Inland Waters: Challenges, Progress and Future Directions.

SEMESTER III | Paper 7. RSM 3013 (Elective) | Credit (6) | Marks 100

Natural Hazards and Disaster Management

Course Objective:

1. To teach about the various principles involved and also the various mitigation to be adopted during the disasters.
2. To understand the different types of disaster, methodology and its role of remote sensing technique

Unit I. Natural Hazards: Types and Classification of Natural Hazards: Causes; Effects; Vulnerable States and Regions of India. Vulnerability Index of Various Natural Hazards in India. Preventive Measures. Indian Policies and Programmes to Tackle Natural Hazards at State and National Level. Role of Remote Sensing in Monitoring and Damage Assessment.

Unit II. Fundamentals of Disaster Management; Disaster Preparedness and Mitigation; Risk Assessment and Vulnerability Analysis; Disaster Preparedness Plan; Community Based Disaster Management; Reconstruction and Rehabilitation; Long-Term Recovery.

Unit III. Floods; Cyclones; Draughts; Landslides. Application of Remote Sensing in Monitoring; Management and Damage Assessment of These Hazards. Earthquake, Volcanoes and Tsunami Warning System, Monitoring and Mapping.

Unit IV. Desertification: Causes; Effects and Impacts of Desertification and Land Degradation. Man-Made Disasters: Forest Fires, Role of Remote Sensing and GIS Application for Mapping Desertification, Forest Fires.

Course Outcome:

On completion of this course, the student shall be able to

1 Understand the fundamentals and measurements of disaster management
2 Gain knowledge in concepts of long term mitigation measures
3 Gain exposure to various space based input for disaster management
4 Understand the use of spatial data for emergency planning

Recommended Books and Suggested Readings

Bryant Edwards (2005): Natural Hazards, Cambridge University Press,U.K.

Roy, P.S. (2000): Space Technology for Disaster Management: A Remote Sensing & GIS Perspective, Indian Institute of Remote Sensing (NRSA) Dehradun.

Hyndman, D., & Hyndman, D. (2016). Natural Hazards and Disasters. Cengage Learning.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2014). At Risk: Natural Hazards, People's Vulnerability and Disasters. Routledge.

Joyce, K. E., Belliss, S. E., Samsonov, S. V., Mcneill, S. J., & Glassey, P. J. (2009). A Review of The Status of Satellite Remote Sensing and Image Processing Techniques for Mapping Natural Hazards and Disasters. Progress in Physical Geography, 33(2), 183-207.

SEMESTER III | Paper 8. 3014 (Elective) | Credit (6) | Marks 100

Remote Sensing and GIS Applications in Urban Planning

Course Objective:

1. To introduce the concepts of urban and regional planning
2. To explore the use of the geospatial technology in advanced analysis in planning.

Unit I. Land Use Classification. Spectral Signatures of Various Land Use Classes. Identification and Delineation on Satellite Images. Land Use and Land Cover Differentiation. Mapping of Various Land Use Features on Remotely Sensed Data. Cultivated Land; Uncultivated Land; Barren Land; Built Up Land; Industrial Land; Wasteland; Saline Alkaline Land; Rocky Terrain.

Unit II. Mapping of Land Cover Types. Forest; Water Bodies; Reservoirs; Snow and Ice. Spectral Signatures and Their Interpretation. Case Studies and Examples. Change Detection Analysis and Change Matrix. Drivers of Land Use; Land Cover Changes. Global Land Use Land Cover Changes; And Change Projection Studies.

Unit III. Concepts of Urbanization and Urban Areas; Urban Land Use Mapping: Relevance of RS & GIS In Urban Studies; Urban Area Classification; Monitoring of Urban Plan and Change Detection; Urban Growth Modeling and Monitoring: Housing Development; Parks and Social Facilities Planning.

Unit IV. Urban Morphology: Residential Area Interpretation and Population Estimation Using Remote Sensing and GIS; Urban Issues and Hazards: Land Suitability Analysis for Urban Renewal; Urban Facility Mapping; Traffic Survey; Solid Waste Management; Case Studies.

Course Outcome:

On completion of this course students shall be able to

1 To Gain knowledge of urban and regional planning concepts, the use of geomatics technology in planning and management in urban areas and regions.
2 Familiarize with case studies, inputs from Remote Sensing and GIS
3 Get exposure in modelling in urban land use, morphology and its forecasting.

Recommended Books and Suggested Readings

Weng, Q., Quattrochi, D., & Gamba, P. E. (2018). Urban Remote Sensing. CRC Press.

Jensen, J.R.2000: Remote Sensing of The Environment: An Earth Resource Perspective. Prentice Hall.

Murayama, Y., Kamusoko, C., Yamashita, A., & Estoque, R. C. (2017). Urban Development in Asia And Africa. Springer Singapore.

Anderson, J. R. (1976). A Land Use and Land Cover Classification System for Use with Remote Sensor Data (Vol. 964). US Government Printing Office.

Anderson, J. R. (1971). Land-Use Classification Schemes. Photogrammetric Engineering.

Lillesand, T., Kiefer, R. W., & Chipman, J. (2014). Remote Sensing and Image Interpretation. John Wiley & Sons.

SEMESTER III | Paper 9. RSM 3015 (Elective) | Credit (6) | Marks 100

Remote Sensing and GIS Application in Wildlife Studies

Course Objective:

1. To understand the basic concept of biogeography and ecology
2. To gain knowledge of ecological components and methods using satellite data

Unit-I Introduction to Wildlife Science and its relation with other disciplines. Basic concepts and structure of ecosystem: biotic and abiotic components, producers, consumers and decomposers, trophy level, functions of ecosystem; energy flow, food chain/food web and bio-geo-chemical cycles.

Unit-II Basic concept of biogeography; biogeographical realms, provinces and ecoregions. The biogeographic affinities of the fauna and flora of the Indian sub-continent. India's biogeographic classification and Protected Area network.

Unit-III Definition and Concept ecological community. Biological attributes of community; species richness, diversity and dominance. Change in community structure and function; temporal changes, colonization and extinction (theory of island bio-geography).

Unit IV Definition and concept of Landscape; composition, structure and function, issue of scale, patch and mosaic, edge and ecotone, fragmentation. Role of human impacts on landscape structure and function. Case studies pertaining to application of Remote Sensing and GIS in wildlife studies.

Course Outcome:

1. To gain knowledge and understanding of ecological parameters for GIS applications
2. Get skilled to obtain knowledge about wildlife sciences its components applicable in solving GIS problems.

Recommended Books and Suggested Readings

Wildlife Ecology, Aaron, N.M., W.H. Freeman Co. San Francisco, U.S.A.
Wildlife Ecology, Conservation and Management Anthony R.E. Sinclair, John M. Fryxell and Graeme Caughly Blackwell Publishing, U.S.A.
Remote Sensing for Hazard Monitoring and Disaster Assessment, Barett, E.C. And Anton Micallef Taylor And Francis, London
Environmental Impact Assessment, Canter, L. W. Graw, Mc, Hill Publication, New York.
Biodiversity Conservation in Managed and Protected Areas, Katwal Banerjee, Agrobios, India
A Handbook of Forestry. Negi, S.S. International Book Distributor, Dehradun.

SEMESTER III | LAB-V:RSM 3071 (Core) Credit (2) | Marks 100

LABWORK V– HYPERSPECTRAL REMOTE SENSING 3001 | REMOTE SENSING AND GIS IN NATURAL RESOURCES 3002 |

Course Objective:

1. To gain knowledge about different spectral profile and Library
2. Hands-on experience on different indices for application of natural resources

Exercise:

1. View USGS / JPL Library Spectra
2. Extract Spectral Profiles from Various Hyperspectral Imagery
3. Compare Radiance and Apparent Reflectance Spectra
4. Preprocessing AVIRIS Imagery
5. Preprocessing Hyperion Imagery
6. Atmospheric Correction Using FLAASH
7. Atmospheric Correction Using ACORN
8. Soil Spectra Analysis
9. Soil Erosion Mapping
10. Surface Water Mapping Using Various Indices
11. Forest Classification
12. NDVI, NDWI, NDSI and Other Indices
13. Lineament Mapping
14. Solar Energy Potential Mapping using RS and GIS

Course Outcome:

1. Apply GIS for natural resource management, urban and land use land cover study
2. Perform preparing different maps integrating spatial and no-spatial data for solving regional issues.

SEMESTER III | LAB-VI: RSM 3072 (Core) | Credit (2) | Marks 100

LABWORK VI– DIGITAL TERRAIN MODELING 3003 | DATA MINING AND CLOUD COMPUTING 3011 | 3003,3004 | ELECTIVES (3012, 3013, 3014, 3015)

Course Objective:

1. To enhance the knowledge of students about various terrain.
2. Hands on experience on various technique of thematic mapping
3. Understanding applications of RS and GIs in natural hazards and urban planning

Exercise:

1. DEM Creation from Point Source
2. DEM from Contours
3. TIN Generation
4. Error Estimation In DEM/DTM
5. DEM Based Morphometric Analysis
6. Overview of SAGA, QGIS, ESRI, Microrem for Terrain Modeling
7. Slope, Aspect, Curvature, Hill shade
8. UAV Obtained Imagery Analysis
9. Point Cloud Analysis
10. Cloud Computing
11. Data Mining Analysis
12. Citizen GIS And Mapping
13. Mapping of various landuse and land cover classes using digitization techniques
14. Landuse/Landcover Mapping using Unsupervised classification techniques
15. Landuse/Landcover Mapping using Supervised classification techniques
16. Change detection analysis
17. Land Suitability Analysis for Urban Renewal.
18. Landslide Susceptibility Mapping
19. Flood Inundation Mapping
20. Sea Level Rise Mapping
21. Mapping and Monitoring Desertification
22. Drainage morphometric analysis (manual)
    - Areal and Linear Parameters
23. Watershed delineation using Digital Elevation Model
24. Drainage morphometric analysis (GIS)
    - Areal, Linear and Relief ParametersBasin hypsometry.
25. Watershed Characterization and Prioritization
26. Hydro geomorphic Mapping for Groundwater Potential

Course Outcome:

1. Students may able to create terrain model on various software
2. Handling of UAV images and data mining processes
3. Monitoring and mapping of natural hazards & resources
4. To obtain knowledge of preparation of various thematic maps

SEMESTER IV | Paper 1. RSM 4071 PROJECT/DISSERTATION (Core)| Credit (10) Marks 100

DURATION (4-5months)

Project/Dissertation

The student of IV Semester are required to undertake a Project / Dissertation work. The students are encouraged to contact faculties and scientists in premier institutions within the Country and abroad for applying as Project interns. Students are free to choose an area of work that will be related to the topics covered during first three semester of the M.Sc. Remote Sensing and GIS Application course in consultation with the concerned faculty member. However, a survey of literature and feasibility studies must be undertaken by the students before taking up the topic of their interest.

The external faculty Members/Scientist shall act as a supervisor/co-supervisor under whom the Dissertation work has been carried out. The internal faculty Members/Scientist shall act as a supervisor/co-supervisor depending upon the feasibility of work. The student will be guided by the internal supervisor/co-supervisor time to time during the project work.

The Dissertation / Project work should consist of field work, Analysis of field data and report preparation. At the end of the semester, students must submit a Dissertation (3 copies) on the assigned topic to the Department of Remote Sensing & GIS Application in order to fulfill the criteria for obtaining their Master's Degree

SEMESTER IV | Paper 2. RSM 4072 (core) | Credit (6) | Marks 100

Presentation and Viva Voce

The student should submit a written report in the form of Dissertation/Power Point Presentation on the day of Examination which will include a Synopsis of the Project. He/she has to present their detailed Project Work in the presence of an External/Internal Examiner/Supervisor/Co-Supervisor in the Department of Remote Sensing and GIS Application as per schedule.