PG Diploma in GIS
(P.G. Department of Geography)

Syllabus

DR. SHYAMA PRASAD MUKHERJEE UNIVERSITY
(Following Upgradation of Ranchi College, Ranchi, under RUSA Programme, Component-I)
Ranchi, Jharkhand.
Semester: I  
Paper Code: GIS 01  
Basic Computer Information and Statistics

Term End Exam: 70 Marks  
Internal Assessment: 30 Marks  
Marks Total: 100

Unit I:  
Computer Components  
Computers and its Generations, Hardware Components of a Computer Processor, Main memory,  
Secondary Memory, Input Devices, Output devices, Storage Devices.

Unit II:  
Software Component  
Software/Program, Application Software; Operating System - OS Functions, Types of OS – Windows,  
Unix/Linux, Solaris. Local Area Network, File Management,

Unit III:  
Internet  
Information Technology, Communication and its Types, Significance of Communication in the Modern  
World, Global Village and Information Revolution, Internet and World Wide Web, Browsing,  
Advantage and Limitation in Information Revolution, Computer Viruses and Management.

Unit IV:  
DBMS  
Introduction; databases, database management system - structure, types of DBMS; application of DBMS  
in GIS; data management using MS-Excel, SQL.

Unit V:  
Basics of Statistics  
Introduction to Statistics; Characteristics of Statistical Data; Statistical Methods; Collections of data-  
primary and secondary data sources, Measurement of Central Tendency- Mean, Mode, Median,  
Geometric mean and Harmonic Mean; Measures of variations - Range, Quintile deviations, Mean  
deivation, Standard deviation and variance, Coefficient of variations, Theory of Sampling, Hypothesis;  
Correlation Analysis; Regression Analysis.
Books Recommended

- Subhash Metha, Understanding and Using Internet, Global Business Press, New Delhi, 1996

Semester: I
Paper Code: GIS 02
Principles of Aerial Photographs and Photogrammetry

Term End Exam: 70 Marks
Internal Assessment: 30 Marks
Marks Total: 100

Unit I:
Aerial photography
Introduction to aerial photography – Basic information and specifications of aerial photographs; Planning and execution of photographic flights Basic; Geometric Characteristics of Aerial Photographs- Types of Aerial Photograph, Flight Strips, Nadir Line, End Lap; Side Lap, Stereoscopic Coverage and Stereopairs, Intervalometer, Air Base and Base Height Ratio; Types of Aerial Camera.

Unit II:
Photogrammetry
Definitions and Development of Photogrammetry; Classifications of Photogrammetry; Uses of Photogrammetry; Soft-Copy Photogrammetry- Interior Orientation, Exterior Photogrammetry, Aero-Triangulation.

Unit III:
Photographic Scale
Concept of Photographic Scale; Methods for Determining Photo Scale; Scale of a Vertical Photograph over Flat Terrain; Scale of a Vertical Photograph over variable Terrain; Other methods for determining scale of Vertical Photographs; Scale of Tilted Photograph.

Unit IV:
Stereo Photogrammetry
Stereo Photogrammetry: Model deformation & Rectification, Relief displacement, vertical exaggeration, Triangulation, Control & Mapping.

Books Recommended

- Digital Elevation Model Technologies and Applications: The DEM user Manual,
- Lecture notes, 1st module, PRS division IIRS Dehradun.2007

Semester: I
Paper Code: GIS 03
Principles of Remote Sensing

Term End Exam: 70 Marks
Internal Assessment: 30 Marks
Marks Total: 100
Unit I: Concepts of Remote Sensing:
Introduction; Definition and Scope; Stages of Remote Sensing data acquisition; Process of Remote Sensing data analysis; Type of Remote Sensing- Active and passive remote sensing; Advantages and Limitations of Remote Sensing.

Unit II: Electromagnetic energy:
Introduction; Electromagnetic energy- Electromagnetic spectrum, Radiation Principal’s; EMR interaction with Atmosphere- scattering, Absorption and Atmospheric Windows; EMR interaction with earth surface features - reflection, absorption, emission and transmission; Spectral response pattern - vegetation, soil, water bodies.

Unit III: Remote Sensing Platforms and Sensors:
Platforms – Types and their characteristics; Satellites and their characteristics – Geo-stationary and sun-synchronous; Earth Resources Satellites- LANDSAT, SPOT, IRS, IKONOS, QUICKBIRD satellite series; Meteorological satellites – INSAT, NOAA, GOES; Sensors – Types and their characteristics, Across track (whiskbroom) and Along track (pushbroom) scanning; Optical mechanical scanners – MSS, TM, LISS, WiFS, PAN; Concept of Resolution – Spatial, Spectral, Temporal, Radiometric

Unit IV: Image Interpretation
Introduction; Fundamental of Visual Image Interpretation; Elements of Image Interpretation; Image Interpretation strategies; Image Interpretation keys.

Unit V: Remote Sensing Data Requirement and Ground Investigation

Books Recommended
- Sabbins, F.F., 1985, Remote sensing Principles and interpretation. W.H.Freeman and
company


Semester: I
Paper Code: GIS 04
Digital Image Processing

Term End Exam: 70 Marks
Internal Assessment: 30 Marks
Marks Total: 100

Unit: 1
Fundamentals of Digital Image

Unit: II
Image Enhancement
Image enhancement Techniques - an overview; Image reduction and magnification; Contrast Enhancement - Linear and nonlinear; Band Rationing; Spatial filtering and Edge enhancement; Density slicing; Multi image manipulation – addition, subtraction; Principal Component Analysis; Enhancement by using colours – advantages, Types of colour enhancements; BGR – coding and generation of FCC’s; Image transformation-Intensity Hue Saturation (HIS)

Unit: III
Image Classification
Principles of Image Classification-Image space, Feature space, Image classification; Image Classification process- Preparation for image classification, supervised image classification, unsupervised image classification, classification algorithms; Fuzzy classification; classification based on Object-oriented Image Segmentation

Unit: IV
Accuracy Assessment
Concept of Accuracy Assessment; Source of Errors in remote sensing derived thematic products; Error Matrix; Sampling consideration; Evaluation of Error Matrices; Kappa Analysis;

Books Recommended

Semester: I
Paper Code: GIS 05
Earth Positioning System

Term End Exam: 75 Marks
Internal Assessment: 25 Marks
Total: 100 Marks

Unit: I
Introduction
Introduction; History of Navigation and Positioning; Objectives, Types of Earth’s, Positioning Systems- GPS, GALILEO, GLONASS and GAGAN; Comparison of Main Parameters for GPS, GLONASS GALILEO and GAGAN.

Unit: II
Datum, Coordinate Systems and Map Projections
Basics Geodesy, Geoid/ Datum/Ellipsoid-Definition and Basic Concepts; Datum, Transformations; Map Projections.

Unit: III
Fundamentals of Positioning Systems
GPS Components – space segment, control segment, user segment; GPS Receiver and its Types -; GPS Errors. GPS Positioning Modes: GPS point positioning, GPS relative positioning; RTK GPS, Factor affecting GPS accuracy

Unit: IV
Differential Positioning System (DGPS):

Unit: V
Applications of GPS
Route Navigation, Forestry and Natural Resources, GPS Tracking, Utility, Mapping, Civil Engineering, Cadastral Surveying and Seismic Applications

Books Recommended

Semester: I
Paper Code: GIS 06
PRACTICAL 100 Marks

Practical Examination will be taken on the following topics:

1. Familiarization with Image Processing software.
2. Visualization; Import and export of Toposheet and satellite data to various formats.
3. Georeferencing of data- image to image, image to maps
4. Layer Stacking of Multispectral Imagery
5. Creating subset of image.
6. Resolution merge and Mosaic.
7. Displaying individual pixel value and image information.
8. Image enhancement techniques- image contrast, histogram equalization and density slicing.
9. Band Rationing; Filtering techniques; Principal Component Analysis.
11. Recoding of Pixels
12. Accuracy Assessment
13. Change detection.
14. Determination of Latitude, Longitude and height by GPS.
15. Collection of Waypoints through GPS.
16. Tracking through GPS.
17. Downloading handheld GPS data into software.

Distribution of Marks of Practical Examination
(i) Mid-term Lab work ......................... 25 Marks
(ii) Annual Lab Work ......................... 25 Marks
(iii) Record Book .............................. 25 Marks
(iv) Viva – Voice ............................. 25 Marks
Semester: II
Paper Code: GIS 07
**Geographic Information System**

Term End Exam: 75 Marks  
Internal Assessment: 25 Marks  
Total: 100 Marks

**Unit: I**  
**Introduction to GIS**

Basic concepts: Definition and history, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Data base design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error.

**Unit: II**  
**Data Types and Data Models**

Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.

**Unit: III**  
**Spatial Data Editing**

Types of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.

**Unit: IV**  
**Attribute Data and Data Exploration**

Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation,

**Unit: V**  
**Spatial Analysis**

Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector- Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect. Geographic Visualization Data Classification, Map Comparison,
Unit: V
Geo Statistical Analysis Techniques:
Introduction to Spatial Interpolation: Control Points, Global Method- Trend surface analysis, regression model, local methods- Thiessen polygons, density estimation, Inverse Distance weighted Interpolation, Kriging- Ordinary Kriging and Universal Kriging, GIS and decision support system, Introduction to AHP, basic principal of AHP. Principal and components of multiple criteria decision making

Books Recommended

Term End Exam: 75 Marks
Internal Assessment: 25 Marks
Total: 100 Marks

Unit: I
Introduction
Introduction to cartography: nature and scope, Significance of Computer Mapping, Mapping in a Digital Age. Categories & Characteristics of maps, Study of different types of maps, Basics of Map scales, Component of Map, Conventional mapping VS Digital Mapping

Unit: II
Toposheet
Survey of India national series maps Interpretation of topographic maps, Indexing and Numbering of topographical maps,

Unit: III
Map Generalization
Concepts and Definition of Map Generalization, Factors Influencing, Generalization, Different operation in Generalization; Semantic Generalization; Geometric Generalization.

Unit: IV
Map Design
Fundamentals of Cartographic Design, Colour, Pattern, lettering, compilation, border information, aesthetics, Generalization: Semantic & Geometric, Symbolization, dot, isopleth and choropleth mapping, Multivariate and dynamic mapping, Map production, methods of map printing

Books Recommended
Semester: II
Paper Code: GIS 09
Advanced Remote Sensing & GIS

Term End Exam: 75 Marks
Internal Assessment: 25 Marks
Total: 100 Marks

Unit: I

Unit: II
Web GIS
Concepts and Principles of Web GIS; Definition and History of Web GIS; Significance of Web GIS; Transferred Geo data, Interactive Web Maps, Internet Map Services, Web GIS Architectures, Web GIS development, Requirement Analysis, Conceptual design, Web GIS system Integration, Open Source GIS; Web Based Geo Portal, India Geoportal; State Geoportal and District Geoportal. Vehicle Tracking System, Mobile mapping, Location Based Services, Intelligent transportation systems

Unit: III
GIS Modeling
Unit: IV
Mobile GIS

Mobile GIS - Concepts, Portable PCs Personal digital assistance (PDAs) or Palm Top, Mobile Phone, Arc GIS Mobile, Characteristics of Mobile GIS, Benefits of Mobile GIS, Mobile Applications.

BOOKS RECOMMENDED

Semester: II
Paper Code: GIS 10

Research Methodology and Application of Remote Sensing and GIS Techniques in Research

Term End Exam: 75 Marks
Internal Assessment: 25 Marks
Total: 100 Marks

Unit: I
Brief description of research,
Concepts and Principles of research, Objectives of research; Types of research; Significance of research; Definition of research problem, Technique involved in defining a problem; Identification of problems of regional and local level.

Unit: II
Research and Sampling Design
Meaning of Research Design; Basic Principles of Experimental Designs; Important Concepts Relating to Research Design; Implications of a sample design; Basic step of sample design; Type of sample design.

Unit: III
Data Collection
Collection of primary data; collection of secondary data; Types of data collection; Advantage and limitation of case study; Reporting of results, References.

Unit: IV
Research Project Proposal and Report Writing
Writing of proposals, Objectives of project, Research questions, Scope of project, Brain storming sessions, Review of similar studies and present level of research, Time scheduling (PERT), Financial estimates, Submission of proposal; Significance of Report Writing; Mechanics of Writing a Research Report

Unit: V
Fundamental Remote Sensing Application in Land and Water Resources
Emergence of Remote Sensing technology in application areas; Remote sensing in mapping Land use / land cover classification and monitoring; Forest resources management; Principles and approaches of crop inventory and crop production forecasting; Soil classification as per soil taxonomy; Hydrological Cycle-Types of precipitation and the analysis.
Unit: VI
Application in Climate Change and Disaster Management
Concept of climate and weather, Climatic classification, Mapping of landslide hazards, Floods, Cyclones, Forest fire and Drought.

Unit: VII
Principles of Urban and Rural Area Development and Planning
Principles of urban/rural area development planning and land use; Urban/Rural area planning and resource development; Data requirement for Urban and Rural Planning; Large scale mapping for cadastral/RS database in urban/rural areas. Transportation/ road network analysis through RS and GIS; Site selection and suitability analysis for rural/urban development; Urban Sprawl and change detection studies.

Unit: VIII
Application in Environmental Management
Selection of disposal sites for industrial and municipal wastes, Solid waste management, Environmental Impact Assessment (EIA) and Auditing.

Books Recommended
Technology for Water Resource Development. CRC Press, Taylor and Francis


Semester: II  
Paper Code: GIS 11  
Practical

Practical Examination will be taken on the following topics:

1. Geodatabase creation  
2. Spatial data Integration (Digitization) – point, line, polygon.  
3. Non-Spatial Data Integration.  
4. Editing of Spatial & Non-Spatial data.  
5. Building Topology; Data Query.  
7. Raster Data calculations.  
8. Accuracy assessment.  
9. Mapping and editing.  
11. Types of Maps.  
12. Map Design or Layout, Map Production.

Distribution of Marks of Practical Examination
(i) Lab Work...........................................50 Marks (Time-2 hours)  
(ii) Record Book......................................25 Marks  
(iii)Viva –Voice.....................................25 Marks
Semester: II
Paper Code: GIS 12

Project Oriented Dissertation

1. Project Evaluation: 25
2. Project Presentation: 25
3. Project Viva Voice: 50

The Subject/ topic of the project work, related to the problems will be allotted to each student in the beginning of the 2nd Semester. The students, in consultation with their respective supervisors, may give their choice of preference of problem/ topic/ area. However, the decision of the Head/ Course Coordinator shall be final. Each student will be required to work independently on the problem assigned including literature consultation, data collection, fieldwork and/ or training, laboratory investigations, report writing etc., under the guidance of his/ her supervisor. The students will have to submit to the department three typed (bound) copies of his/ her work, in the form of Project Report. After the evaluation, a copy a which will be returned to the concerned supervisor and the student separately.

The Project topic should consist of the following:

- Relevance of the problem to be studied and its aims and objectives,
- Review of Literature
- Methodology adopted to study such problem
- Data acquisition / collection
- Field work
- Data processing
- Results and interpretation
- Limitation of work
- Finding and Conclusion

presentation: -

On satisfactory completion of the Project, each student is required to defend his/ her thesis through a power point presentation in front of an external expert and faculty and students which will be followed by Viva- Voce. This should be a substantial piece of research work, which both reinforces the skills learned in the taught component of the course and provides a genuine opportunity to undertake valuable- research.