

Manonmaniam Sundaranar University, Tirunelveli - 12

PG DIPLOMA IN GEOINFORMATICS UNDER DIRECTORATE OF DISTANCE AND CONTINUING EDUCATION Effective from the Academic Year 2014-2015 onwards

Eligibility for Admission:

Degree in Science/Engineering/Agriculture Science/Fisheries Science

Duration: 1 Year

PG DIPLOMA IN GEOINFORMATICS SCHEME OF EXAMINATION (EFFECT FROM 2014-2015 ONWARDS)

S. No.	SUBJECT
1	Basics of Remote Sensing
2	Fundamentals of Geographic Information Systems
3	Introduction to Digital image processing
4	Principles of Cartography & Digital Mapping
5	RDBMS and Web GIS
6	Application of Geoinformatics
7	Geoinformatics in Water Resources Management
8	Geoinformatics in Geology & Oceanography
9	Geoinformatics in Agriculture and Forestry
10	Practical – Remote sensing and GIS*

* Hands on training and practical for a period of 30 days will be conducted at the University Department or Department identified by the University.

SYLLABUS

Paper 1: Basics of Remote Sensing

Unit – 1

Definition of Remote sensing, Advantages and limitations, Remote sensing process, Electromagnetic Radiation (EMR): EMR Spectrum and its properties, EMR wavelength regions and their applications, Atmospheric windows, Interaction of EMR with matter, Spectral signatures, Resolutions: Spectral, Spatial, Temporal and Radiometric

Unit – 2

Fundamentals of aerial photography, Vertical and Oblique aerial photography, Aerial cameras, Photogrammetry; Basic concepts of scale, object height and length, object area and perimeter, grayscale tone/color of objects, Photo interpretation techniques, Stereo photogrammetry and stereovision, Parallax bar and its applications.

Unit – 3

Photographic System: Cameras, Sensor classification: Active and Passive, along track and across track scanners, Infrared Scanners, Thermal Sensors and Microwave Sensors, Passive Microwave Sensors, Active Microwave Sensors, Side looking RADAR, Scatterometer

Unit – 4

Introduction to Thermal Infrared Radiation Properties: Kinetic Heat, Temperature, Radiant Energy and Flux, methods of transferring heat, Thermal properties of terrain: Thermal Capacity, Thermal conductivity, Thermal Inertia, Thermal Infrared Multispectral scanners, Thermal IR Remote sensing examples

Unit – 5

Orbits of satellite, Kepler's laws of motion, IRS Series of Satellites, LANDSAT, SPOT, IKONOS, QUICKBIRD, MODIS, RADARSAT, NOAA, TERRA, MOS and ERS, Brief introduction to Weather and Communication Satellites, Spectral Signature and its Response: of Soil, Vegetation and Water, Basics of visual interpretation of satellite images, Hyper-spectral remote sensing

REFERENCE

1. Jensen, J.R., "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi, 2000
2. George Joseph, "Fundamentals of remote sensing", Universities press (India) Pte Ltd., Hyderabad, 2003
3. Sabins, F.F. Jr., "Remote Sensing – Principles and Interpretation", W.H. Freeman & Co., 2002 Edition.
4. Reeves, Robert G., "Manual of Remote Sensing, Vol. I, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA
5. Lillesand, Thomas M. and Kiefer, Ralph, W., "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York, 2000
6. Rampal, K.K., Handbook of Aerial Photography and Interpretation, Concept Publishing Company, New Delhi, 1999

Paper 2: Fundamentals of Geographic Information Systems

Unit – 1

Basic Concepts about spatial information, Philosophy and definition of GIS, features, pictures, variables: points, lines, areas, Position on the earth; Basics of map. Fundamentals of Data Storage, Information Organization and Data Structure Basic File Structures; Tabular Databases; Advantages of Databases, Types of Databases- hierarchical systems, network systems, relational systems and Object-oriented database systems (OODS), Data Models-Entity Relationship model, Relational Model, Data Structures; Raster Structures, Vector Structures.

Unit – 2

GIS Data Requirement, sources and collection, Methods of data capture-scanning, digitization and associated errors, Conversion from Other Digital Sources, Attribute data input and management, Edge matching, creating digital data - remote sensing; generating data from existing data ; Metadata ;Different Kinds of geospatial data, Detecting and Evaluating Errors, Data Quality Measurement and Assessment, digital output options.

Unit – 3

Image storage formats, Data retrieval, Data compression, NSDI,GSDI; geographic information in decision making; human resources and education; Interactive data exploration, Vector & Raster data query, Geographic visualization;

Unit – 4

Raster data and structure, Local operations, Neighborhood operations, Zonal operations, Distance measure operations, Spatial auto correlations, DEM generation, Spatial Modeling, combining data; terrain mapping finding and quantifying relationships; spatial interpolation;

Unit – 5

Vector data base , Topological Relationships; Creation of Topology and Error Correction; Accuracy and Precision; The Importance of Error, Accuracy, and Precision, types of error, sources of error, data quality, Spatial interpolation, Overlay Operations and Buffering, Neighborhood functions Distant Measurement , Map Manipulation, Network analyses, GIS and Remote Sensing data Integration, Thematic Mapping , GIS and Integration of other types of data, Virtual GIS and SDSS, Project design and management, need assessment.

REFERENCES

1. Kang-tsung Chang 2002, 'Introduction to Geographic Information Systems' Tata McGraw Hill, New Delhi.
2. C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India, New Delhi.
3. Burrough, Peter A. and Rachael McDonnell, 1998, ' Principles of Geographical Information Systems' Oxford University Press, New York.
4. Magwire, D. J., Goodchild, M.F. and Rhind, D. M. Ed. 1991, 'Geographical Information Systems: Principles and Applications', Longman Group, U.K.
5. Graeme Bonham-Carter, Geographic Information Systems for Geoscientists : Modelling with GIS, Elsevier Publications, 1994

Paper 3: Introduction to Digital Image Processing

Unit – 1

Image acquisition and format - Satellite data acquisition, DN characters-kernels- storage devices, Export and import, Data formats, BSQ, BIL, BIP, Data products , hard copy, digital products, Image display system, requirement.

Unit – 2

Image rectification and restoration: introduction-Sensor model, Preprocessing and Post processing Geometric distortion, GCP, Resampling, Image registration, transformation,

Radiometric distortion, Computation of radiance, Computation of reflectance, cosmetic operations, Noise removal, atmospheric correction.

Unit – 3

Image enhancement - Satellite image statistics, Univariate and multi-variate statistics. Basics of Histogram, noise models, image quality, contrast manipulation, grey level thresholding, level slicing, contrast stretching- Spatial feature manipulations, spatial filtering, convolution Low pass, high pass, edge enhancement, edge detection.

Unit – 4

Image classification - Introduction, Classification techniques, feature extraction, Supervised, training stage, classification stage, scatterogram, minimum distance to mean classifier, Parallelepiped classifier, Gaussian maximum Likelihood classifier, unsupervised classification, Hybrid classifier, classification of mixed pixel-fuzzy classification, output stage, classification accuracy, error matrix.

Unit – 5

Image analysis - Digital Image interpretation, Pattern recognition, shape analysis, Textural analysis, Decision concepts, fuzzy sets and Evidential reasoning, Change detection, multitemporal data merging, multi sensor image merging-merging image data with ancillary data,

REFERENCES

1. M. Anji Reddy, "Textbook of Remote Sensing and Geographical Information systems" BS Publications, Hyderabad. 2011. ISBN : 81-7800-112-8
2. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, "Remote sensing and Image interpretation" John Wiley & Sons, 2008
3. John R. Jenson "Introducing Digital Image Processing" - Prentice Hall, New Jersey 1986
4. Robert A. Schowengerdt, "Techniques for Image Processing and Classification in Remote Sensing"; 1984. ISBN 13: 9780126289800
5. Rafael C. Gonzalez and R.E. Woods, "Digital Image Processing", Pearson Edu. 2009
6. C. Chandra and D. Dutta Majumdar, "Digital Image processing and Analysis", Prentice Hall India, 2009
7. S. Jayaram, S. Esakkirajan, T, Veerakumar, "Digital Image Processing", Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2009
8. Honzales "Digital Image Processing"

Paper 4: Principles of Cartography & Digital Mapping

Unit – 1

Basic Concept of cartography, Categories of maps, Interpretation of topographic maps, Cartographic databases, data measurement, cartographic design issues, colour and pattern, map lettering, map compilation, map scale, Generalization, symbolization, dot, isopleths and choropleth mapping, multivariate and dynamic mapping, map production, methods of map composing and printing,

Unit – 2

Basic Assumptions of projection system, Map Projections, Grouping of map projections: conic projection, cylindrical projection, Zenithal, Projection Types: Mercator, Transverse Mercator, Polyconic, Lambert, Orthomorphic, UTM Projections and their comparison, Choosing a Map Projection, Map Projection transformation, Analysis and visualization of distortion,

Unit – 3

Visualization of geospatial data: Design aspects, Multiscale and geometric aspects scale, dissemination of (visualized) geospatial data, data products, use and users of products, Various issues in map visualization.

Unit – 4

Computer Cartography, the nature of Data, Database and Data structures, Data Input: Method of data capture, digitisation and scanning method,

Unit – 5

Techniques and procedure for digitising, Vector and Raster; Data output: Screen display system, file organization and formats, rectification of digital maps, software for digital mapping.

REFERENCES

1. Keates, J.S. (1973): Cartographic Design and production, London, Longman
2. Ramesh, P. A. (2000): Fundamentals of Cartography, Concept Publishing Co., New Delhi.
3. Rampal, K.K. (1993): Mapping and Compilation, Concept Publishing Co., New Delhi.
4. Anson, R.W. & Ormeling, F.J. (1993), Basic Cartography, Vol. 1, 2nd ed., Elsevier Applied Science, Publishers, London.
5. Robinson A.H. & Morrison J.L, (1995) Elements of Cartography, John Wiley & Sons
6. Gregory, S. (1978): Statistical Methods for Geographers, Longman
7. Singh, R.L & Dutt. P.K, “Elements of Practical geography”, Students Friends Allahabad
8. Peterson, M.P. (1995) “Interactive and Animated Cartography” Upper Sadde River, NJ: Prentice Hall.

Paper 5: RDBMS and Web GIS

Unit – 1

Introduction to Database Management Systems: Introduction-Characteristics of Data- Types of Databases-Introduction to RDBMS- The relational data structure-Relational Data integrity-Interfaces E-R Model concepts,-Notations and Examples For E-R Diagrams-Architecture And Concepts Of Relational Databases.

Unit – 2

Introduction SQL- Characteristics of SQL-Advantages of SQL- Data types. Table: creation-Insertion-Updation-Deletion of data contents-Modification of structure-Removing-Deleting-Dropping of tables- Select of commands-Alter table command-Data constraints: Null value-Unique key-Primary key-Foreign key-Logical operator-Range searching-Pattern matching, Oracle functions.

Unit – 3

Joins: Introduction-Joining multiple tables-Equi-joins-Self join. Union: Introduction-Triggers-Types- of Triggering-Intersect and minus clause-indexes. Views: creation-Updation-Destroying-Selection of data-Granting permissions-Permissions on the object created by user-Grant statement.

Unit – 4

Web design: Introduction-Web Page Basics-Web Mapping Basics-basics of Web GIS system-Geospatial Web Services-mobile GIS - the functionality of geoportals - Web mapping interoperability - OpenGIS-Web GIS applications: e-Government, e-Business, e-Science-Geospatial web services

Unit – 5

Basics of Web GIS: Web GIS concept-Web GIS system architecture-Web-based data editing-GIS analysis on the web- Mobile GIS Structure and design- GIS and online maps publish-Web GIS applications.

REFERENCES

1. C.J. Date, "An introduction to Data Base System: Vol. 1, Addison Wesley.
2. Bipin Desai, An introduction to Data Base System, Galgotia Publications, New Delhi.
3. Korth, Database and its Concept, TMH.
4. Pind Fu and Jiulin Sun. Web GIS: Principles and Applications. ESRI-Press. Redlands,CA. 2010. ISBN 158948245X

Paper 6: Applications of Geoinformatics

Unit – 1

Emergence of geoinformatics technology in application areas, understanding potentials of geoinformatics in allied sectors, geoinformatics advantage over conventional techniques. Indian satellite missions with focused applications, Recent trends in geoinformatics applications.

Unit – 2

Application in Land Resource: Remote sensing in mapping soil degradation, impact of surface mining on land resources, forest resources.

Unit – 3

Application in Water Resources: Remote sensing in hydro-geomorphological interpretation for groundwater exploration, water quality monitoring, reservoir sedimentation, snow cover mapping and modeling approaches.

Unit – 4

Application in Disaster Management: Mapping and modeling Landslide hazards, floods, Cyclones Forest fire and drought.

Unit – 5

Application in Environmental Management: Selection of disposal sites for industrial and municipal wastes, solid waste management, Environmental Impact Assessment (EIA)

REFERENCES

1. Schultz, G. A. and Engman, E. T. 2000. Remote Sensing in Hydrology and Water Management, Springer-Verlag, Berlin, Germany.
2. Lillisand, T. M. and Keifer, R. W. 1994. Remote Sensing and Image interpretation', John Willey and Sons, New York, Third Edition
3. Jenson, J.R. 2000. Remote Sensing of the environment – An Earth Resource Perspective, Prentice Hall Inc.
4. P.S. Roy (2000). Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS), 2000.
5. Spatial Technologies for Natural Hazard Management. Proceedings of ISRS National Symposium, Nov. 21-22, 2000, IIT, Kanpur

Paper 7: Geoinformatics in Water Resources Management

Unit – 1

Hydrological components - Hydrological cycle, Estimation of various components of hydrological cycle, rainfall, runoff, evaporation, transpiration, evapotranspiration, crop evapotranspiration, depression and interception loss, infiltration and percolation losses.

Unit – 2

Watershed characters - Watershed, types, divide, catchment, command area, stream types, influent, effluent, ephemeral, non perennial. Drainage network, different pattern, morphometric analysis, linear, area, relief aspects. GIS applications for watershed analysis

Unit – 3

Hydrological studies - Hydrological aspects- mapping and monitoring, management, soil moisture estimation, drought zonations, Agricultural, meteorological and hydrological, flood

mapping pre and post flood area estimation and control measures –GIS applications for hydrological disaster studies

Unit – 4

Ground water resources applications - Types of Aquifers formations confined and unconfined aquifers Assessment of Groundwater potential zones and Groundwater mapping. Site selection for recharge structures- Hydrogeological Mapping GIS applications to ground water studies

Unit – 5

Surface water resources applications - Surface water bodies, lakes, reservoirs, ponds, rivers, channels, mapping change detection, Water harvesting structures, in-situ and Ex-situ, Water logging and salt affected area GIS applications to surface water studies.

REFERENCES

1. H.M. Raghunath. Hydrology – Principles – Analysis – Design. New Age International Publishers, New Delhi. 2006
2. Ramasamy, SM ., Remote sensing in water resources Rawat publications, New Delhi, 2005
3. V.V.N. Murty. Land and Water Management Engineering, Kalyani Publishers, New Delhi – 2002.
4. C.S. Agarwal and P.K. Garg. Text Book on Remote Sensing in Natural Resources, Monitoring and Management.2000. Wheeler publishing Co & Ltd., New Delhi.

Paper 8: Geoinformatics in Geology & Oceanography

Unit – 1

Spectral properties of rocks and minerals - Reflectance Properties of Rocks, minerals in visible, NIR, MIR, SWIR, TIR and Microwave regions, Spectral reflection curves for important Rocks, Minerals.

Unit – 2

Geological structure and applications - Significance of Geological structures, Role of aerial photographs, Photo interpretation characters of photographs and satellite images, structural mapping, Fold, fault, Lineaments, Direction circular features.

Unit – 3

Geomorphological mapping - Significance of landform, Geomoprphological guide, interpretation and image/photo characters, Tectonic landforms, Fluvial landforms, Denudational landforms, Volcanic landforms- Aeolian landforms, Coastal landforms. Importance of ground truth and geological field data collection.

Unit – 4

Oceans and coasts - Introduction- origin- ocean importance, boundaries, continental margins and ocean basin, shelves, slopes, canyon, and rises, deep ocean basins, ridges, seamounts,

abyssal plain, sedimentation processes- Coastal processes circulation, current Measurement, Waves, Surface waves, reflection, diffraction and refraction, wave generated currents, Tides, sediment drift

Unit – 5

RS and GIS applications in coastal studies - Role of remote sensing, advantages, resolutions, scale parameters, regional studies, coastal regulation zone mapping, Issues, Coastal Hydrodynamic, Coastal erosion and protection, salt water intrusion studies, Estuaries and their impact on coastal process wetland mapping, Thematic data base generation in GIS and analysis, mangroves and coastal zone management.

Paper 9: Geoinformatics in Agriculture and Forestry

Unit – 1

Spectral characteristics of leaf - Structure of leaf - Spectral behavior of leaf – Vegetation indices – NDVI, TVI, SVI, PCA – Vegetation classification and mapping - Estimation of Leaf area index, Biomass estimation – Estimation of terrestrial carbon assimilation in forests.

Unit – 2

Remote Sensing techniques for estimation of soil moisture and evapotranspiration. Spectral behavior of different crops and vegetation in VIS, NIR, MIR, TIR and Microwave regions.

Unit – 3

Forest mapping - Forest type and density mapping and forest stock mapping using RS technique -factors for degradation of forests – deforestation/afforestation/. Change detection in forests - case studies. Biodiversity characterization mapping - Forestry – Forest taxonomy. Linnaeus classification – Biodiversity characterization – Forest fire risk zonation – wildlife habitats suitability analysis - case studies.

Unit – 4

Agricultural applications - Identification of crops -acreage estimation -production forecasting. Pests and disease attacks through remote sensing -crop stress detection due to flood and drought - catchments and command area monitoring. Water management in command areas - monitoring, assessing crop water availability, demand and utilization pattern through Remote Sensing.

Unit – 5

Soil applications - Soil survey and land use classification - water logging - characters of saline, alkali soils - soil erosion – types – Estimation of soil loss from USLE using Remote sensing and GIS - Wasteland development.

REFERENCES

1. Steven, M.D and Clark, J.A., "Applications of Remote Sensing in Agriculture", Butterworths, London 1990.

2. Remote Sensing Applications Group, Space Applications Centre, Crop Average and production Estimation (CAPE): An Anthology from January 1986 - June 1996. (Publications in Journals, Seminars I Symposium proceedings), Ahmedabad, August 1996.
3. Negi, S.S., A Handbook of forestry. International Book distributors, Dehradun, 1986. Space Applications Centre, Manual of procedure for Forest mapping and Damage Detection using satellite data, Ahmedabad, 1990

Paper 10: Practical - Remote sensing and GIS

Unit I: Remote Sensing

1. Aerial photograph interpretation
2. Visual interpretation of multispectral and panchromatic image
3. Histogram stretching, linear, non linear stretching, histogram equalization
4. Image rectification
5. Image classification, supervised and unsupervised classifications
6. Image fusion
7. Stitching of scenes
8. Change detection from multi-date imagery

Unit II: GIS

1. Analog to Digital Conversion – Scanning methods
2. Introduction to software
3. Digital database creation – Point features, Line features, Polygon features
4. Data Editing-Removal of errors – Overshoot & Undershoot, Snapping
5. Data Collection and Integration, Non-spatial data attachment working with tables
6. Dissolving and Merging
7. Clipping, Intersection and Union
8. Buffering techniques
9. Spatial and Attribute query and Analysis
10. Contouring and DEM
11. Advanced Analyses – Network analyses
12. Layout Generation and report

Unit III: Cartography

1. Construction of different types of scales
2. Construction of different types of map projection: Conical projection, Cylindrical Projection, WGS 84
3. Preparation of UTM grid
4. Base Map

5. Designing and Symbolization
6. Analog to Digital Conversion
7. Analysis of Toposheet
8. Updation of maps from Satellite Imagery.

Unit IV: Applications of Geoinformatics

1. Satellite image based hydro-geomorphological interpretation for ground water targeting.
2. Open cast mining impacts on land resources using satellite images.
3. Mapping flood hazards in a region using satellite images
4. Mapping landslide hazards in a region using satellite images
