SCHOOL OF STUDIES IN GEOLOGY & WRM

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

SYLLABUS FOR
POST GRADUATE DIPLOMA IN REMOTE SENSING & GIS
IN COLLABORATION WITH
SCHOOL OF STUDIES IN GEOGRAPHY & CG COUNCIL OF SCIENCE & TECHNOLOGY

The **AIM** of the Course is capacity building & Research within the state of Chhattisgarh.

OBJECTIVE OF THE COURSE is to provide an opportunity for individuals to learn remote sensing & GIS for the benefit of their professional career; allow students to quickly gain RS & GIS knowledge and qualification and to add the credentials: to develop learner's research, analytical and problem solving skills.

1. COURSE STRUCTURE AND DURATION

The course shall comprise of four modules and the duration of the course will be of one year duration. The details are as follows:

Theory Paper
Paper 1: Remote Sensing & Digital Image Processing
Paper 2: GIS, GPS, Digital Cartography & Surveying
Paper 3: Application of RS & GIS
Practicals
Lab Course 1: Image Processing
Lab Course 2: Digital Cartography & GIS
Lab Course 3: Application of RS & GIS
Dissertation
Field work + Project Report + Viva Voce

2. SCHEME OF EXAMINATION

The total marks for the course shall be 600, including theory, practical and dissertation.

Theory Paper	Maximum Marks
Paper 1: Remote Sensing & Digital Image Processing	100
Paper 2: GIS, GPS, Digital Cartography & Surveying	100
Paper 3: Application of RS & GIS	100
Practicals	**Maximum Marks**
Lab Course 1: Image Processing	50
Lab Course 2: Digital Cartography & GIS	50
Lab Course 3: Application of RS & GIS	50
Dissertation	**Maximum Marks**
Field work (50) + Project Report (75) + Viva Voce (25)	150
Grand Total	**600**

3. SYLLABUS

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PAPER 1: Remote Sensing & Digital Image Processing
Maximum Marks: 100

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1.1 Fundamentals of Remote Sensing

Concept and scope of Remote Sensing; characteristics of Remote Sensing; advantages and limitations; concept of Electromagnetic Radiation (EMR);atmospheric window; interaction of EMR with matter; spectral signatures; sources of energy; energy interaction in the atmosphere; energy interaction with earth surface; Remote Sensing scenario in Indian context

1.2 Platform & Sensors

Types of platform-ground, airborne and space borne; types of orbits; orbital characteristics; satellite basics: Kepler's law, launch vehicle, payload; types and characteristics of sensors; Resolution of sensors: spatial, spectral, temporal & radiometric; scale ,mapping unit; false colour composite; specification of some popular satellites.

1.3 Photogrammetry

Historical development and fundamental of aerial photographs; types of aerial photographs; digital camera; components of aerial cameras; camera calibrations; photogrammetric applications & products; stereoscope: pocket & mirror; photographic overlap; image parallax; height determination from stereo-pairs; scale, geometry and ground coverage of aerial photographs; area calculation; flight planning; relief distortion; tilt distortion; ortho-rectification; Digital Photogrammetry, block adjustment; DEM; Ortho-mosaic.

1.4 Image Interpretation

Interpretation key; types of interpretation; spectral pattern recognition; spatial pattern recognition; temporal pattern recognition

1.5 Digital Image processing

Definition of digital image; sources of data; data formats; hardware & software consideration for DIP; sources of error in images; Geometric corrections: rectification, registration, geo-referencing & geo-coding; Resampling technique; radiometric correction; image enhancement; spatial filtering; band ratio; density slicing; principal component analysis; image fusion; ground truth collection for image classification; training verification; unsupervised & supervised classification; iso-data, K-mean; accuracy assessment; change detection analysis

PAPER 2: GIS, GPS, Digital Cartography & Surveying
Maximum Marks: 100

2.1 Fundamental of Geographic Information System

Basic Concepts: definition of GIS, Components of GIS, Variables - points, lines, polygon, Functionality of GIS, Areas of GIS application, Advantage and Limitation of GIS; *GIS Data:* Spatial and Attribute Data, Information Organization and Data Structures - Raster and Vector data structures, Data file and database; *Creating GIS Database*: GIS Software's, file organization and formats, Advantages of Data base Management System. Conceptual implementation models, Hierarchical, Network, Relational models. RDBMS: components, concept, database schema, tables and relationships. Database design Normalization Geo-database, Rectification, Digitization; *GIS Data Input:* Nature and Source of data, Method of spatial data capture - Primary and Secondary, digitization and scanning method, Techniques and procedure for digitizing, Errors of Digitization, Attribute data capture; *Data Editing:* Detecting and correcting errors, Re-projection, Transformation and Generalization, Edge matching and Rubber sheeting, Topology, Conversion from Other Digital Sources.

2.2 Remote Sensing Data and GIS Integration

Introduction to different spheroid / ellipsoid systems with special reference to Everest and WGS-84 - Geometric Constants, Indian Geodetic Datum; Rectangular and Geographical Co-ordinate System - Conversion of latitudes and longitudes to linear distances, Coordinate Transformations, Geoidal parameters and their relationship.

2.3 Global Positioning System (GPS)

Introduction, Satellite constellation, GPS signals and data, Geo-positioning- Basic Concepts. NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS), Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning; *GPS Surveying Methods and Accuracy:* Methods-Static & Rapid Static, Kinematic-Real Time Kinematic Survey- DGPS-GPS Data Processing and Accuracy, Factors Affecting GPS

Accuracy; *Reference Station:* Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna; *Mobile Mapping and GPS Applications:* Mobile Mapping basic concepts and Applications, GPS Application in Surveying and Mapping.

2.4 Digital Cartography

GIS and Digital Cartography: Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography; *Concept of Map Scales:* Defining Map, Projection Systems, Categories of maps, Map Scales; *Digital Mapping:* Cartographic Design Issues, Concept of Visual Variables, Map Lettering, Map Compilation, Generalization, Map Composition, Multivariate and Dynamic Mapping; Map Production; Visualization of geospatial data- 2D and 3D visualization; study & interpretation of SOI maps, cadastral maps & thematic maps.

2.5 Surveying

Validation of Data: Importance of Field Survey, Collection of Ground Truth.

PAPER 3: APPLICATION OF RS & GIS
Maximum Marks: 100

3.1 Application of RS & GIS in Geology, Structural Evaluation and Geomorphology 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 and Minerals. Digital image processing techniques for geological and lithological mapping. Significance of Geological structures, Identification of geological structures and structural mapping of Fold, Fault, Lineaments, Direction circular features, Intrusive rocks, rock exposure, Fractures and Joints. Digital image processing techniques for structural mapping. Image/photo characters for identification of various geomoprphological features i.e. Tectonic landforms, Fluvial landforms, Denudational landforms, Volcanic landforms, Aeolian landforms, Coastal landforms.

3.2 Application of RS & GIS in Water Resource, Agriculture & Forest Study Data Sources for GIS in Water Resources, Agriculture and Forest. Spatial analysis in Hydrology, Digital Elevation Model Watershed and Stream Network Delineation, Terrain Analysis Using Digital Elevation Models, Height above Nearest Drainage (HAND) flood inundation mapping, LIDAR and flood plain mapping. Spectral behavior of leaf – Vegetation indices – NDVI,TVI, SVI, PCA, Biomass estimation – Estimation of terrestrial carbon assimilation in forests Forest type and density mapping and forest stock mapping using RS technique -factors for degradation of forests. Change detection in forests. 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.

3.3 Application of RS & GIS in Planning & Rural Development Study Relevance of remotely sensed data for Urban & Regional Analysis and Planning - Identification of settlement features from aerial photo and

satellite images, Visual and digital analysis techniques, Concept of Scale and Resolution. Methodology for Regional Mapping and City Mapping, Base map preparation, Change Detection and mapping, Classification terminology - Urban fringe, CBD, Urban sprawl, Regional plan, Master plan, Detailed Development plan, Delineation of planning area. Sustainable development plans.

3.4 Application of RS & GIS in Disaster/ Hazard Assessment Study Risk assessment - Damage assessment – Land use planning and regulation for sustainable development, Vulnerability analysis of infrastructure and settlements - Pre-disaster and post-disaster planning for relief operations - Potential of GIS application in development planning and Disaster management plan

3.5 Application of RS & GIS in Environmental Studies Concept and Elements of EIA, Classification of environmental parameters, preparation of Environmental Base map; E I A Methodologies: Ad-hoc methods, matrix methods, Network method, Environmental Media Quality Index method, overlay methods, cost/Benefit Analysis. Impact of Developmental Activities and Land use on soil and ground, on Vegetation and wildlife. Impact prediction, Assessment of Impact, Identification and Incorporation of mitigation measures. E I A studies for Air and Biological environment. Environmental Audit: Types of environmental Audit, and preparation of Audit report.

Lab Course 1: Image Processing
Maximum Marks: 50

Introduction to RS software; satellite image annotation; open source data downloading from various sites; export, import of files; conversion of file format; rectification; registration; creating region of interest; mosaicing; sub-setting; spectral response of different landcover object; image statistics & histogram; visual interpretation of aerial images, visual image interpretation of satellite imagery; interpretation of landuse/landcover map; determination of photo scale; orientation of stereo model under stereoscope; map projection; image enhancement; filtering; image data fusion; change detection analysis; supervised & unsupervised classification; accuracy assessment; Ortho-rectification; DEM & Ortho-Image generation.

Lab Course 2: Digital Cartography & GIS
Maximum Marks: 50

Georeferencing & projection; Managing Geo-database; geometric measurements tools & Changing Projection; creation of gdb, shapefile, feature class; Digitization: Point, Line, Polygon; Vector Editing, Data base creation, Managing Attribute Table, Thematic Maps; Select and Query in vector layers; Network, Neighborhood, Buffer, Proximity [thiessen polygon], Overlay, Intersection ⋃ Topographic & Morphometric analysis: TIN, DEM, Contour & Isopleth generation; conversions and Topology; Spatial Analysis; GPS based field survey; plotting of GPS point & map preparation; geo-tagging

of photographs; Digital cartography: base map preparation, thematic map preparation; generation of 2D & 3D maps

Lab Course 3: Application of RS & GIS
Maximum Marks: 50

Watershed delineation; Morphometric Analysis (DEM); surface water-bodies inventory; groundwater quality based on different parameters; irrigation ; agriculture land use; use of multi temporal satellite data; identification of crop and acreage estimation; vegetation indices for crop health & forecasting; plantation mapping; urban change detection, utility mapping, urban database creation; urban expansion; forest Fire Identification; forest type mapping; forest species mapping; forest density mapping; wildlife mapping; village map generation; cadastral map rectification; rural settlement mapping; rural road mapping; other rural facilities mapping and inventory; population study; flood zonation, drought assessment, deforestation, mining inventory; Literature review for dissertation. Word Processing, Referencing and Template preparation.

DISSERTATION
Maximum Marks: 150

Dissertation is an essential component of the course. Every student will have to do 2 to 3 weeks of fieldwork (in continuation or in breaks). The candidate will be required to submit a field report for evaluation as a part of the examination. The candidate can choose a theme or a combination of themes in consultation with the assigned Supervisor.

The candidate will have to complete his fieldwork related to Project. The Dissertation thesis must be submitted within 30 days after the completion of theory examination.

Recommended Textbooks: Only the basic textbooks are mentioned here. The student is advised to consult Library and e-resources for in-depth knowledge.

1. Remote Sensing and Image Interpretation. Lillesand, TM and Kiefer, RW. John Willey and Sons, 2008.
2. Remote Sensing and GIS. B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System. Kang-Tsung Chang, McGraw-Hill 2015.
4. Concepts & Techniques of GIS. C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
5. Basics of Remote sensing & GIS. S. Kumar, Laxmi Publications.
6. James B. Campbell & Randolph H. Wynne. Introduction to Remote Sensing, The Guilford Press, 2011.
7. Textbook of Remote Sensing and Geographical Information systems. M. Anji Reddy, BS Publications, Hyderabad. 2011. ISBN: 81-7800-112-8.

8. Remote Sensing and GIS. A.M.Chandra and S.K. Gosh, Narosa Publishing Home, New Delhi 2009.
9. Introducing Digital Image Processing. John R. Jenson, Prentice Hall, New Jersey 1986.
10. Techniques for Image Processing and Classification in Remote Sensing. Robert A. Schowengergt, 1984. ISBN 13: 9780126289800
11. Fundamentals of Remote sensing. George Joseph, 2005, 2nd edition, University Press Pvt, Ltd, Hyderabad.
12. Principles of Geographical Information Systems for Land Resources Assessment by P.A. Burrough
13. Elements of Photogrammetry by PAUL R. WOLF, 3rd edition, ISBN 007-123689-9
14. Introduction to Modern Photogrammetry (Paperback) by Edward M. Mikhail, James S. Bethel
15. Manual of Photogrammetry – American Society of Photogrammetry By ALBERT.D
16. Aerial Photographic Interpretation by D. R. Lueder, McGraw-Hill Companies
17. Photogrammetry- Vol I by Krauss, J., - Springler – Verlag Publications
18. Photogrammetry 3rd Edition by Moffitt, Francis H. & Mikhail, Edward M., - Harper and Row Publishers.
19. Principles and Applications of Photo Geology By Shiv Pandey
20. John R. Jenson, .Introductory Digital Image Processing., Prentice Hall Series, 1996.
21. John A. Richards, Springer-Verlag, .Remote Sensing Digital Image Analysis. 1999.
22. Rafael C. Gonzalez, .Digital Image Processing (2nd Edition)., Prentice Hall, 2002.
23. Gopi, "Advanced surveying: Total station, GIS and Remote Sensing", Pearson Education India, 2007.
24. Borden D. Dent, Jeffrey Troguson, Thomas W. Hodler, "Cartography: Thematic map Design", McGraw-Hill Higher Education, 2008.
25. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.
26. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke – Prentice Hall Publishers.
27. Burnside, C.D., Electromagnetic distance measurement, Crosby Lockwood staples, U.K., 1971.
28. Rueger, J.M., Electronic distance Measurement, Springer - Verlag, Berlin, 1990.
29. Laurila, S.H., Electronic Surveying in Practice, John Wiley & Sons, Inc, 1983.
30. Soastamoinen, J.J., Surveyor's Guide to electro-magnetic distance Measurement, Adam Hilger Ltd., 1967.
31. Santheesh Gopi., Global Positioning System – Principles and Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
32. Seeber, G., Satellite Geodesy, Walter de Gruyter, Berlin, 1993.
33. Alfred Leick, GPS Satellite surveying, John Wiley and Sons, 1995.
34. Hofmann Wellenhof, B. Lichtenegger, H. and Collins, J., Global Positioning System, SorinQer - Verlag, New York, 1994.
35. Drury, S.A. (2001): Image Interpretation in Geology, Allen and Unwin.
36. Halis, J.R. (1983): Applied Geomorphology.
37. Holmes,A.(1992): Holmes Principles of Physical Geology, Edited by P. McL. D. Duff. Chapman and Hall.