Chaudhary Bansi Lal University, Bhiwani

(A State University established under Haryana Act No. 25 of 2014)

Scheme & Syllabi

for

PG Diploma in Geoinformatics (PG-DGi)

(SEMESTER- I to II)

(w.e.f. 2020-21)

PG Diploma in Geoinformatics (PG-DGi)

Semester-I

Total Credits: 24 **Total Marks: 600**

Sr. No.	Course/ Paper Code	Courses	Type of Course	Contact Hours Per Week			Credit			Examination Scheme		
				T*	P**	Total	T*	P**	Total	End Semester Exam	Internal Assessment Marks	Max Marks
1	PG-DGi -101	Principles of Remote Sensing	C.C.	4	--	4	4	--	4	80	20	100
2	PG-DGi -102	Fundamentals of GIS & GPS	C.C.	4	--	4	4	--	4	80	20	100
3	PG-DGi -103	Cartographic Techniques & Spatial Data Analysis	C.C.	4	--	4	4	--	4	80	20	100
4	PG-DGi -104	Digital Image Processing	C.C.	4	--	4	4	--	4	80	20	100
5	PG-DGi-105	Digital Cartography and Photogrammetry (Practical)	C.C.	--	8	8	--	4	4	80	20	100
6	PG-DGi -106	Digital Image Interpretation (Practical)	C.C.	--	8	8	--	4	4	80	20	100
Total				**16**	**16**	**32**	**16**	**8**	**24**	**480**	**120**	**600**

T*: Theory **P**: Practical**

PG Diploma in Geoinformatics (PG-DGi)

Semester-II

Total Credits: 20 **Total Marks: 500**

Sr. No.	Course/ Paper Code	Courses	Type of Course	Contact Hours Per Week			Credit			Examination Scheme		
				T*	P**	Total	T*	P**	Total	End Semester Exam	Internal Assessment Marks	Max Marks
1	PG-DGi -201	Spatial Analysis & Modeling	C.C.	4	--	4	4	--	4	80	20	100
2	PG-DGi -202	Geoinformatics and Water Resources	C.C.	4	--	4	4	--	4	80	20	100
3	PG-DGi -203	Geophysical Survey and 3D Mapping	C.C.	4	--	4	4	--	4	80	20	100
4	PG-DGi -204	Remote Sensing and GIS Project Report	C.C.	--	08	08	-	08	08	140	60	200
Total				**12**	**08**	**20**	**12**	**08**	**20**	**380**	**120**	**500**

T*: Theory **P**: Practical**

Syllabi of PG Diploma in Geoinformatics (PG-DGi)
(w.e.f.: 2020-21)

Semester: I
Course Code: PG-DGi -101
Course Title: Principles of Remote Sensing

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *To provide the basic understanding about Principles of Remote Sensing, Aerial Photography & Photogrammetry, Working Principles of Remote Sensing, Satellites & Sensors and their application in mapping and management of Earth Resources.*

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Basic Principles
Remote Sensing: Definition, Concept, Principles & Historical Development, Electromagnetic Radiation (EMR): Spectrum and its properties, Atmospheric Windows, Interaction of EMR with Atmosphere & Earth's Surface; Spectral signatures & Resolutions: Spatial, Spectral, Radiometric and Temporal; Remote Sensing Systems: Platform, types of platforms & its characteristics.

Unit 2: Aerial Photography & Photogrammetry
Introduction: Fundamentals of Aerial Photography: flight planning & execution; Photogrammetry: Basic concepts of measurements of object height and length; Stereo Photogrammetry: Stereovision & Stereoscopes, Stereoscopic Parallax & Parallax Equations; Digital photogrammetry: Model deformation & Rectification, Relief displacement, Vertical exaggeration, Triangulation, Control & Mapping.

Unit 3: Remote Sensing Sensor
Sensor classification: Active and Passive, Optical-Mechanical Scanners & Push-broom scanners; Thermal Infrared: Introduction, Radiation Properties, Kinetic Heat, Temperature, Radiant Energy and Flux, methods of transferring heat; Thermal properties of terrain: Capacity, conductivity, Inertia, Infrared; Microwave: Passive & Active Sensors, RADAR, Scatter Radiometer

Unit 4: Remote Sensing Satellites and their application
Satellites & their characteristics – Geostationary & Sun Synchronous; Earth Resource Satellite: (Sun Synchronous) IRS, Cartosat, Landsat, ERS etc.; Weather &Communication Satellites: (Geostationary) NOAA, TERRA, MOS, INSAT, GOES, etc.; Spectral Signature: Concept, Properties and Importance. Ground Verification; Remote Sensing Applications: Geoscience, Metrology,

Agriculture, Natural Resource Management, Regional Development and Urban Planning. Disaster Management and Mitigation.

Suggested Readings:

1. Avery, T. E., & Berlin, G. L. (1992). *Fundamentals of Remote Sensing and Airphoto Interpretation*. New York: Macmillan.
2. Campbell, J. B. (1996). *Introduction to Remote Sensing*. New York: Guilford.
3. Curran, P. J. (1985). *Principles of Remote Sensing*. London & New York: Longman.
4. Drury, S. A. (1998). *Images of the Earth: A Guide to Remote Sensing*. Oxford: Oxford University Press.
5. George, J. (2004) *Fundamentals of remote sensing*. Hyderabad, India: Universities Press.
6. Jensen, J. R. (2006). *Remote Sensing of the Environment – An Earth Resources Perspective*. Indian edition, Delhi: Pearson Education.
7. Joseph, G. (2005). *Fundamentals of Remote Sensing*. Hyderabad: Universities Press.
8. Leica, A. (2003). *GPS Satellite Surveying*. New York: John Wiley & Sons.
9. Lillisand, T. M., and Kiefer, P. W. (1986). *Remote Sensing and Image Interpretation.* New York: John Wiley & Sons.
10. Lillesand, T. M., & Kiefer, R. W. (2007). *Remote Sensing and Image Interpretation*, (4th ed.). New York: John Wiley and Sons.
11. Rampal, K. K., (1999). *Handbook of Aerial Photography and Interpretation,* New Delhi: Concept Publishing Company.
12. Reeves, R. G. (1991). *Manual of Remote Sensing* (Vol. I)., Falls Church, Virginia, USA: American Society of Photogrammetry and Remote Sensing.
13. Terry-Karen S. (2002) *Integrating GIS and the Global Positioning System*. ESRI Press
14. Wolf, P. R. (1983). *Elements of Photogrammetry*. New York: McGraw-Hill.

Semester I
Course Code: PG-DGi -102
Course Title: Fundamentals of GIS & GPS

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *To develop the basic understanding of the concept of Geographical Information System (GIS), Global Positioning System (GPS) Spatial Data Structure, Spatial Statistics, Spatial Analysis in GIS, spatial interpolation, map algebra etc. and its application.*

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Introduction
Basic concepts: Definition and history; Components 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; Various data input methods in GIS.

Unit 2: Raster and Vector Data Analysis
Integration of Raster & Vector Data; Raster Data & its Representation: Types, Data Structure; Raster Data Analysis; Vector data representation: Topological & Non-topological Vector Data; Vector Data Sources; Comparison between Raster & Vector Data; Cartographic Modeling - Map Algebra; Statistical Analysis; Geometric Transformations - Affine Transformation and Geometric Transformation Coefficients, RMS Error; Spatial Resolution, Spatial Data Accuracy, Location Data Accuracy and Precision,

Unit 3: Data Exploration, Integration and Application
Interactive Data Exploration, Vector Data Query, Attribute Data Query; Logical Expressions, Types of Operations; Relational Database Query: Use of SQL, Descriptive Statistics of Attribute Data; Spatial Data Query, Raster Data Query, Query by Cell Value, Query using Graphical Methods, Charts; Geographic Visualization, Data Classification, Spatial Aggregation, Map Comparison; Problem Identification & Designing a Data Model; Application of GIS Techniques in Various Fields; Web GIS

Unit 4: Global Positioning System (GPS) & its Application
Fundamentals of GPS – applications – Geoid and Ellipsoid; Satellite orbital motion: Keplerian motion, Kepler's Law, Perturbing forces, Geodetic satellite, Doppler effect; Positioning concept – GNSS; Coordinate systems and transformation techniques, Segments of GPS: Control Segment, Space Segments, User Segment; Accuracy assessment, Methodology for data collection; GPS Systems: NAVSTAR, GLONASS, GAGAN, GALLILEO, BeiDou etc.; Application of GIS & GPS

in Navigation, Regional Development, Natural Resource Mapping & Management, Disaster Management etc.

Suggested Readings:

1. Burrough, P. A., & Rachael, A. M. (1998). *Principles of Geographical Information Systems*. New York: Oxford University Press.
2. C Lo, C. P., & Yeung. A. K. W. (2006). *Concepts and Techniques of Geographic Information Systems.* New Delhi: Prentice Hall of India.
3. Demers, M. N. (2000). *Fundamentals of Geographic Information Systems*. Singapore: John Wiley.
4. ESRI 1993. *Understanding GIS.* Redlands, USA
5. George, J. (2003). *Fundamentals of Remote Sensing*. Hyderabad: Universities Press (Pvt.) Ltd.
6. Girard, M. C., & Girard, C. M. (2003. *Processing of Remote Sensing Data*. New Delhi: Oxford & IBH
7. Heywood, I. (2003). *An Introduction to Geographical Information Systems* (2nd ed.). Singapore: Pearson Publ. Co.
8. Chang., K. T. (2007). *Introduction to Geographic Information Systems*. New Delhi: Tata McGraw Hill.
9. Longley, P., Goodchild, M.F., Maguire, D. and Rhind, D. (1999). *Geographic Information Systems. Principles, Techniques, Management, Applications*. John Wiley, New York.
10. Magwire, D. J., Goodchild, M.F., & Rhind, D. M. (2005). *Geographical Information Systems: Principles and Applications*. U.K.: Longman Group.
11. Martin, D. (1996). *Geographic Information Systems: Socioeconomic Implications*. London: Routledge.
12. Ralston, B. A. (2002). *Developing GIS Solutions with Map Objects and Visual Basic*., New York & Singapore: OnWord Press: Thompson Learning.
13. Reddy, M. A. (2001). *Textbook of Remote Sensing and Geographic Information Systems*. Hyderabad: B. S. Publs.

Semester I
Course Code: PG-DGi -103
Course Title: Cartographic Techniques & Spatial Data Analysis

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: To provide the understanding about basic principles, history & importance of cartography map projection, co-ordinate system, generalization of different aspects of map design/layout and different techniques of Map Production and Spatial Analysis.

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Basic Concepts of Cartography

Introduction to cartography: nature and scope; Approximation of Earth, Introduction to Geometrics; Categories & Characteristics of maps, Study of different types of maps, Survey of India, Interpretation of topographic maps; Basics of Map scale; Reference and coordinate system; Indexing and Numbering of topographical maps

Unit 2: Designing and Map Production

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; Visualization of geospatial data: Design aspects, Multiscale and geometric aspects scale, dissemination of (visualized) geospatial data, Graphic Symbology & Variables.; Data products, use and users of products; 3D Visualization, Various issues in map visualization, Interactive Cartography

Unit 3: Digital Mapping, Data Structure and Spatial Data Analysis

Digital Cartography - Elements of digital Cartography; Analog to Digital Conversion of Data; Conventional mapping VS Digital Mapping; Nature of Data, Database and Data structures; Data Input: data capture, digitization and scanning; Digital database creation: Point features, Line features, Polygon features; Data Editing-Removal of errors – Overshoot & Undershoot, snapping; Data Collection and Integration, Non-spatial data attachment working with tables; Dissolving and Merging. Spatial Data Analysis: Mathematical operations, Distance operators, Regression analysis etc.

Unit 4: Spatial Database & its Application

Spatial Data Base: Survey of India, NRSC, BHUVAN, NATMO, Geological Survey of India, Census of India; Foreign Sources of Data: Earth Data Search; USGS EarthExplorer etc., Application of Spatial Data in Understanding Earth Surface Process, Human Resource Management & Development, Regional Development, Urban Land Use & Planning, Morphology of Settlement, Human Resource Mapping & Management, Disaster Management, Watershed Management and Sustainable Development.

Suggested Readings:

1. Anson, R.W., & Ormeling, F.J. (2008). *Basic Cartography* (Vol. I&II ed.). London: Elsevier Applied Science Publishers.
2. Cartwright.W., & Gartner G. A. L. (2009). *Cartography and Art*. Heidelberg: Springer – Verlag Berlin.
3. Clark, I. (1979). *Practical Geostatistics*. London: Applied Science Publishers
4. Davis, J.C. (1973). *Statistics and Data Analysis in Geology*. New York: Wiley
5. Keates, J. S. (2008). *Cartographic Design and Production*. London: Longman
6. Misra, R.P., & Ramesh, A. (2002). *Fundamentals of Cartography*. New Delhi: Concept Publishing Company.
7. Peterson, M. P. (1995). *Interactive and Animated Cartography*. Upper Sadde River, NJ: Prentice Hall.
8. Ramesh, P. A. (2000). *Fundamentals of Cartography*. New Delhi: Concept Publishing Co.
9. Rampal, K. K. (2004). *Mapping and Compilation*. New Delhi: Concept Publishing Co.
10. Robinson A.H., & Morrison J. L (1995) *Elements of Cartography*. John Wiley & Sons
11. Singh, R.L & Dutt. P.K. (2008). *Elements of Practical geography*. Allahabad: Students Friends.

Semester: I
Course Code: PG-DGi -104
Course Title: Digital Image Processing

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *To develop the basic understanding about the basic concepts of Digital Images, its basic properties, Image Enhancement and Filtering Techniques, Image Classification Techniques, Satellite image processing, and its application for mapping and measuring the various spatial process and phenomena.*

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Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Introduction
Spectral, Spatial, Radiometric and Temporal resolution; Visual vs. Digital methods, Image data storage and retrieval; Image restoration and Noise Abatement, Radiometric and Geometric correction technique; Interpolation methods – linear and non-linear transformation for geometric corrections

Unit 2: Image Enhancement and Filtering Techniques
Look-up Tables (LUT) and Types of image displays and FCC; Image Enhancement Techniques: Radiometric and Spatial; Contrast stretching: Linear and non-linear methods; Spatial Filtering: High and Low frequency, Image smoothing; Accuracy Assessment, Error Matrix

Unit 3: Image Classification Techniques
Band ratio, Indices: Vegetation, Water, Snow, Soil etc.; Digital Image Classification: Supervised & Unsupervised, Hybrid, Fuzzy; Hyperspectral Image Processing; Accuracy Assessment, Temporal Data Analysis and Change detection; Principal Component Analysis

Unit 4: Patter Recognition
Concept of Pattern Recognition, Multi-spectral pattern recognition, Change detection; Spectral discrimination, Signature Bank, Parametric and Non-Parametric classifiers; Application of Digital Image Processing in Analysis of Spatial Phenomena; Earth Resource Mapping, Urban Land Use & Planning, Disaster Management & Mitigation, Flood & Drought Management, Watershed Management, and Sustainable Development

Suggested Readings:

1. Campbell, J. B. (2006). *Introductory Remote Sensing: Principles and Concepts*. Routledge.
2. Curran, P. (1985). *Principles of Remote Sensing*. London: Longman
3. Cracknell, A.P., & Hayes, L.W B. (2007). *Introduction to Remote Sensing*. London: Taylor & Francis

4. Gibson, P.J. (2000), *Introduction to Remote Sensing* (2nd ed.). London: Taylor & Francis.
5. Jensen, J. R. (2006). *Remote Sensing of the Environment- An Earth Resources Perspective*. Prentice Hall Inc.
6. Lillesand T. M., & Kiefer, R. W. (2007). *Remote Sensing and Image Interpretation*. New York: John Wiley & Sons.
7. Rencz, A. N. (1999). *Remote Sensing for the Earth Sciences: Manual of Remote Sensing* (3rd ed.). New York: John Wiley & Sons, Inc.
8. Sabins, F. F. (2007). *Remote Sensing: Principles and Interpretation*, New York: H. Freeman and C.

Semester: I
Course Code: PG-DGi -105
Course Title: Digital Cartography and Photogrammetry (Practical)

Maximum Marks: 100
Practical Record book:30
Internal Assessment: 20
Lab. Exercises: 30
Viva Voce: 20

Objective: *To provide practical and hands on experiences about Scale, Map Projection techniques, coordinate system, different aspects of map design/layout and different techniques of Map Production and Spatial Analysis capabilities of different GIS software, Stereoscopic Parallax, Interpretation of Aerial Photographs and application of GPS.*

Note: The examiner shall set six questions, two from each unit. The candidate shall attempt three questions/exercises in all, selecting at least one question/exercise from each unit.

Unit: 1

- **Exercise 1.** Construction of different types of scales Simple, Comparative, Diagonal Scale.
- **Exercise 2.** Construction of different types of map projection Conical projection, Cylindrical Projection, Zenithal Projection
- **Exercise 3.** Preparation of UTM grid
- **Exercise 4.** Preparation of Base Map
- **Exercise 5.** Designing, Symbolization, Pattern and Shading techniques

Unit: II

- **Exercise 1** Data Organization (location, attributes, consistency, scale)
- **Exercise 2** Spatial and Non Spatial data collection, representation and standardization
- **Exercise 3** Graphical Representation of Spatial data (Raster/Vector Method)
- **Exercise 4** Overlay Analysis, data Linkage for Analysis
- **Exercise 5** Relational Data Base Query

Unit: III

- **Exercise 1** Test of Stereo Vision, computation of photo scales, Orientation of Stereo pair
- **Exercise 2** Parallax bar handling and height measurements
- **Exercise 3** Interpretation of Aerial Photographs for landuse/ landcover etc.
- **Exercise 4** Creating codes and attribute table in GPS
- **Exercise 5** Data collection: Measurements, Line, Area Calculation
- **Exercise 6** Data collection in GPS mode.
- **Exercise 7** Processing of GPS data in the software

Semester: I
Course Code: PG-DGi -106
Course Title: Digital Image Interpretation (Practical)

Maximum Marks: 100
Practical Record book:30
Internal Assessment: 20
Lab. Exercises: 30
Viva Voce: 20

Objective: *To provide practical and hands on experiences on visual interpretation elements, digital image processing, classification techniques and their application in Hydrology, Earth Resource Mapping*

Note: The examiner shall set six questions, two from each unit. The candidate shall attempt three questions/exercises in all, selecting at least one question/exercise from each unit.

Unit: I

- **Exercise 1** Tracing of Details from Stereo Pair
- **Exercise 2** Interpretation of Satellite Imagery in different Bands
- **Exercise 3** Interpretation of Thermal Image and Drawing of Isotherms
- **Exercise 4** Identification of different Features using TM, FCC and Thermal Imagery
- **Exercise 5** Identification of Cultural Details from Satellite Imagery

Unit: II

- **Exercise 1** Import / Export of files using DIP Software
- **Exercise 2** Geo-reference of the Toposheet and imageries
- **Exercise 3** Display, Analysis and interpretation of Imageries
- **Exercise 4** Performing contrast enhancement techniques, Filtration: High, Low frequency
- **Exercise 5** Mosaic of Images
- **Exercise 6** Sub-setting of area of interest from the satellite image
- **Exercise 7** Classification: Supervised, Unsupervised
- **Exercise 8** Application of DIP in Earth Resource Mapping
- **Exercise 9** Disaster Mitigation and Management

Unit: III

- **Exercise 1** TIN Generation & Digital Elevation Model (DEM) Data Processing
- **Exercise 2** Generation of Slope, Aspect etc.
- **Exercise 3** Flow Direction, Flow Accumulation
- **Exercise 4** Watershed delineation and its basic Characteristics
- **Exercise 5** Morphometric Analysis of watershed
- **Exercise 6** Runoff & Hydrological Modeling

Semester: II
Course Code: PG-DGi -201
Course Title: Spatial Analysis & Modeling

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *To develop the basic understanding of the concept of spatial statistics, spatial analysis in GIS, spatial interpolation map algebra etc., and application of Spatial Decision Support System (SDSS) in analysis of spatial phenomena.*

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Introduction of Spatial Data and Modelling
Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools; Raster-Based and Vector-Based GIS Modeling, Binary Models, Index Models, Regression Models, Process Models; Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing

Unit 2: Techniques of Spatial Data Analysis
Classification Scheme of Vector-Based and Raster-Based GIS Operations; Raster–Based Techniques: Methods of Reclassification, Overlay Analysis, Slope and Aspects, Buffering, Cost-Distance Calculation; Vector-Based Techniques: Map Manipulation Techniques, Buffering, Overlay Analysis, Network Analysis; Digital Terrain Analyses and Modeling: TIN and DEM, Surface Representation & Analysis

Unit 3: Geostatistical Analysis Techniques
Introduction to Spatial Interpolation: Control Points; Global Methods: Trend Surface Analysis, Regression Models; Local Methods: Thiessen Polygons, Density Estimation, Inverse Distance Weighted Interpolation; Kriging: Ordinary Kriging (Semivariance, Semivariogram), Universal Kriging,

Unit 4: Spatial Decision Support System (SDSS) and GIS
Spatial Decision Support System (SDSS), its framework and GIS, Application of Spatial Decision Support System in Analysis of Spatial Phenomena, Human Resource Management & Development, Regional Development, Urban Land Use & Planning, Morphology of Settlement, Human Resource Mapping & Management, Disaster Management, Watershed Management and Sustainable Development.

Suggested Readings:

1. Bonczek, R. H., Holsapple C.W., & Whinston, A.B. (1981). *Foundations of Decision Support Systems*., New York: Academic Press
2. Burrough, P. A., & Rachael M. A. (1998). *Principles of Geographical Information Systems*. New York: Oxford University Press.
3. House, W.C. (1983). *Decision Support Systems*. New York: Petrocelli
4. Laurini, R. & Thompson, D. (1992). *Fundamentals of Spatial Information Systems*. London: Academic Press.
5. Sprague, R. H. & Carlson, E. D. (1982). *Building Effective Decision Support Systems*., Englewood Cliffs NJ: Prentice-Hall

Semester: II
Course Code: PG-DGi -202
Course Title: Geoinformatics and Water Resources Management

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *To enable students in exploring various dimensions of application of Geoinformatics in Watershed Development, Water Resource Exploration, Operational Application, Mapping, Management and Development.*

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Basic Concept

Hydrologic Cycle, hydrological parameters; Watershed characterization, delineation and codification; Watershed problems and management strategy; Geoinformatics approach for watershed prioritization; Drainage Morphometric Analysis

Unit 2: Remote Sensing in Ground Water Exploration

Application of remote sensing in hydrogeomorphological interpretation for ground water exploration; Water quality monitoring through remote sensing; Geophysical Methods for Groundwater Exploration.

Unit 3: Operational Application of RS & GIS in Water Resource

Flood Prediction, Drought Evaluation; Snow Cover Mapping; Reservoir Sedimentation Evaluation; Geoinformatics Based Runoff & Hydrological Modeling; Flood Hazards Modeling, Snowmelt Runoff Modeling.

Unit 4: Geoinformatics & Water Resources Management and Development

Mountain Hydrology; Flood Zonation and Planning; Aquifer Mapping, Seasonal & Temporal Variations in Quantity & Quality; Impact of Human and Economic Activities on Water Resource & its Management; Management of Urban Flash Floods, Irrigation Methods and its impact on water Resources, Drought Assessment & Mitigation Strategies, Micro-water management and Sustainable Development

Suggested Readings:

1. Murthy, J. V. S. (1994). *Watershed Management in India*. New Delhi: Wiley Eastern Ltd.

2. Schultz, G. A., & Engman, E. T. (2000). *Remote Sensing in Hydrology and Water Management*. Springer-Verlag, Berlin, Germany.
3. Schultz, G.A. & Engman, E.T. (2000), *Remote Sensing in Hydrology and Water Management,* Berlin, Germany: Springer-Verlang,
4. Todd K. D. (2005). *Groundwater Hydrology (2nd ed.)*. New York John Wiley & Sons.

Semester: II
Course Code: PG-DGi -203
Course Title: Geophysical Survey & 3D Mapping

Maximum Marks-100
Theory Examination-80
Internal Assessment-20
Max. Time- 3 hrs

Objective: *The basic aim of this course is to develop the understanding in advance survey concepts, methods & technology and hands-on exercise on various modern survey techniques in 3-D mapping and visualization.*

Note: There shall be nine questions in all. Question no. 1 shall be compulsory, consisting of eight short answer type questions covering the entire syllabus. Two questions will be asked from each unit. Student will have to attempt one question from each unit. Each question shall carry equal marks.

Unit 1: Fundamentals of Survey and Total Station
Methods of Measuring Distance; Basic Principles of Total Station; Historical Development, Classifications, applications and comparison with conventional surveying; Working principles of total station; Propagation of EMR through atmosphere and corrections for its effects; The functioning various types total station equipment and their applications; Various techniques available for surveying and mapping with total station

Unit I1: Fundamentals of GPS and DGPS
Basic concepts of GPS: Historical development and its applications; GPS surveying methods and accuracy; Factors affecting GPS accuracy; Working principal of DGPS, Method of DGPS Surveying: Static and Rapid Static Survey; Real-time Kinematic (RTK) Survey. Application of GPS and DGPS in Geodetic control surveys, Cadastral surveys, Engineering and Construction, Military applications, Geographical Information System, Navigation and tracking etc.

Unit III: Fundamentals of GPR
Basic concepts and working Principal of Ground Penetrating Radar (GPR); Types of antennas used in GPR Survey and their frequency & Utility; Material conductivity, Dialectical Constant and other geophysical properties of ground; Application of GPR in geophysical survey, geological stratigraphy, Ice thickness and snow depth, soil profiling and characterisation, Mineral Exploration and Mine safety, Archaeological Application, Utility Mapping etc.

Unit IV: Microwave and 3D Mapping
Microwave & Radio Waves, Microwave Sensing, Radar, Radar Applications; Types of Active Microwave Sensors, Non-Imaging Radar (Scatterometer, Altimeter, Doppler Radar), Imaging Radar (SLAR, SAR, ASAR), Shuttle Imaging Radar (SIR-A, SIR-B, SIR-C), LIDAR, LIDAR Applications, GLAS; 3D Laser Scanning Survey-LiDAR; Application of LiDAR in 3D Mapping, Utility Mapping, Urban Planning, Generation of High Resolution Digital Elevation Model (DEM) etc.

Suggested Readings:

1. Agrawal, N. K (2006). *Essentials of GPS*. Spatial Networks.
2. Alfred, L. (2004). *GPS satellite surveying* (3rd ed.). John Wiley & Sons Inc.
3. Guochang, X. (2007). *GPS: Theory, Algorithms and Applications*. Berlin, Germany: Springer.
4. Laurila, S.H. (1993). *Electronic Surveying in Practice*. John Wiley and Sons Inc.
5. Leick, A. (2004). *GPS Satellite Survey* (2nd ed.). New York: John Wiley & Sons.
6. Lucas T. X., & Pantoja M. F. (2018). *Ground Penetrating Radar*. In: Ida N., Meyendorf N. (eds) Handbook of Advanced Non-Destructive Evaluation. Springer Cham.
7. Guocheng X. (2003). *GPS Theory, Algorithms and Applications*" Berlin: Springer.
8. Rueger, J. M. (1990). *Electronic Distance Measurement*, Berlin: Springer-Verlag.
9. Satheesh, G., Rasathish, K., & Madhu N. (2007) *Advanced Surveying, Total Station GPS and Remote Sensing*. Pearson Education.
10. Seeber, G. (1998). *Satellite Geodesy*. Berlin: Walter De Gruyter.
11. Seeber Gunter, (2003). *Satellite Geodesy*, Walter de Gruyter, Berlin (Germany).
12. Sickle, J. V. (2004). *Basic GIS Coordinates*, CRC Press LLC.
13. Sickle, J. V. (2001). *GPS for Land Surveyors*. Michigan: Ann Arbor Press.
14. Strang, G. & Borre, K. (1997). *Linear Algebra, Geodesy, and GPS*. Wellsley: Cambridge.
15. Wolf, P. R., & Ghilani, C. D. (1997). *Adjustment Computations: Statistics and Least Squares in Surveying and GIS*. Publisher: John Wiley & Sons.

Semester: II
Course Code: PG-DGi-204
Course Title: Remote Sensing and GIS Project Report

Maximum Marks-200
Project Report/Dissertation-100
Internal Assessment-60
Viva-Voce-40

Objective: *To provide an exposure to students for framing research problems independently and application of Geoinformatics for the understanding and possible solution for the societal wellbeing.*

Note: Students have to submit a Remote Sensing and GIS based Project Report individually on the topics duly approved by Department on the following themes. Report should have approx. 80-120 pages in the format decided by the department.

Major Themes for the Remote Sensing Project Report:

- Land Use Land Cover (LULC)
- Natural Resource Management
- Deforestation and Land Degradation
- Land Degradation and Desertification
- Water Resource Management
- Agriculture, Crop Combination & Pattern
- Urban Land use, Land Cover and Planning
- Planning for Smart Cities
- Micro Climate of Urban Areas
- Infrastructure Development and Planning
- Analysis of Transport Network
- Hotspot Analysis
- Health Care System
- Disaster Mitigation & Management
- Mining and Environmental Degradation
- Snow Cover and Glacial Mapping
- Hydrological and Runoff Modelling

Outline for Remote Sensing and GIS Project Report:

Students have to submit a Remote Sensing and GIS Project Report based on the analysis of remotely sensed data and field observations in the following format (Approx. Pages: 80-120):

- Statement of the problem
- Research Objectives
- Database
- Research Methodology
- Analysis of Data (Maps, Table etc.)
- Research Findings and Discussion
- References
- Annexure and Additional Data