

Post Graduate Diploma in Geoinformatics August 2016

Course Modules:

Sr. No.	Module Name	Hours
1.	Geographic Information Systems & Global Positioning System	86
2.	Remote Sensing	58
3.	Digital Image Processing	50
4.	Spatial Analysis	70
5.	Geostatistics with R	36
6.	Geospatial Programming	276
7.	Project	214
8.	Seminar	10
9.	Effective Communication	50
10.	Aptitude and English	50
	Total	900

MODULE: Geographic Information Systems & Global Positioning Systems (86 hrs)

Geographic Information Systems

- Introduction to Geoinformatics
- Introduction to GIS
 - Overview, History and Concepts of GIS
 - Purpose and Benefits of GIS
- Applications of GIS
- Map Projections
 - Geoid/Datum/Ellipsoid
 - Coordinate systems
 - Scale factor
 - Distortion on map projections
 - Classification of map projections
 - Polyconic, LCC, Mercator, UTM projections
- Map projections transformation
- Geographic Data Quality & Structure
 - Data Quality
 - Data Uncertainty of Geo-spatial Data
 - Functional Elements of GIS
 - Raster Data Structure
 - Vector Data Structure
- Objects & GIS
- Data Compression Techniques
- Geographic Data Acquisition
 - Analogue to digital conversion
- Digital Cartography
 - Categories of maps
 - Cartographic design
 - Colour and pattern

- Map lettering, Generalization, Symbolisation
- Open Source GIS
 - OSGeo Introduction
 - QGIS Installation, Overview of QGIS interface
 - Plugins
 - Google layer plugin
 - Database creation
 - Using QGIS plugin in QGIS

Global Positioning Systems

- Introduction to surveying
- Introduction to GPS
 - Introduction
 - History
 - Segments of GPS
 - Operating Principle
 - Surveying with GPS
 - Methods of observations
 - Differential GPS
 - Kinematics GPS
 - Application of GPS
 - GPS in INDIA
 - Research Areas and Future developments
- Global GPS programmes and India's Contribution
 - GPS programmes
 - Indian Contribution
- Adjustments and Errors
 - Introduction
 - Types of Errors
 - Basic Statistical concepts
- GIS and GPS: Present status and future scenario
 - Crustal Deformation studies
 - Vehicle Tracking
 - Disaster monitoring and management

MODULE: Remote Sensing (58 hrs)

- Introduction to Remote Sensing
 - Overview and concept of remote sensing
 - In-situ Vs. Remote sensing methods
 - Advantages and limitations
 - History
 - Components of a Remote Sensing System
 - Scope and application areas
- Energy sources & radiation principles
 - Electromagnetic radiation
 - Energy interactions in atmosphere
 - Energy interactions with earth surface features
 - Spectral response patterns of common earth surface features
 - Atmospheric influence on spectral response
- Remote sensing data acquisition & platforms

- Data acquisition and Platforms
- Satellites and satellite orbits
- Image resolutions
- Data acquisition & interpretation
 - Image vs. Photograph
 - Energy recording technology
 - Across track and along track scanning
- Colour fundamentals & false color composites
- Image Interpretation
 - Elements & techniques of image interpretation
 - Visual interpretation
- Satellites and sensors
 - Major earth observation satellite programmes
 - Current Satellites & sensors
- Thermal Remote Sensing

Advanced Remote Sensing

- Hyperspectral remote sensing
 - Introduction
 - Multispectral Vs hyperspectral remote sensing
 - Hyperspectral sensor system
 - Scope and application areas
 - Fuzzy analysis
 - Hyperspectral image classification using Support Vector Machine
- Microwave remote sensing
 - Introduction
 - Radar System and Microwave
 - Components of Active Microwave Remote Sensing
 - SAR and SLR
 - Geometric and other Characteristics of Side Looking Radar Imagery
 - Response of common earth surface features
 - Radar image interpretation
 - Passive microwave remote sensing
 - Scope and Applications

MODULE: Digital Image Processing (50 hrs)

- Introduction to Digital Image processing
 - Digital image fundamentals
 - Image processing fundamentals
 - Image processing system considerations
 - Scope & application areas
- Image Statistics
 - Univariate and multivariate statistics
- Image histogram and its significance
- Digital data acquisition
 - Remote sensing data acquisition
 - Acquisition of Digital Images
 - Direct Digital Recording

- Scanning of Analog Images
- Remote sensing data products and formats
 - Remote sensing data products
 - Image formats: BIP, BIL and BSQ
 - Levels of data correction
- Image rectification & restoration
 - Geometric correction
 - Radiometric correction
 - Noise removal
- Image enhancement
 - Contrast manipulation
 - Gray level thresholding
 - Level slicing
 - Contrast stretching
 - Spatial feature manipulation
 - Spatial filtering
 - Convolution
 - Edge enhancement
 - Linear edge enhancement
 - Nonlinear edge enhancement
 - Multi image manipulation (Image transformation)
 - Spectral ratioing
 - Vegetation indices
 - Principal component analysis
 - Application of principal component analysis
 - Introduction to image data fusion
 - Image fusion techniques
- Image classification
- Introduction
- Unsupervised classification
 - Clustering (k-means)
 - ISODATA algorithm
- Supervised Classification
 - Classification stage
 - Supervised classification algorithms
 - Minimum distance classification
 - Parallelepiped classifier
 - Maximum likelihood classifier
 - Other approaches
 - Mahalanobis classifier
 - Table look up classification
- Comparison of supervised & unsupervised classification methods
 - Field data
 - Introduction
 - Kinds of field data
- Sampling scheme and sample size
- Post classification steps
 - Recoding
 - Post classification filtering
 - Assessment of classification accuracy

- Area statistics calculation

Advanced DIP

- Change Detection
 - What is Change Detection
 - Consideration Of Remote Sensing Systems for Change Detection Analyses
 - Environmental Characteristics Consideration For Change Detection Analyses
 - Types of Change Detection Algorithms

MODULE: Spatial Analysis (70 hrs)

- Introduction
 - Introduction to spatial analysis
 - Various mathematical and logical operations
 - Various Techniques of Statistical analysis
 - Measurement
- Raster analysis
 - Local operations
 - Zonal operations
 - Global operations
- Vector analysis
 - Proximity analysis (buffering)
 - Overlay Analysis
 - Purpose of overlay analysis
 - Various overlay analysis techniques
- Distance measurement
- Pattern analysis
 - Nearest Neighbour analysis
 - Moran's I
 - G-statistics
 - Applications
- Spatial and Non spatial query
 - Introduction to simple queries
 - Non spatial queries
 - Spatial queries
- Network Analysis
 - Introduction to Network Analysis
 - The Network Data model
 - Elements of Network
 - Setting up of a Network
 - Path Determination
 - Reduction of Network to a graph
 - Understanding various network parameters
- Classification
 - Different ways of classifying various spatial data
- Multi Criteria Analysis and AHP
 - Introduction to multi criteria analysis
 - Performing multi criteria analysis
 - Sensivity Analysis using Analytical Hierarchy Process (AHP)
- Site suitability Analysis
 - Understanding Land Suitability Model

- Implementing the criteria for getting the desired output
- Surface mapping
 - Surface mapping model
- Regression and Correlation analysis
 - Various regression and correlation analysis techniques
- Spatial interpolation
 - Variogram, Krigging and Gravity Model
 - Need of Krigging
 - Different types of variogram
 - Different types of Krigging
 - Gravity Modeling
 - Dynamic Terrain Visualization
 - Introduction to Dynamic terrain concept
 - Basic methodology
 - Rendering of terrain data
 - Perspective view
 - Real time terrain visualization
 - Thiessen polygons
 - TIN
- Terrain mapping and analysis
 - Digital Elevation Model
 - Introduction to DEM and DTM
 - Different sources of DATA for DEM generation
 - Terrain Reclassification Techniques
 - Introduction to DEM Derivatives
 - Wire mesh model
 - Irradiance
 - Slope and aspect
 - Angle of Incidence
 - Viewshed analysis
 - Parameters & applications
 - Shaded Relief

MODULE: Geospatial Programming- IT Domain & GIS Domain (276 hrs)

GP in IT (216 hrs)

- **C programming (30 hrs)**
 - C basics
 - C character set, Identifiers and keywords,
 - Data types, constants, variables and
 - C constructs: If statement,
 - if....else statement,
 - if.....else if....else statement,
 - while statement,
 - do....while statement,
 - for statement,
 - switch statement,
 - nested control statement, break

- operator,
- continue operator,
- Comma operator,
- Goto statement.
- Basic Commands to write, compile & execute programs
- Programs to implement Pointers, array of pointers.
- Programs to implement arrays using pointers.
- arrays, declarations, expressions statements,
- symbolic constants, compound statements,
- arithmetic operators, unary operators,
- relational and logical operators,
- assignment operators,
- conditional operators, bit operators.
- Pointers
- Arrays
- array & pointer relationship, pointer arithmetic, dynamic memory
- allocation, pointer to arrays,
- array of pointers, pointers to functions,
- array of pointers to functions,
- Preprocessor directives: #include, #define,
- macro's with arguments
- file handling [text , binary]

- **DBMS (46 hrs)**
 - Introduction to DBMS
 - Types of DBMS: Introduction to Hierarchical Model,
 - Network and Relational Models, Object Oriented Database
 - Data models (conceptual physical and logical)
 - DDL Commands
 - Data Integrity & integrity rules
 - DML Commands: Select/Insert/Update/Delete
 - DCL Commands: Rollback, Commit, savepoint.
 - Number Functions: -Single Value Functions: NVL,ABS,CEIL etc,
 - Group Value Functions: AVG,COUNT,MAX etc
 - Grouping Things Together (Group By, Having Clause) ,Joining
 - Introduction to PL/SQL
 - Exceptions
 - Cursors
 - Procedures
 - Functions
 - Triggers
 - Packages
 - Indexes
 - Clusters
 - Snapshots
 - Creating Database
 - Users, Roles & Privileges
 - Import & Export

- **Core Java (70 hrs)**
 - JVM Architecture
 - Setting a ClassPath
 - Simple Program in Java (Compile & Run)
 - Data Types & Identifiers
 - Operators
 - Conditional Statements
 - Array & Looping (Mix concepts)
 - Classes & Objects
 - Access Modifiers (Private, Public, Protected, Default)
 - Inheritance (IS A, HAS A)
 - Polymorphism (Overloading & Overriding) (Super & This Keyword).
 - Packages & Imports
 - Visibility of Access Modifiers
 - Final with Variable, Classes & Methods
 - Static
 - Abstract & Interface
 - Passing an object in Argument
 - Inner Classes & Wrapper Class
 - Collections
 - Exception Handling
 - Threading
 - I/O Classes
 - Applet
 - JDBC overview through ODBC

- **Advanced Java & JSP (40 hrs)**
 - Web Architecture
 - RMI
 - Servlets
 - JSP
 - Session Management

- **HTML, XML, JavaScript (30 hrs)**
 - Architecture of the Web
 - HTML programming
 - DHTML
 - CSS
 - JavaScript
 - The Purpose and Nature of XML
 - XML Syntax and Structure rules
 - XML Document Type Declaration
 - XML and Data Binding
 - XML linking mechanisms
 - XML style language

GP in GIS (60 hrs)

- **Python(24 hrs)**
 - Python – Introduction
 - What is Python?
 - Python Installation - Windows
 - Introducing Dictionaries
 - Defining Dictionaries
 - Modifying Dictionaries
 - Deleting Items From Dictionaries
 - Introducing Lists
 - Defining Lists
 - Adding Elements to Lists
 - Searching Lists
 - Deleting List Elements
 - Using List Operators
 - Introducing Tuples
 - Declaring variables
 - Referencing Variables
 - Assigning Multiple Values at Once
 - Formatting Strings
 - Exceptions and File Handling
- **Google Map API (8 hrs)**
 - Introduction to Google map API
 - Mapping Fundamentals
 - Creating first map Application
 - Use of Marker icons and Info Windows
 - Geocoding
 - Google API and KML
- **PostGIS (8 hrs)**
 - Introduction to PostGIS
 - Spatial Objects for Postgre SQL
 - Simple spatial SQL
 - Viewing data in PostGIS
 - Creating spatial Indexes
 - Spatial analysis in SQL
 - Distance Queries
 - Spatial Joins
- **DesktopGIS Customisation (12 hrs)**
 - Q-GIS
 - Introduction to the QT and QGIS Classes
 - Customization of Quantum GIS using Python
 - How to create a python plugin for QGIS
 - The python syntax (indentation, colon, ...)
 - My first python plugin: display a message box
 - The main QGIS API classes and their relations

- Constants and settings: QGIS and QgsApplication classes
- Plugin interface: Q-GIS Interface and common methods used in plugins
- Arc-GIS
 - Introduction to Arcpy and Python window
 - Working with Map Layers
 - Create a search cursor using list of string fields in python
 - Create a search cursor using an SQL expression in python
- **Geo Server (8 hrs)**
 - An Introduction to Geoserver
 - Anatomy of a Geoserver Application
 - Styling
 - Feature Map Layer
 - Geoserver User Interface
 - Non-Spatial Query
 - Web Mapping
 - Web Services and GIS
 - Different Kinds of Web Mapping
 - Working with Geoserver
 - Building Geoserver
 - Developing applications using Geoserver
 - Creating Mapping Application Using HTML, Java Script and Geoserver
 - Connecting Geoserver with spatial database
 - Fetching and displaying layers on QGIS from Geoserver

GeoStatistics with R (36 Hrs)

- Introduction to R Syntax
- Introduction & Installation of R, R Basics,
- Finding Help, Code Editors for R,
- Command Packages,
- Manipulating and Processing Data in R,
- Reading and Getting Data into R,
- Exporting Data from R,
- Data Objects-Data Types & Data Structure.
- Viewing Named Objects,
- Structure of Data Items,
- Manipulating and Processing Data in R (Creating, Accessing, Sorting data frames, Extracting, Combining, Merging, reshaping data frames)
- Descriptive statistics and sampling Techniques
- Central Tendency, Median, Mode, Standard deviation, variance.
- Handling Spatial Data in R
- Frequency distribution, Covariance and Correlation
- Regression: Linear & Multivariate,
- Covariance & Correlation in multivariate data, data transformations (logarithmic, indicator, Normal-score, rank-order)
- Geographically Weighted Regression (GWR)
- Introduction to Graphical Analysis,

- Using Plots(Box Plots, Scatter plot, Pie Charts, Bar charts, Line Chart),
- Plotting variables, Designing Special Plots, Simple Linear Regression, Multiple Regression
- Probability
- Basic concepts of Probability
- Random Variable, Discrete Variable and Continuous Variable
- Probability Distribution of Discrete Random variable (Binomial, Poisson)
- Probability Distribution of Continuous Variable (Normal)
- Basic Components of Geo-Statistics
- (Spatial Continuity-Variogram Modeling)
- Spatial estimation (Interpolation Techniques)
- Nongeostatistical (Deterministic) Estimation
- Global Estimation
- Local Estimation
- Geo-statistical (Probabilistic) Estimation
- Optimality criteria
- Simple Kriging
- Prediction Intervals
- Universal Kriging
- Examples of Kriging using R
- Mapping & Geo-Visualization With R

Project (214 hrs)

Trends in Geoinformatics & RS and GIS Applications (20 hrs)

Cover this module based on latest trends

Seminar (10 hrs)

Note

1. *Uptation of softwares to latest one (ArcMap 9.3 to ArcGIS 10.2.1, ERDAS to ERDAS 2014 and MapInfo Professional to latest version of MapInfo)*
2. *Reference copy of courseware (books) to the faculties for reference*
3. *QGIS lab sessions should be on QGIS 2.2*