

**MAHARSHI DAYANAND SARASWATI UNIVERSITY  
AJMER**

**पाठ्यक्रम**

***SYLLABUS***

**SCHEME OF EXAMINATION AND  
FACULTY OF SCIENCE**

**COURSES OF STUDY**

**M. Sc. REMOTE SENSING &  
GEO-INFORMATICS**

**M. Sc. Semester I & II**

**(Year 2018-19)**

**M. Sc. Semester III & IV**

**(Year 2019-20)**



**महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर**

**MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER**  
**SYLLABUS**

*Scheme of Examination and Courses of study*

**M. Sc. Remote Sensing and Geo-Informatics (Semester I) – 2018**

**M. Sc. Remote Sensing and Geo-Informatics (Semester II) – 2018**

**M. Sc. Remote Sensing and Geo-Informatics (Semester III) – 2019**

**M. Sc. Remote Sensing and Geo-Informatics (Semester IV) - 2019**

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1. Candidates for admission of the Master of Science Remote Sensing and Geo-Informatics degree shall be required to have passed the Bachelor of Science, Bachelor of Computer Application, Engineering or M.A. / M.Sc. in Geography. Candidate should have stereoscopic normal vision. Candidate having a minimum of 55% marks at graduate/ postgraduate level will be eligible for the course and admission will be taken on the merit basis.
2. Students of reserves category will be given relaxation in percentage as per university rules.
3. The duration of the course is four semesters in two academic years covering two semesters in each year. The course work of the M. Sc. Degree in Remote Sensing and Geo-Informatics shall be in accordance with the scheme of examination and syllabus prescribed.
4. The minimum attendance required by a candidate will be as per university rules.
5. A candidate for a pass at each of semester examination and shall be required to obtain:
  - a. At least 36% marks in the aggregate of the papers prescribed for the examination and
  - b. At least 36% marks in the practicals.
6. Wherever prescribed at the examination, provided that a candidate fails to secure at least 25% marks in each individual paper at the examination he/ she shall be deemed to have failed at the examination notwithstanding having obtained the minimum percentage of marks required in the aggregate for the examination.
7. No division will be awarded at the first three semester examination. Division shall be awarded at the end of the second year after four semesters of examination and combined marks obtained at the each semester examination will be taken together as noted below:

**First Division:** 60% of aggregate or above marks taken together.

**Second Division:** 48% of aggregate or above marks taken together.

8. Educational tours for M. Sc. Students (at least once in two semesters) will be organized to important places related to Remote Sensing and Geo-Informatics interest within or outside the state under the supervision on faculty member/s of the department as per the requirement of the syllabus. The expenses will be borne by the participating students. However, the university will provide Train/ Bus concession as per necessity and university rules. Travelling expenses of the teacher/s will be borne by the university as per rules of TA/ DA.

### SCHEME OF EXAMINATION

Paper	Nomenclature	Max. Marks.
<b>M. Sc. Semester I</b>		
<b>Paper I</b>	Principal of Satellite Remote Sensing	50
<b>Paper II</b>	Fundamentals of Geographic Information system	50
<b>Paper III</b>	Geodesy, Projections and Global Position System	50
<b>Paper IV</b>	Digital Cartography and Topographical Maps	50
<b>PRACTICAL</b>		<b>100</b>
	Experimental Work	60
	Practical record & Scientific Material Preparation	20
	Viva voce (Based on Experiments)	20
<b>Total</b>		<b>300</b>
<b>M. Sc. Semester II</b>		
<b>Paper V</b>	Thermal, Microwave and Hyperspectral remote Sensing	50
<b>Paper VI</b>	Aerial Photography and Photogrammetry	50
<b>Paper VII</b>	Digital Image Processing and Classification of Remote Sensing Data	50
<b>Paper VIII</b>	Indian Space Programme and Earth Systems	50
<b>PRACTICAL</b>		<b>100</b>
	Experimental Work	60
	Practical record, Seminar & Map Preparation	20
	Viva voce (Based on Experiments)	20
<b>Total</b>		<b>300</b>
<b>M. Sc. Semester III</b>		
<b>Paper IX</b>	Spatial Modeling and Analysis in GIS	50
<b>Paper X</b>	Basics of Computing and Programming Fundamentals	50
<b>Paper XI</b>	Applied Statistics and Research Methodology	50
<b>Paper XII</b>	Application of Remote Sensing and Geo-Informatics	50

<b>PRACTICAL</b>		<b>100</b>
	Experimental Work	60
	Practical record & Scientific Material Preparation	20
	Viva voce (Based on Experiments)	20
<b>Total</b>		<b>300</b>
<b>M. Sc. Semester III</b>		
Dissertation based on Project Work		<b>150</b>
Project Presentation and Viva Voce		<b>150</b>
<b>Total</b>		<b>300</b>
<b>Total of M. Sc. All Semesters</b>		<b>1200</b>

1. Practical Examination would be conducted by Board of Examiners consisting of one internal and one external Examiner.
2. Dissertation work will be carried out by the candidate from the institute/ company/ NGO related to Remote Sensing and Geo-Informatics to be selected by candidate however recommendation letter will be issued by the Head of Department. The duration of the project will be of one semester of the M. Sc. The dissertation will be submitted in the department under the supervision of the subject expert and one faculty member of department. Evaluation of dissertation work will be done by the internal and external at the time of practical examination of IV semester. The remuneration to external and internal examiner will be paid as per university rules for evaluating project work of each candidate.

## **Semester I**

### **Papers I: Principle of Satellite Remote Sensing**

#### **Unit: A**

##### **Basic of Remote Sensing:**

Definition of Remote Sensing: History and development, concept and components, advantage and limitations, Remote Sensing in India, Electro-Magnetic Radiation (EMR), EM radiation and EM spectrum, Law of radiation, Interaction of EMR with atmosphere and Earth's surface, Spectral signature- Water, Soil, Vegetation and Snow, Resolution- Spatial, Temporal, Spectral and Radiometric.

#### **Unit: B**

##### **Sensors and Platforms:**

**Sensors-** Remote Sensing sensors and their characteristics, Across track (Whiskbroom) and Along track (Push broom) scanning, Optical mechanical scanners- MSS, TM, LISS, WIFS, PAN; Active and Passive sensors.

**Platforms-** Remote Sensing platforms types and characteristics, Satellite and their characteristics- Geostationary and Sun-synchronous, Satellite mission: IRS satellite series, LANDSAT series, SPOT series, QUICK BIRD, IKONOS, Metrological satellite- INSAT, NOAA, GOES, NIMBUS.

#### **Unit: C**

##### **Image Interpretation:**

Basic principles, Types, Steps and elements, Techniques of visual interpretation and interpretation key, Multidate, Multispectral and multidisciplinary concepts, Ground truth instruments and spectral signature, Requirements of ground truth, Remote Sensing data products and their procurements, Application of Remote Sensing, Real and Ideal Remote Sensing system.

### **Papers II: Fundamentals of Geographic Information System**

#### **Unit: A**

Definition of GIS, Historical development, Terminology, GIS components, Hardware and software requirements for GIS, Concept of data, Geographic data sources (Remote Sensing, GPS, Maps and Field observations), Data structure in GIS, Type of data (Point, Line and Polygons), Data acquisition procedure, GIS data formats (Raster and Vector), GIS software, GIS workflow, Theoretical framework for GIS, Recent trends in GIS and Future directions.

### **Unit: B**

Data input methods (Capture, Scanning, Digitization, Creation), Source of errors, Topology, Data quality, Different types of geospatial data (Spatial and Non-Spatial data), Concept of spatial data modeling (Raster and Vector), Object- Based vector data model, Types of spatial data structure (Raster and Vector), Advantage and Disadvantage of various data structure, Database concepts, Development, Implementation and design, database management system (DBMS), Relational database model (RDBMS), Object Oriented database (OODS).

### **Unit: C**

GIS and Remote data integration, concept and need of integration, Image storage formats, Database query, Concept of SQL and Metadata, Overlay operations, Buffer Analysis, Data quality, Concepts and Models of Network analysis, Digital Elevation Model (DEM), Methods of development and application of DEM, Triangulated Irregular Network (TIN), Geo-visualization, Application of Remote Sensing and Geographic Information System

## **Papers III: Geodesy, Projections and Global Position System**

### **Unit: A**

Brief history of Geodesy, Introduction of geodesy, Geoid, Datum and Ellipsoid or Spheroid, Mean sea level, Indian Geodetic system, Coordinate systems, Transformations, Map type, Symbols and Scales, Application of Geodesy, Indian grid system and Map numbering, Earth fixed X, Y and Z, Historical evaluation and spatial information system.

### **Unit: B**

Basics concepts of map projection, Properties of map to be considered for projection, Geographical coordinate system of Earth, Classification of map projection- Conical, Cylindrical and Azimuthal, Aspect and new points of projections- Transverse Mercator, Lambert Polyconic, Lambert Conical Conformal and UTM projection, UTM zones.

### **Unit: C**

Introduction to Global Position System (GPS) - Fundamental concepts of GPS, History of GPS development and GPS satellite system, Functional segments of GPS, GPS satellite constellation, GPS positioning type, GPS receivers and codes, antenna, GPS accuracy, Error correction, GPS measuring techniques, signals structure and data.

Factors affecting of GPS, Methods- static and rapid static, kinematic, Real time kinematic Survey, DGPS, Basic concepts- IRNSS, NAVSTAR, GLONASS, GALILEO, MTSAT, Beidou and GAGAN, Mobile mapping, Applications of GPS.

## **Papers IV: Digital Cartography and Topographical Maps**

### **Unit: A**

Introduction to cartography, Nature and scope of cartography, Basic concept of map, Direction and its principles, Elements of digital cartography, principle of digital cartography, Purpose and Classification of map- according to scale, according to amount of topographic details, according to purpose, according to style of construction (Qualitative and Quantitative), Spatial database: Survey of India, NRSA, India-WRIS, BHUVAN, USGS Earth Explore, Census of India, National Information Centre.

### **Unit: B**

Elements of Digital Cartography- Map scale, Content of map, Map projection, Map Layout, Map Symbols, Use of colors and pattern, Lettering, Generalization of map, Compilation of map; Data models for digital cartographic information, Concepts of cartographic database, Qualitative mapping techniques: Chorochromatic and Chorochromatic. Quantitative mapping techniques: Choropleth and Isopleth.

### **Unit: C**

Introduction of topographical maps, Survey of India maps, Classification of Toposheet, Conventional Sign and Symbol, Interpretation of physical and culture features from topographical map, Triangulated height, Spot height, Bench marks, Relative height, Measurement of distances, directions, Gradients and area, Locating places in topographical maps: Latitudes and Longitudes, Universal Transvers Mercator zones, Four and Six- Figure grid references.

## **Practical**

### **1. Visual Image Interpretation**

- a. Interpretation of satellite images derived from Landsat, Spot, QuickBird, PAN, LISS, Wifs etc. and visualizations of satellite image for physical features: Urban, Forest, Agriculture land use, Scrub land, Network patterns etc.
- b. Visual analysis of satellite data and their area calculation using dot grid and planimeters.

### **2. Geographic Information System (GIS) using open source GIS software QGIS:**

Spatial data creation (Point, Line and Polygon), Digitization, Editing, Topology building, Spatial and Non-spatial data integration (Linking of tables and joining tables).

### **3. Mapping and Surveying using GPS and DGPS**

### **4. Cartography and Topographical Maps**

- a. Introduction of topographical maps.
- b. Identification to SOI topographical maps- Numbering, Scale, Grid reference, Sign and Symbol, Color System.
- c. Profile and Identification and representation of Land forms.
- d. Interpretation of physical and culture features from topographical map.
- e. Identification of location through four grid and six grid system
- f. Measurement of distance.
- g. Digital map preparation using Dot, Isopleth and Choropleth.



## **Semester II**

### **Papers V: Thermal, Microwave and Hyperspectral Remote Sensing**

#### **Unit: A**

Introduction to thermal IR radiation properties and law, Thermal radiation principle, Thermal properties of materials, Characteristics of thermal IR images and Factors affecting thermal imagery- atmospheric and other factors, Thermal Remote Sensing sensors, Thermal data sets: Landsat and ASTER, Application of thermal remote sensing, Qualitative and Quantitative analysis.

#### **Unit: B**

Concepts of microwave remote sensing and its components, Active and Passive microwave system, Backscattering, Cross-Section, Wavelength, Incidence angle, aspect angle, Polarization, Complex dielectric properties, Surface roughness, Surface geometry, Volume scattering, Application of microwave image. LiDAR components, Types and system, Basics concepts of LiDAR, RADAR, SONAR, SAR

#### **Unit: C**

History of Hyperspectral imaging, Spectral radiometry difference between remote sensing, Comparison of Multispectral and Hyperspectral image data, Spectral signature, Hyperspectral types and characterization, Hyperspectral remote sensing atmosphere, Data format and system, Hyperspectral data processing techniques software, Hyperspectral data classification, Techniques for analysis of Hyperspectral data, Hyperspectral remote sensing imaging spectrometers, Sensors, System and Mission, Application of Hyperspectral remote sensing

### **Papers VI: Aerial Photography and Photogrammetry**

#### **Unit: A**

Aerial photography: Definition, Scope, Advantages and Limitation; Specifications of aerial photographs (Vertical and Oblique), Flight planning, Aerial cameras types and their characteristics, Including digital mapping camera, Types and geometry of aerial photographs, Aerial photography, Season and time, Photo Index, Scale of aerial photographs and its determination, Comparison of aerial photographs and Map.

### **Unit: B**

Basics concepts of photogrammetry terms, Definition of photogrammetric, Stereovision: Overlap required for stereovision, Binocular vision, Accommodation and Convergence, Stereoscopic viewing, Principle of stereoscope, Pocket and Mirror stereoscopes; Application of photogrammetry, Digital Photogrammetry: methods and principles, Comparison of aerial photo and terrestrial photographs.

### **Unit: C**

Parallax: Measurement of absolute and differential parallax, Parallax bar and wedge, Measurement of height, principle of floating marks, contouring from stereometric height, Measurement of slopes/ Dips. Stereoscopic exaggeration; model deformation, Elements of exterior and interior orientation,

Aero-Triangulation: Radial line method, graphical mechanical and analytical methods, scaling, GCP and rectification, Plotting

Aerial Mosaic: Uncontrolled, Semi-controlled and controlled mosaics, comparison with maps, Ortho-photographs,

## **Papers VII: Digital Image Processing and Classification of Remote Sensing Data**

### **Unit: A**

Basic concepts of digital image and its characteristics, Analog vs. Digital image, Display of digital image, Digital image format (BSQ, BIL and BIP), Image histogram, Look- up table (LUT), Resolution: Spectral, Spatial, Radiometric and Temporal resolutions; Image pre-processing: Radiometric and Geometric correction of remotely sensed data, correction in image processing resampling and interpolation methods (Nearest Neighbor, Bilinear and Cubic Convolution); Image rectification; Number and selection of ground control points (GCPs), Source of image degradation, Image processing system design: Hardware and Software requirements.

### **Unit: B**

Image enhancement techniques: Overview, Contrast enhancement-Linear and Non-linear, Histogram equalization, Density slicing and Pseudo colors; Spatial filtering techniques- Low pass filters, High pass filters; Edge enhancement and edge detection, image smoothing, Thresholding; Image transformation techniques: Principle component analysis, vegetation indices, Image fusion, Image ratioing, Resolution merge.

### **Unit: C**

Concept of pattern recognition, Multi spectral pattern recognition, Feature extraction, Signature bank, Concept of image classification, Image classification techniques: Parametric and Non-parametric classifiers, Supervise and unsupervised classification system; Change detection techniques, Advanced Classification Techniques: Hybrid Classification, Artificial Neural Network, Fuzzy Classifiers; Classification accuracy assessment, Error matrix, Advantage and Disadvantage of classification.

## **Papers VIII: Indian Space Programme and Earth Systems**

### **Unit: A**

Concept of Indian Space Programme, History of the Indian space programme, Organizational structure of the ISRO and other space research organizations, Milestones in Indian space programme and its major events, Indian Remote Sensing application mission- Natural Resource Management System, Earth observation system, Space application, INSAT application, Forthcoming Indian and foreign Remote Sensing satellites

### **Unit: B**

#### **Earth's System**

Earth: Orbit, Rotation, Revolution, Time; Oceans: Temperature, Salinity, Density of seawater, Waves, Tides, Currents; Climate and atmosphere: Composition and vertical division of the atmosphere, Vertical and horizontal distribution of temperature, Heat balance, Role of Ozone, Methane and greenhouse gases, CO<sub>2</sub> emission, Concepts of the origin of Indian monsoon, El Nino and La Nina, Jet streams, ITCZ (Inter Tropical Convergence Zone), Cyclone and anti-cyclone, Impact of climate change; Landforms: River and related landforms, Aeolian landforms (Wind), Glaciers and glacial landforms.

### **Unit: C**

Indian Remote Sensing (IRS) series of satellites, orbits, sensors and its application, Communication satellite- INSAT, series of satellites; Launch vehicles of satellite, Launch facilities, Launch vehicles-PSLV, ASLV, GSLV, SLV, GSLV MK-3, RLV-TD, Scramjet Engine-TD, Earth observation mission, satellite communication, satellite navigation, space application and Societal services, IRS data application

## **Practical**

### **1. Aerial Photograph and Photogrammetry**

- a. Study of Aerial stereo photo.
- b. Lens/ Pocket stereoscope.
- c. Identification of Objects.
- d. Determination of photo scale and relief displacement mirror stereoscope and parallax bar.
- e. Annotation of aerial photographs, drawing of flight line, Height measurement of an object using stereo model.
- f. Determination of height of object and slope.
- g. Interpretation of single aerial photograph and comparison with a stereo pair,
- h. Interpretations of aerial photographs for the mapping of geomorphology, land use/ land cover and transport network.

### **2. Digital Image Processing**

- a. Digital conversion- Scanning method.
- b. Reading and display satellite data from BIL, BSQ and BIP format.
- c. Image rectification, Define projection, Reprojection and mosaicking.
- d. Study of histogram and layer information.
- e. Digital database creation- Point, Line and Polygon, Editing, topology building, area and perimeter estimation.
- f. Radiometric enhancement- Linear and Nonlinear stretching, Histogram equalization, LUT stretch and Noise reduction.
- g. Image enhancement technique- Low pass filtering and High pass filtering.
- h. Data compression techniques- PCA.
- i. Resolution merging.
- j. NDVI.
- k. Supervised classification.
- l. Unsupervised classification.
- m. Object-oriented classification.
- n. Accuracy Assessment.
- o. Change detection.
- p. Map composition.
- q. Output preparation, Land use/ Land cover mapping.

### **3. Introduction to open source SAGA GIS software and exercises.**

## Semester III

### Papers IX: Spatial Modeling and Analysis in GIS

#### Unit: A

Introduction to spatial data analysis, Significance of spatial analysis, Vector based spatial analysis: Overlay operation (Point-in-polygon, Line in-polygon, polygon-in-polygon), Buffering, Spatial measurement, Reclassification, Map manipulation, Thiessen polygons, Nearest Neighbor analysis, Network Analysis

#### Unit: B

Raster based spatial analysis: Map algebra, Local, Arithmetic, Focal, Zonal, Global functions, Neighborhood operations, Digital Elevation Model, TIN, Spatial interpolation method: Trend surface analysis, Density Estimation, IDW, Kriging; Gravity modeling, Spatial and Non-spatial query,

#### Unit: C

Surface analysis: Contour, Slope, Aspect, Hill shade, Vertical profile, Viewshad, Watershed and surface intersection; Web GIS, 3D and 4D GIS, Mobile GIS, Spatial data warehousing, Spatial data mining, Knowledge based GIS, GIS and integration of other types of data, Application of Remote Sensing based and GIS

### Papers X: Basics of Computing and Programming Fundamentals

#### Unit: A

**Fundamental of Computers:** Computer basic, Introduction, Characteristics of computers, Application of computers, Basic component of PC, Computer architecture; Number system: Binary, Decimal, Hexadecimal and octal system, conversion from one system to the other; Binary arithmetic; Addition, Subtraction, Manipulation and Division

**PYTHON:** Introduction to python, History and python features, Identifiers, Reserved words, Comments, Variables and data types; Operators in python: Arithmetic operators, Relational operators, Assignment operator, Logical operators, Membership operators, Indentify operators, Decision making statement, Loop statement.

## **Unit: B**

**HTML:** Introduction of HTML, Elements, Tags, Attributes, Common Tags, Heading, Paragraph, Formatting, Fonts, Styles, Links, Images, Tables, List, Forms and Frames

**C-Language:** History of C, Introduction of C programming language, Structure of C program, Compilation and execution of C program, Debugging techniques, Data types and size, Variables, Comments, identifiers and key words; Operators: Unary operators, arithmetic and logical operators, Bitwise operators, Assignment operator, Conditional operators; Control statements: if-else, switch, break, continue, go to; Loops: for while, do-while; Functions: built-in and user-defined, function declaration, define and function call, array and string

## **Unit: C**

**DBMS:** Introduction: An overview of Database Management System, Database system Vs. file system, Database concepts and architecture; Data modeling using the entity relationship model: ER model concept, ER diagram mapping constraints; key: Primary key, Super key, Candidate key; Relationship one to one, one to many, many to one and many to many.

**SQL:** Introduction, Advantage of SQL, SQL data type, Types and SQL commands, SQL operators, Data base table; Queries: Insert, Update, Delete; select distinct: Where, AND, OR, NOT, Null Value

## **Papers XI: Applied Statistics and Research Methodology**

### **Unit: A**

**Statistics:** Basics concepts, Population, Sample, Parameter frequency distribution, Cumulative frequency, Graphics and Diagrammatic representation of data, Techniques of data collection, Primary and Secondary data, Sampling Vs. Population,

Measures of central frequency; Mean, Mode and Median, Standard deviation, Measures of dispersion; Range, Quartile deviation, Skewness, Concept of growth rate

Correlation; Coefficient of correlation- Karl Pearson and Rank correlation, Regression analysis, Simple Linear, Construction of Regression line, Multiple Regression and correlation, regression residuals, Estimation of regression line in a Bi-variate distribution, Least squares method, Interpretation of regression coefficients

### **Unit: B**

**Statistics:** Interpolation- Binomial and Newton's method, Association of attributes and Chi-square test, Goodness of fit test and T-test, F-test, Analysis of variance

Time series analysis; Concepts and components, concepts of probability, Design of experiment introduction of randomized block design, Latin square and factorial design

### **Unit: C**

**Research:** Basic concepts of research, Objectives, Types of research, Significance of research, Research approach; Research problem: Identification and techniques of defining a research problem, review of literature, Hypothesis; Research design: Exploratory, Descriptive, Experimental, Types of data and sampling techniques, Data analysis and Hypothesis testing, Measurement of research and data

## **Papers XII: Application of Remote Sensing and Geo-Informatics**

### **Unit: A**

**Human Settlement and Urban analysis:** Settlement types and patterns, Urban Land use classification and change detection analysis, urban master plan, Solid waste management, Urban sprawl and urban planning, Utility mapping, Slum management and Smart city, urban hazard and risk Management.

**Rural Development:** Concepts of rural area, Facts, Major issues and rural development, Need for rural development, Rural infrastructure development (Housing, Drinking, Water supply, Road network), Study of poverty alleviation programs implementation, Governance of rural information and communication technology, Sustainable rural development

### **Unit: B**

**Agriculture, Forestry and Climate Change:** Importance of remote sensing in agriculture and forestry, crop yield and acreage estimation, Draught assessment and monitoring, Forest types and classification, Wild life management, Agro-Climatic zoning, Forest management system, Land degradation and erosion, Desertification

**Environmental Studies:** Resources management, Concepts and definitions, Resource classification system, Resource area management, resource conservation and planning for development, Land use Land cover classification.

**Disaster Management:** Introduction of disaster management, Natural disaster management plans, Risk analysis of natural disaster and hazard estimations, Types of Natural disaster and nature of impacts

### **Unit: C**

**Water Resources Management:** Basic concepts of water resources, Hydrological cycle, Issues in water resources development, management and utilization, Watershed definition and scope, watershed conservation planning and management, Runoff estimates from watersheds, Watershed modeling for sustainable development, Watershed approach for natural resource management, Hydrological modeling.

**Surface and Ground Water Exploration:** Classification of stream, catchment and basin, Ground water prospecting, Ground water exploration and factors affecting ground water occurrence, Ground water resources estimation and production, pollution of the ground water resource, Application of remote sensing for the ground water exploration, Special Reference to Arid Region of Rajasthan.

### **Practical**

#### **1. Exercises based on ARC GIS and Software prepared by ISRO for combined image processing and GIS**

- a. Overview of ArcGIS- Arc Map, Arc Catalog, Arc Toolbox.
- b. Create spatial data (Shapefile) and Geodatabase in Arc Catalog.
- c. On screen digitization, editing features, modifying and attributes editing.
- d. Projection and Reprojection of spatial data.
- e. Maintaining database.
- f. Spatial and Attribute query and analysis.
- g. **Vector Analysis-** Clip, Merge, Erase, Buffer, Split, Append, Intersection, Joining tables, Thiessen polygon, Dissolving and Create point shapefile of X, Y coordinates.
- h. **Surface Analysis-** TIN, Contour, Slope, Aspect, Hill shade, View shade, Generate drainage and watershed modeling in DEM.
- i. Topology building.
- j. Network Analysis.
- k. Map design and Map composition.

#### **2. Exercises based on Programming**

##### **A. List of Programs (C Language)**

- a. Program to Print an Integer (Entered by the User).
- b. Program to Add Two Integers.  
Program to Multiply two Floating Point Numbers.



- c. Program to Swap Two Numbers.
- d. Program to Check Whether a Number is Even or Odd.  
Program to Find the Largest Number Among Three Numbers.
- e. Program to Find Factorial of a Number.  
Program to Check Whether a Number is Palindrome or Not.
- f. Program to Check Whether a Number is Prime or Not.
- g. Program to Check Armstrong Number.
- h. Program to Make a Simple Calculator Using switch...case.
- i. Program to Find the Length of a String.
- j. Program to Concatenate Two Strings.  
Program to Copy String With Using strcpy().

**B. List of Programs (Python Language)**

- a. Program of print hello world
- b. Program of basic operators
- c. Programs of decision making statements
- d. Programs of loops

**C. List of Programs (HTML)**

Programs of Heading tag, attribute, paragraph, style, font, list, formatting, color, border, comments, table, images, frame etc.

- 3. **Introduction to open source *ILWIS-ITC GIS* software and exercises.**
- 4. **Introduction to AutoCAD Map software and exercises.**

**Semester IV**

**Dissertation based on Project Work**

**Project Presentation and Viva Voce**