MAHARSHI DAYANAND SARASWATI UNIVERSITY,
AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND
COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. REMOTE SENSING & GEO-INFORMATICS

Semester I & II Examination

(w.e.f. 2018-19)

Semester III & IV Examination

(w.e.f. 2019-20)

ALKA PUBLICATIONS

Purani Mandi, Ajmer

NOTICE

1. Change in Statutes/Ordinances/Rules/ Regulations Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुन: निर्माण कर परिनियमों/ अध्यादेशों/नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

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

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

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

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
Paper I: Principle of Satellite Remote Sensing
Unit: A

Basic of Remote Sensing:

Definition of Remote Sensing: History and development, concept and components, advantages and limitations, Remote Sensing in India, Electro-Magnetic Radiation (EM radiation and EM spectrum, Law of radiation, Interaction of EMR with atmosphere and Earth 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. Meteorological 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, Applications of Remote Sensing. Real and Ideal Remote Sensing system.

Paper 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 sensing 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.

Paper III: Geodesy, Projections and Global Positioning 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 Positioning 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.

Paper 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: Choroschematic and Chorochromatic. Quantitative mapping techniques: Choropleth and Isopleth.

Unit: C

Introduction of topographical maps, Survey of India maps, Classification of Toposheet, Conventional Signs and Symbols, Interpretation of physical and culture features from topographical map, Triangulated height, Spot height, Bench marks, Relative height, Measurement of distance, direction, Gradient and area, Locating places in topographical maps: Latitudes and Longitudes, Universal Transverse 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 of SOI topographical maps- Numbering, Scale, Grid reference, Sign and Symbol, Color System.
  c. Profile, 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

Paper 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, 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, Hyperspectral data classification, Techniques for analysis of Hyperspectral data, Hyperspectral remote sensing imaging spectrometers, Sensors, System and Mission, Application of Hyperspectral remote sensing.

Paper 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

Basic 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.

Paper 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, 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.

Paper VIII: Indian Space Programme and Earth Systems

Unit: A

Concept of Indian Space Programme, History of the Indian space programme, Organizational structure of 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, CO2 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 satellite, orbits, sensors and its application, Communication satellite- INSAT, series of satellite: Launch vehicles of other countries, Indian 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. Interpretation 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

Paper 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), Multi criteria analysis, Buffering, Spatial measurement, Reclassification, Map manipulation, Thiessen polygon, 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.

Paper X: Basics of Computing and Programming Fundamentals

Unit: A

Fundamental of Computer: Computer basics, Introduction, Characteristics of computers, Applications of computer, 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, Identifirs, Reserved words, Comments, Variables and data types; Operators in python: Arithmetic operators, Relational operators, Assigment 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

Paper XI: Applied Statistics and Research Methodology

Unit: A

Statistics: Basic concepts, Population, Sample, Parameter frequency distribution, Cumulative frequency, Graphics and Diagrammetric 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, Constructions 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.

Paper 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: Resource 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 estimations from watershed, 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, Hillshade, 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 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

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