

Gis Vision India

ISO 9001:2015 Certified Organization

Course Training Module

Advanced Geoinformatics & Remote Sensing Training.

The information provided in this training module is intended for educational purposes only. At GVI, our mission is to provide high-quality geoinformatics training to empower you with practical skills and industry-relevant knowledge.

This training module has been developed for educational and learning purposes, ensuring each topic supports your growth and understanding in spatial data management using GIS. We encourage our learners to apply critical thinking and professional judgment when implementing the concepts shared during the training. The GIS field is dynamic and constantly evolving-with new tools, practices, and technologies emerging regularly. As such, we recommend continuous learning and exploration beyond this course to stay aligned with industry advancements.

Table of Contents

GIS Fundamentals, Spatial Thinking & Data Models

1. Introduction to GIS & Geospatial Thinking

- What is GIS? Why is it important today?
- Evolution from paper maps to real-time dashboards
- Real-world applications: Smart Cities, Agriculture, Disaster Management

2. Core Components of GIS

- Hardware (GPS devices, servers)
- Software
- Data (raster, vector, tabular)
- People, procedures and networks

3. Spatial vs Aspatial Data

- Understanding location-based (spatial) data
- Difference between spatial and attribute tables
- Real-world analogy: Google Maps vs Excel

4. Vector Data Model

- Geometry types: Point, Line, Polygon
- Topology and its importance
- File formats: Shapefile, GeoJSON, KML, GPKG
- Use Case: Road networks, parcel maps

5. Raster Data Model

- Cells and pixels: storing continuous data
- Raster file formats: GeoTIFF, IMG, JPEG2000
- Applications: Satellite images, elevation, temperature
- When raster is better than vector

6. Comparative Analysis: Raster vs Vector

- File size, resolution, storage needs
- Use cases: LULC classification vs administrative boundaries
- Hands-on: Compare land cover (raster) with roads (vector)

7. Coordinate Systems & Location Reference

- Geographic Coordinate System (GCS): latitude, longitude
- Projected Coordinate System (PCS): meters, feet
- Real-world comparison: measuring areas in hectares vs degrees

8. Datum and Ellipsoid Concepts

- WGS84, NAD83, Everest Datum
- Why projections matter: Indian maps vs global maps
- EPSG codes: how to identify coordinate systems
- Tool: EPSG.io for reference

9. Map Projections and Distortions

- UTM zones, Lambert Conformal Conic, Mercator, etc
- How projections distort shape, area or direction
- Choosing the right projection for your study area
- Exercise: Load same layer in 3 projections and observe differences

10. Map Scale & Resolution

- Scale representation: Verbal, Fractional, Bar scale
- Difference between spatial, spectral, temporal resolution
- Exercise: Zoom in on Google Earth vs high-res DEM imagery

11. Accuracy, Precision and Error Propagation

- Definitions: Horizontal/Vertical accuracy, precision, bias
- Data quality issues: GPS error, digitizing mistakes
- Real-world: Why a small GPS shift matters in property boundaries

12. Understanding GIS Data Types

- Nominal, Ordinal, Interval, Ratio data in attribute tables
- Example: Population classification, elevation, land use type
- Hands-on: Classify attributes into their data types

13. Georeferencing Principles

- Definition and importance of spatial referencing
- Source of non-spatial data: scanned toposheets, old maps
- Role of Ground Control Points (GCPs)

14. Hands-On: Georeferencing a Toposheet

- Import raster map
- Add GCPs, apply transformation (1st order polynomial, Thin Plate Spline)
- Assess RMSE (Root Mean Square Error)
- Export a georeferenced GeoTIFF

Data Creation, Digitization & Field Data Collection

1. Digitization Techniques in GIS

- Manual digitization (heads-up vs heads-down)
- Semi-automated digitization from raster backdrops
- Best practices: snapping, topology rules, avoiding sliver polygons

2. Creating Point, Line, Polygon Layers

- Use cases: assets, roads, boundaries
- Set geometry type, CRS, and attribute schema
- Hands-on: Create administrative boundary and water body layers

3. Editing Geometry & Topology Rules

- Avoiding gaps, overlaps, and dangles
- Use of topology checker tools in QGIS/ArcGIS
- Practical: Validate digitized boundary layers using topology rules

4. Attribute Table Structure and Editing

- Adding and editing fields (text, integer, date, etc.)
- Field calculator: derived attributes, conditional logic
- Hands-on: Add population density field to districts using area & pop

5. Field Calculation & Derived Data

- Dynamic fields: area, perimeter, geometry-related calculations
- Conditional expressions: if-else queries, classifying land types

6. Data Formats and Interoperability

- Shapefile, GeoPackage, GeoJSON, CSV, KML, GDB
- File structure of Shapefile (.shp, .shx, .dbf)
- When to use what: static vs web-based vs database GIS

7. Importing External Tabular Data

- Importing Excel/CSV into GIS
- Joining based on common ID (e.g., village code)
- Hands-on: Link census data to polygon layer by village code

8. Joining Tables – Spatial & Non-Spatial

- One-to-one, one-to-many relationships
- Spatial joins: Points to polygon, buffers to features
- Lab: Join schools (points) to administrative boundaries (polygons)

9. Data Cleaning & Quality Control

- Identify and fix nulls, duplicates, unmatched joins
- Use Field Calculator and "Select by Expression" tools
- Lab: Validate attribute table consistency

10. Survey Planning – Field Data Design

- Preparing field survey questionnaire (type, field, domain)
- Choosing spatial features to collect: location, photos, notes
- Field checklist: What to capture, why and how

11. Field Data Collection (Hands-On)

- Capture points, photos, notes using a smartphone
- Import field data back into QGIS and analyze
- Fieldwork plan: Collect tree positions in a public park

12. Capturing GPS Coordinates

- Using apps like **GPS Essentials**, **MapIt**, or **GeoODK**
- Exporting GPS logs in GPX or CSV format
- Importing and visualizing waypoints and tracks

13. Time-Enabled Data in GIS

- Adding timestamps to collected data
- Applications: disease tracking, migration, weather event logs
- Visualize temporal changes

14. Data Integration Workflow (Lab)

- Collect field points → Export to GeoJSON → Link attributes from survey form → Symbolize results
- Use case: Mapping road condition survey results on a basemap
- Export project package for web or presentation

Cartography, Thematic Mapping & Visualization Techniques

1. Fundamentals of Cartography

- What makes a good map?
- Understanding map communication and design hierarchy
- Map-reading vs map-making perspectives

2. Types of Thematic Maps

- Choropleth (e.g., literacy rates)
- Dot Density (e.g., population distribution)
- Graduated Symbols (e.g., income levels)
- Isopleth / Contour Maps (elevation, pollution)
- Heat Maps / Kernel Density (e.g., crime hotspots)

3. Choosing the Right Map Type

- Qualitative vs Quantitative data
- Continuous vs Discrete representation
- Matching data scale to visual form

4. Symbolology Fundamentals

- Feature-based styling (points, lines, polygons)
- Symbol libraries and custom SVGs
- Practical: Style roads, rivers, and building footprints in QGIS

5. Classification Techniques

- Natural Breaks (Jenks), Equal Interval, Quantile, Standard Deviation
- When to use what? Avoiding visual bias
- Hands-on: Apply 3 classification methods to the same data and compare

6. Color Theory & Color Schemes

- Sequential, Diverging and Qualitative color types
- Color accessibility and contrast for readability

7. Designing Multi-variable Maps

- Bivariate symbology: choropleth + symbols
- Custom symbol layers with combined properties
- Lab: Map literacy and unemployment on the same map

8. Labeling Techniques

- Dynamic labeling vs Annotation
- Placement settings (curved, offset, conflict resolution)
- Lab: Customize rule-based labeling (label large cities only)

9. Advanced Labeling Rules

- Expression-based labeling in QGIS (e.g., if population > 100000, show label)
- Label prioritization, collision detection, font styling
- Manual annotation layers for reports

10. Designing Layouts for Printing

- Page setup, paper size, orientation
- Adding north arrow, scale bar, legends, title
- Hands-on: Print Composer

11. Legend and Map Composition Principles

- Legend item grouping, symbol explanations
- Hierarchical visual order and clarity
- Framing the map — use of inset maps, locator maps

12. Multi-scale Map Design

- Scale-dependent visibility of features and labels
- Level-of-detail rules for web vs print
- Lab: Create zoom-based visibility settings for highways and streets

13. Common Cartographic Errors and How to Avoid Them

- Too many colors, inconsistent scales, misleading classification
- Improper legend symbols
- Checklist for quality control

14. Cartographic Storytelling with GIS

- Using maps to tell stories and present evidence
- Examples of story maps, timeline-integrated maps
- Map critique session: evaluating maps for impact

Spatial Databases & Data Integration

1. What is a Spatial Database?

- Definition and need for structured spatial data storage
- Differences between flat files (like shapefiles) and spatial databases (like GeoPackage, Geodatabase)
- Advantages: one-file structure, multi-layer storage, long-term integrity

2. Exploring GeoPackage and Geodatabase Formats

- Understanding .GPKG and Geodatabase as container formats
- Benefits over shapefiles (no field name limits, better geometry handling)
- Hands-on: Create a GeoPackage file and add multiple layers to it

3. Creating Spatial Layers in Databases

- How to create new layers using QGIS's "Create Layer → New GeoPackage Layer"
- Setting coordinate reference system (CRS), field types (text, integer, date)
- Save styles and symbology within the same file

4. Importing Existing Layers into GeoPackage/ Geodatabase

- Copy-paste or drag-drop into the GeoPackage using QGIS Browser panel
- Use of the **DB Manager** plugin to manage imported data
- Exercise: Consolidate district, roads, and school shapefiles into one GeoPackage

5. Adding and Managing Attribute Fields

- Using Field Calculator to create new fields (area, length, classification)
- Calculating basic fields: land use type, population density
- Adding domains (value lists) for consistent data entry

6. Linking Tabular Data (CSV, Excel) with Spatial Data

- Importing Excel or CSV
- Field-based joins using "Join Attributes by Field Value"
- Example: Link population census Excel sheet with district boundary layer

7. Understanding Attribute Joins (One-to-One)

- How non-spatial tables relate to spatial layers using IDs
- When to use inner join, keep all records
- Lab: Join rainfall data table to district polygons

8. Joining Multiple Spatial Layers (Spatial Join Tools)

- QGIS: "Join attributes by location" tool
- Spatial Join tool
- Example: Assign number of schools (points) per district (polygon)

9. Understanding Table Relationships

- Concept of one-to-many using relationship classes
- Visual linking using "Layer Properties → Joins → Add Join"

10. Exporting Integrated Data

- Export joined/spatially combined layers to GeoPackage or shapefile
- Ensure attribute retention and geometry integrity
- Practical: Export final project layers into one packaged file

11. Working with Spatial Bookmarks and Layer Grouping

- Save and organize views for quick data navigation
- Group layers by theme (admin boundaries, infrastructure, environment)
- Use in project reports or map composition

12. Metadata Entry and Layer Documentation

- Add metadata in layer properties: title, abstract, source, CRS
- Export project metadata as .XML or PDF
- Why metadata is crucial for future use and sharing

13. Mini Project: Build a Local Spatial Database

- Create a GPKG file with 3–5 layers: roads, buildings, schools
- Join Excel census data to the polygons
- Use spatial join to count points inside polygons
- Export final project as a self-contained GIS package

Principles of Remote Sensing & Satellite Data Sources

1. Introduction to Remote Sensing

- What is Remote Sensing and how it differs from traditional surveying
- Passive vs Active sensors
- Real-life examples: weather forecasting, disaster monitoring, agriculture

2. Electromagnetic Spectrum (EMS) Basics

- Definition and structure of EMS
- Visible, infrared, thermal, and microwave regions
- Importance of EMS in understanding satellite data collection

3. Energy Interactions with the Earth Surface

- Reflection, absorption, transmission
- How vegetation, water, soil, and built-up surfaces interact with EM waves
- Examples of different surface reflectance

4. Spectral Signatures

- Concept of spectral response curves
- How different land covers have unique spectral fingerprints
- Visual interpretation of vegetation, water, soil in imagery

5. Atmospheric Windows

- Why some wavelengths are blocked and others pass through
- Importance of clear atmospheric conditions for imagery
- Factors like clouds, aerosols and haze

6. Spatial Resolution

- Definition and examples (e.g., Landsat 30m, Sentinel-2 10m, WorldView 0.3m)
- Impacts on mapping detail and scale
- Use case comparison: urban mapping vs regional planning

7. Spectral Resolution

- Number of bands a sensor can detect (multispectral vs hyperspectral)
- Applications: NDVI, water quality, geology
- Band examples: Red, NIR, SWIR, Thermal

8. Temporal Resolution

- Revisit frequency of satellite (e.g., Sentinel-2 every 5 days)
- Importance for crop monitoring, flood tracking, deforestation detection

9. Radiometric Resolution

- Sensitivity of sensors to detect differences in reflectance
- 8-bit vs 12-bit vs 16-bit imagery
- Impact on visual quality and classification accuracy

10. Satellite Platforms Overview

- Differences between geostationary and polar orbiting satellites
- Key platforms: Landsat (USA), Sentinel (ESA), IRS (India), MODIS (NASA)
- Application examples for each

11. Commonly Used Sensors

- **Landsat 8 & 9:** Free data for land use mapping
- **Sentinel-2:** High-resolution optical imagery
- **MODIS:** Large area monitoring (NDVI, fire)
- **CartoSAT:** Indian high-resolution mapping
- **AWiFS & LISS-III:** Indian regional-scale applications

12. UAVs (Drone-Based Remote Sensing)

- Introduction to UAVs and sensors used (RGB, thermal, multispectral)
- Typical use cases: precision farming, land survey, mining
- Legal & practical considerations in India

13.Data Sources for Free Satellite Imagery

- **USGS Earth Explorer** (Landsat, MODIS)
- **Copernicus Open Access Hub** (Sentinel series)
- **NRSC Bhuvan** (ISRO imagery & products)
- **EO Browser** (Quick visualization & download)
- Account setup, area-of-interest selection, filtering by date/sensor

14.Hands-On: Search and Download Imagery

- Locate your district in USGS Earth Explorer
- Choose Landsat 8 or Sentinel-2 images
- Download GeoTIFF files

15.Imagery Interpretation (Visual Approach)

- Understand RGB vs False Color Composites (FCC)
- Visual indicators for water, urban areas, vegetation
- FCC creation using band combinations (e.g., 4-3-2, 5-4-3, 8-4-3 for Sentinel-2)

Image Pre-processing & Enhancement Techniques

1. Why Image Preprocessing is Critical

- Raw imagery vs. processed imagery
- What errors exist in raw satellite data
- When pre-processing is required (for LULC, NDVI, change detection)

2. Understanding Radiometric Errors

- Causes: sensor noise, sun angle, atmospheric interference
- Effects on reflectance and pixel intensity
- Example: cloudy vs clear image of the same location

3. Radiometric Correction

- Convert DN to TOA reflectance (Top of Atmosphere)
- Apply surface reflectance correction using available coefficients
- Use case: Landsat 8 imagery correction for vegetation study

4. Atmospheric Correction

- Use Sen2Cor processor
- Level-1C to Level-2A conversion (surface reflectance)
- Input settings: resolution, output folder, save file
- Visual verification: before/after reflectance changes

5. Geometric Distortions in Imagery

- Sensor angle, terrain, earth curvature impacts
- Common issues: skewed features, misalignment with vector data
- Identifying errors using overlay comparison

6. Image Subsetting (Cropping)

- Define AOI (Area of Interest) using vector boundary
- Extract subset image using Raster > Extraction tools
- Hands-on: Crop a Sentinel-2 image to one administrative district

7. Image Reprojection (Coordinate System Adjustment)

- Why reprojecting imagery is necessary
- Use of **Raster > Projections > Warp (Reproject)**
- Match CRS of imagery with vector layers for analysis
- Lab: Reproject MODIS image from Sinusoidal to UTM

8. Image Mosaicking (Combining Multiple Scenes)

- When to mosaic: coverage gaps, large regions
- Mosaic > Build Virtual Raster (VRT) vs merge output
- Exercise: Merge 2 Landsat scenes for a full district coverage

9. Clipping Imagery with Vector Boundaries

- Use of mask layers to clip rasters
- Advantages: lightweight file size, focused analysis
- Tool: Raster > Extraction > Clip Raster by Mask Layer

10. Cloud Masking

- Sentinel-2 QA band or cloud classification layer
- Visual inspection and threshold filtering
- Create clean composite for vegetation studies

11. Contrast Stretching and Histogram Equalization

- Types: Linear, Min-Max, Percent Stretch
- Improve visual interpretability of image features
- Tools: Raster Layer properties > Symbology > Contrast enhancement

12. Filtering and Smoothing (Spatial Enhancement)

- Smoothing filters (mean, Gaussian) vs Edge-enhancing filters (Sobel, Laplacian)
- Use in identifying landform edges or removing noise

13. False Color Composite (FCC) Generation

- Assigning bands to RGB for interpretation
- Common FCC combinations:
 - Landsat 8 (5-4-3) – vegetation
 - Sentinel-2 (8-4-3) – land use
- Lab: Create and compare FCC and natural color images

14. Visual Quality Assessment and Metadata Reading

- Examine histogram, pixel values, band statistics
- Review metadata for acquisition date, sensor, resolution
- Exercise: Compare 2 images of same area before and after enhancement

Image Classification & Change Detection

1. Concept of Image Classification

- Converting raw imagery into meaningful land categories
- Key applications: agriculture, forestry, water mapping, urban planning
- Difference between pixel-based and object-based methods

2. Unsupervised Classification (GUI-Based)

- Clustering algorithms: K-Means, ISODATA
- Number of classes and band selection
- Lab: Classify a region into 5–7 land cover types

3. Interpreting Unsupervised Results

- Visual analysis of clusters
- Assigning classes post-classification using field data or visual validation
- Reclassify classes based on interpretation

4. Supervised Classification – Basics

- Signature collection (training samples): Points, polygons
- Use known land types for sample collection
- Tips: Use RGB + FCC imagery for better interpretation
- Add training areas
- Classification using minimum distance or maximum likelihood
- Preview and reclassify results based on interpretation accuracy

5. Pre-classification Considerations

- Use of corrected and cloud-free images
- Importance of selecting optimal bands
- Choosing the right number of classes for your region

6. Post-classification Smoothing & Cleaning

- Use majority filters to remove isolated pixels
- Remove salt-and-pepper noise using raster filters
- Visual cleanup using raster calculator reclassification

7. Reclassification of Raster Layers (GUI)

- Convert raw classification values (e.g., 1, 2, 3...) to meaningful categories (forest, urban, agriculture)
- Use QGIS Raster Calculator to assign new values
- Visualize using custom symbology

8. Accuracy Assessment – Error Matrix Concept

- Confusion Matrix: comparing classification with reference data
- Producer's Accuracy, User's Accuracy, Overall Accuracy
- Kappa coefficient explanation (in simple terms)

9. Ground Truth Collection for Accuracy

- Using Google Earth or field GPS points for validation
- Sampling minimum 50 points across classes

- Use field survey or secondary data for reference

10.Zonal Statistics for Class Area Estimation

- Measure area per class using raster and polygon overlay
- Tool: Zonal statistics
- Example: Estimate forest cover per taluk

11.Generating Land Use Land Cover (LULC) Maps

- Combine classification results with administrative boundaries
- Add legend, north arrow, labels using Print Composer
- Export map as PDF or image

12.Introduction to Change Detection

- Why and when to perform change detection
- Types: post-classification comparison, NDVI differencing, band subtraction
- Example: urban expansion, deforestation, waterbody shrinkage

13.Post-Classification Change Detection

- Classify two different time images (e.g., 2013 vs 2023)
- Compare class transitions using raster calculator
- Generate change matrix: forest to agriculture, water to urban, etc.

14.Hands-On: NDVI Differencing Method

- Calculate NDVI from two dates (e.g., monsoon vs summer)
- Subtract old NDVI from new to detect vegetation loss/gain
- Apply color ramp to visualize change intensity

Spatial Analysis & Modeling

1. Introduction to Spatial Analysis

- What is spatial analysis and how is it different from traditional analysis
- Vector-based vs raster-based analysis techniques

- Real-world applications: site planning, resource mapping, risk zoning

2. Attribute-Based Spatial Queries

- "Select by location" and "select by attribute" tools
- Use case: select all schools within a specific district boundary
- Lab: Use “Query Builder” to extract features by name or code

3. Buffering Analysis

- Create proximity zones around features (e.g., roads, rivers, wells)
- Difference between fixed-distance and multiple-ring buffers
- Example: Buffer of 2 km around hospitals to identify underserved areas

4. Overlay Analysis – Vector Tools

- Union, Intersect, Clip, Erase tools explained
- Combine spatial datasets to get common or exclusive areas
- Lab: Intersect land use with flood zone to identify vulnerable cropland

5. Weighted Overlay Analysis (Raster-Based)

- Combine multiple raster layers with assigned weights
- Normalize values using raster calculator
- Application: site suitability for agriculture, industries, schools

6. Multi-Criteria Decision Making (MCDM)

- Criteria-based decision making with multiple spatial factors
- Define weights using real-world logic
- Hands-on: Develop a suitability model for renewable energy plant location

7. Interpolation Techniques (Surface Modeling)

- Generate continuous surfaces from point data
- Methods: IDW (Inverse Distance Weighted), Kriging (via GUI only), Spline
- Application: Groundwater depth, temperature, air pollution

8. Terrain Analysis from DEMs

- Derive slope, aspect, hillshade, and curvature

- Understanding how terrain influences development
- Tools: Raster > Terrain Analysis

9. Hydrological Modeling – Basics

- Extract watersheds and drainage networks from DEM
- Concepts: Fill sinks, flow direction (D8), flow accumulation
- Practical: Delineate watershed for a village using Hydrology tools

10. Stream Network Extraction

- Use flow accumulation thresholds to extract streams
- Convert raster to vector streamlines
- Overlay stream network on base maps

11. Watershed Delineation

- Identify pour points (outlets) using interactive map tools
- Generate catchment area and drainage basin boundaries

12. Visibility & Viewshed Analysis

- Determine areas visible from a location (e.g., towers, fire watch stations)
- DEM-based visibility modeling
- Tool: Raster > Viewshed Analysis

13. Hotspot Mapping & Cluster Detection (GUI Tools)

- Kernel Density Estimation (KDE) for point features
- Identify high-density areas (e.g., accident locations, wells)
- Heat map generation with advanced symbology

14. Zonal Statistics (Attribute from Raster to Polygon)

- Extract mean, max, min values from raster to polygon zones
- Example: average elevation per district

15. Site Suitability Modeling

- Combine proximity to roads, slope, land use, water source
- Reclassify layers, assign weights, perform overlay
- Output: Ranked suitability map with classes (low, medium, high)

Advanced GIS Applications in Real-World Sectors

(Hands on Research Project)

1. Urban Planning and Land Use Analysis

- Land Use/Land Cover change analysis for master plans
- Delineate built-up growth zones using past imagery
- Practical: Create zoning map (residential, industrial, parks) from classified imagery

2. Infrastructure and Utility Mapping

- Map electricity poles, transformers, underground cables
- Design utility networks using existing roads and buildings
- Digitize infrastructure assets and assign service zones

3. Road Network and Transport GIS

- Map road hierarchies: highways, major, minor, local roads
- Proximity analysis: schools and hospitals near roads
- Visualize transport corridors and access areas

4. Agriculture GIS Applications

- NDVI-based vegetation health mapping using Sentinel-2
- Identify irrigated vs rainfed crops using seasonal imagery
- Overlay soil, slope, rainfall maps for crop suitability

5. Precision Farming Techniques in GIS

- Divide fields into management zones
- Use UAV/drone images for plant stress detection (imagery given)
- Lab: Map intra-field variability using NDVI and yield data

6. Watershed and Irrigation Planning

- Extract micro-watershed boundaries from DEM
- Identify check dam locations using slope and stream data
- Combine LULC and runoff layers for water budgeting

7. Forest and Biodiversity Monitoring

- Use Sentinel-2 or Landsat to detect forest loss
- Map buffer zones around protected areas
- Create habitat suitability zones for wildlife conservation

8. Environmental Impact Assessment (EIA)

- Use buffer analysis for proposed roads/industries
- Overlay sensitive zones: wetlands, forest, water bodies
- Generate EIA maps and identify mitigation zones

9. Climate Vulnerability Mapping

- Combine rainfall, temperature, NDVI, soil moisture indicators
- Visualize drought or flood-prone areas
- Temporal map comparison for vulnerability assessment

10. Disaster Management Applications

- Flood risk mapping using DEM and historical water extent
- Land subsidence or landslide susceptibility analysis
- Lab: Combine slope, land use, and soil layers for landslide risk zone

11. Public Health GIS

- Spatial distribution of hospitals, dispensaries
- Buffer and service area mapping (5 km, 10 km coverage)
- Identify underserved regions based on road and population density

12. Village Information System (VIS)

- Integrate layers like households, landholding, water points
- Thematic mapping of village resources for local planning
- Combine field survey data with base village maps

13. Tourism and Cultural Mapping

- Map historical sites, tourist spots, transport links
- Route mapping for eco-tourism zones
- Map viewer design for tourist district using QGIS

14. Smart City & Urban Analytics

- Use of GIS for smart city pillars: energy, traffic, utilities
- Monitor green cover, heat zones, waste management routes

- Develop dashboard-ready thematic maps

15.Capstone Sector Selection & Initial Planning

- Choose one focus domain for project
- Select a Focus Domain, Choose one sector for your project (e.g., Agriculture, Urban Planning, Disaster Management, Environment, Health, etc.).
- Define Project Objectives, Clearly outline what you aim to achieve using GIS—state your goals and expected outcomes.
- Identify Data Sources & GIS Layers, List required spatial/non-spatial data (e.g., satellite imagery, admin boundaries, roads, land use) and mention data sources (e.g., Bhuvan, USGS, field surveys).
- Plan Map Outputs & Analysis Methods, Decide on types of maps (e.g., LULC, suitability, risk zones) and techniques (e.g., buffer, overlay, interpolation, change detection).
- Set Tools, Timeline & Risk Measures, Choose GIS tools/software, set weekly milestones, and note any potential data or tech issues with backup options.

This syllabus is designed to provide you with a general overview of the course content and learning objectives. However, the **real value lies in the hands-on experience**. Working with satellite imagery, geospatial datasets, and real-world applications is not just technical-it's transformative.

Understanding and interpreting space-based data is a unique skill that goes far beyond theory. This course offers **a one-of-a-kind practical journey** that opens your mind to how the world functions-layer by layer, map by map.

By the end of this course, you won't just have learned GIS-you'll have experienced it. And with the rapid rise of geospatial technologies across all sectors, **GIS and space data skills are becoming essential for tomorrow's careers**. Whether you're in environmental science, urban planning, agriculture, or technology, **this is a skillset for the future-and a lifetime**.



Think before you print.