COURSE NAME : ISRO IIRS (OUTREACH PROGRAM)

PROJECT TITLE

Geodata Processing using Python and Machine Learning

Introduction

Overview of a curriculum focused on Geospatial Technologies, encompassing Image Statistics, Remote Sensing, Photogrammetry, Digital Image Processing, Geographical Information Systems (GIS), Global Navigation Satellite Systems (GNSS), Customization of Geospatial Tools, and their Applications. Below is a breakdown of the key components

1. Image Statistics Theory:

Introduction to statistical methods for image processing.
Understanding image data and its properties.

Practicals:

Hands-on experience with R Software for statistical analysis.

Learning measures of central tendency, correlation, covariance, and multivariate statistics.

Applying regression, least square analysis, and probability distributions to image data.

2. Basics of Remote Sensing Theory:

Physics of Remote Sensing: Principles of electromagnetic radiation and interaction with Earth's surface.

Data Acquisition Mechanisms: Sensors, platforms, and data types.

Specialized remote sensing techniques: Microwave, LiDAR, Thermal, and Hyperspectral.

Practicals:

Satellite Image Annotation: Labeling and interpreting satellite data.

Spectral Response Patterns: Analyzing how different land cover types reflect energy.

Ground Data Collection: Using instruments like radiation thermometers.

Visual Interpretation: Aerial, thermal, SAR, and satellite imagery.

Land Use/Land Cover (LULC) Mapping: Interpreting and analyzing LULC maps.

3. Photogrammetry and Cartography Theory:

Aerial and Satellite Photogrammetry: Principles of capturing and analyzing 3D data from images.

Image Matching: Techniques for aligning and comparing images.

Terrain Analysis: Studying elevation and landforms.

Cartography: Principles of map design and projection.

Practicals:

Photo Scale Determination: Calculating scale from aerial photographs.

Base Map Preparation: Creating foundational maps.

Stereo Model Orientation: Using mirror stereoscopes for 3D visualization.

Height Determination: Using parallax bars and single photographs.

DEM Generation: Creating Digital Elevation Models and their derivatives.

Map Projection: Understanding and applying different projection systems.

4. Digital Image Processing Theory:

Image Preprocessing: Techniques like radiometric and geometric corrections.

Image Enhancement: Improving visual quality for interpretation.

Image Classification: Supervised and unsupervised methods.

Image Fusion and Change Detection: Combining data and identifying temporal changes.

Hyperspectral and Microwave/LiDAR Data Processing: Specialized techniques for advanced data types.

Practicals:

Software demos: ILWIS, ERDAS IMAGINE, and GRASS.

Knowledge-Based Classification: Using rules for image classification.

Neural Network Classification: Applying machine learning techniques.

Change Detection Analysis: Identifying changes over time.

Hyperspectral and LiDAR Data Processing: Handling complex datasets.

5. Geographical Information System (GIS) Theory:

Introduction to GIS: Concepts, components, and applications.

Geospatial Database Generation: Creating and organizing spatial data.

Spatial Data Analysis: Techniques for analyzing vector and raster data.

Technology Trends: Emerging tools and applications in GIS.

Practicals:

QGIS and ArcGIS: Hands-on experience with popular GIS software.

Vector and Raster Data Analysis: Performing spatial operations.

Map Composition: Designing and creating maps.

Network Routing and Multi-Criteria Analysis: Advanced spatial analysis techniques.

Geo-Web Services: Configuring and using web-based GIS services.

6. Global Navigation Satellite System (GNSS) Theory:

Introduction to GNSS and GPS: Principles and components.

Error Sources and Positioning Types: Understanding accuracy and precision.

Practicals:

Handheld GPS Receivers: Collecting and processing GPS data.

DGPS Data Collection: Using Differential GPS for improved accuracy.

Mobile Mapping and LBS: Applications in location-based services.

7. Customization of Geospatial Tools Theory:

Customization Techniques: Tailoring geospatial tools for specific applications.

Development Environments: Setting up environments for GIS customization.

Practicals:

ArcGIS and QGIS Customization: Using Python for automation and customization.

GDAL/OGR Customization: Handling geospatial data formats.

Web-Based GIS Development: Building applications using OpenLayers.

Server Configuration: Setting up Apache Tomcat, Mapserver, and Geoserver.

8. Applications of Geospatial Technologies Theory:

Operational Remote Sensing: Real-world applications in monitoring and analysis.

Natural Resource Management: Using geospatial tools for sustainable resource use.

Disaster Management: Applications in risk assessment and response.

Planetary Missions: Extending geospatial techniques to space exploration.

Key Takeaways:

This curriculum provides a blend of theoretical knowledge and practical skills in geospatial technologies.

It covers a wide range of tools and techniques, from remote sensing and photogrammetry to GIS and GNSS.

Emphasis on customization and application development prepares students for real-world challenges in natural resource management, disaster management, and beyond.

This program is ideal for students and professionals looking to build expertise in geospatial technologies and their applications across various domains.