



Project No.
4015CIV

Date
2025

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Serial No
4015/2025

Rev.
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المكتب الهندسي لخدمات التكنولوجيا والبرمجيات

Engineering office for Technology and Software Services

Remote Sensing and Python for Earth Observation



Course 2: Remote Sensing and Python for Earth Observation

Code: 4015Soft-RS-CIV

Level: Beginner – Intermediate

Duration: 25 Hours

Target Audience: Earth scientists, researchers, GIS beginners

Introduction

This course introduces learners to the principles of remote sensing and the powerful capabilities of Python in processing, analyzing, and visualizing satellite imagery. With the rise of Earth observation missions and open-access satellite data (e.g., Sentinel, Landsat),

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understanding how to harness these resources using modern tools is essential for solving global challenges such as deforestation, climate change, urban sprawl, and agricultural health monitoring.

Course Description

This hands-on course teaches students how to access and process satellite imagery using Python tools. Starting from foundational remote sensing concepts, you'll learn how to acquire data from various sources, conduct spectral analysis, perform land use classifications, and carry out real-world environmental monitoring tasks. The course blends scientific understanding with practical programming, culminating in mini projects that simulate real research or industry scenarios.

Module 1: Fundamentals of Remote Sensing (3h)

- Electromagnetic spectrum & satellite sensors
- Imagery types: Landsat, Sentinel, MODIS
- Resolutions: spatial, spectral, temporal, radiometric

Module 2: Acquiring and Managing Satellite Data (3h)

- Download from USGS, Copernicus Open Hub
- Metadata & band interpretation
- Handling multi-band rasters in Python

Module 3: Image Processing with Python (5h)

- Band combinations (NDVI, NDWI, false color)
- Image enhancement & filtering
- Radiometric and atmospheric correction

Module 4: Classification and Land Use Mapping (6h)

- Supervised vs. Unsupervised classification
- Land cover classification using Scikit-learn
- Change detection & temporal analysis
- Accuracy assessment and evaluation

Module 5: Python Tools for Remote Sensing (4h)

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- Key libraries: Rasterio, GDAL, EarthPy, PyProj
- Google Earth Engine Python API
- Visualization: Matplotlib, Folium

Module 6: Mini Projects & Case Studies (4h)

- Deforestation monitoring
- Urban expansion tracking
- Crop health analysis via NDVI
- **Course Outcomes**

By the end of this course, learners will be able to:

- ✓ Confidently access, download, and process satellite imagery using Python
- ✓ Perform image enhancement and spectral analysis (e.g., NDVI, NDWI)
- ✓ Apply supervised and unsupervised classification to identify land use types
- ✓ Evaluate classification accuracy using statistical assessment techniques
- ✓ Use libraries like Rasterio, GDAL, and EarthPy for real-world geospatial analysis
- ✓ Create maps and visualizations from processed satellite data
- ✓ Analyze environmental phenomena such as urban growth, deforestation, and crop health
- ✓ Design and complete small Earth observation projects using open-source data

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