GIS and Remote Sensing - JEE 684
(Course coordinators: Dr. Savitri Garivait and Dr. Uday Pimple)

1. Course Description

The objective of the course is to enhance students' ability to apply Geographic Information Systems (GIS) and Remote Sensing technologies to environmental and sustainability research. At the beginning of the course, classes are devoted to providing (1) the fundamental principles of GIS, Earth observation, and satellite remote sensing, (2) practical methods and tools to acquire, process, analyze, interpret, and visualize geospatial data using modern open-source and cloud-based platforms (e.g., QGIS, Google Earth Engine, and the JRC IMPACT Toolbox), and (3) techniques for spatial analysis, digital image processing, machine learning, and the integration of multi-source geospatial data for environmental applications. Hands-on laboratory exercises, field survey training, and practical guidance accompany these live classroom sessions. Students will be required to work independently and interact with other students and academic staff as part of a process that involves developing geospatial workflows, critically evaluating analytical results, and communicating scientific findings for environmental and sustainability applications.

2. Target Knowledge, Skills, and Abilities (KSA)

This course provides students with knowledge about the concepts and principles of Geographic Information Systems (GIS), Earth observation and remote sensing, skills to acquire, process, analyze, interpret, and visualize geospatial data using modern geospatial tools, as well as an ability to apply GIS and remote sensing techniques to environmental and sustainability research and communicate scientific information in an international environment.

3. Target group of students

The course is open to Master's and PhD students with a background in energy and environmental sciences, engineering, natural resources, geography, forestry, agriculture, geology, hydrology, ecology, or related disciplines.

4. Prerequisites

Students are expected to have basic knowledge of computer applications, mathematics, physics, and statistics. A personal laptop computer is required for practical laboratory sessions. No prior experience in Geographic Information Systems (GIS) or Remote Sensing is required.

5. Course Learning Outcomes (CLO)

CLO 1: Be able to understand the principles of Geographic Information Systems (GIS), Earth observation, and remote sensing for sustainable energy and environment-related applications.

CLO 2: Be able to acquire, process, analyze, interpret, and visualize geospatial data using modern GIS and remote sensing techniques.

CLO 3: Be able to apply GIS and remote sensing methods to solve environmental problems and communicate geospatial information effectively through maps, technical reports, and oral presentations based on an individual mini project.

6. Method of Teaching and Learning

This course will be delivered primarily in an on-site format, complemented by online learning materials, hands-on laboratory exercises, field survey training, and student presentations. Students residing outside Thailand may participate remotely through online learning resources and recorded lecture materials, where appropriate.

7. Course Outline and Organization

This course is offered in Semester 1 of each academic year. It is organized into four modules following the Outcome-Based Education Module (OBEM) approach. Each module comprises lectures, hands-on laboratory exercises, and practical activities designed to achieve the corresponding Course Learning Outcomes (CLOs). The course concludes with an individual mini-project presentation.

For Semester 1/2026, the course is scheduled every Monday afternoon (13:30–16:30) from Monday 10 August to Monday 14 December 2026, with no class on public holidays.

MODULE 1: Fundamentals of Remote Sensing

MLO 1: Understand the fundamental principles of remote sensing, Earth observation, and electromagnetic radiation.

MLO 2: Understand the characteristics of satellite sensors, remotely sensed data, and their applications to environmental and sustainability studies.

MLO 3: Be able to access, visualize, and perform basic processing of satellite imagery using modern geospatial platforms, including Google Earth Engine (cloud computing platform) and QGIS.

Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Introduction to Remote Sensing, Earth Observation, and Environmental Applications; Installation of QGIS, Google Earth Engine, and the JRC IMPACT Toolbox	Dr. Uday Pimple (JGSEE, KMUTT)	August 10, 2026
LECTURE 2: Principles of Electromagnetic Radiation, Satellite Sensors, and Image Characteristics	Dr. Uday Pimple (JGSEE, KMUTT)	August 17, 2026
LECTURE 3: Introduction to Google Earth Engine and QGIS for Satellite Data Visualization and Basic Image Processing	Dr. Uday Pimple (JGSEE, KMUTT)	August 24, 2026
Evaluation: Practical Assignments (10% of course grade) **31 August 2026:** Submission of Practical Assignments (10%)		

MODULE 2: Geographic Information Systems (GIS) and Spatial Analysis
MLO 1: Understand the fundamental concepts of Geographic Information Systems (GIS), spatial data models, and coordinate reference systems.
MLO 2: Be able to manage, analyze, and visualize spatial data using GIS techniques for environmental and sustainability applications.
MLO 3: Be able to apply spatial analysis and cartographic principles to produce maps for environmental decision-making.

Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Introduction to Geographic Information Systems (GIS), Environmental Applications, and QGIS	Dr. Asamaporn Sitthi (Srinakharinwirot University)	August 31, 2026
LECTURE 2: Spatial Data and Map Projections (Data Models, Coordinate Reference Systems, and Map Projections)	Dr. Asamaporn Sitthi (Srinakharinwirot University)	September 7, 2026
LECTURE 3: Spatial Data Analysis-I (Spatial Measurements, Attribute and Spatial Queries, Selection Methods, and Geoprocessing Tools)	Dr. Asamaporn Sitthi (Srinakharinwirot University)	September 14, 2026

LECTURE 4: Spatial Data Analysis II (Interpolation, Point Pattern Analysis, and Thematic Mapping)	Dr. Asamaporn Sitthi (Srinakharinwirot University)	September 21, 2026
Evaluation: Practical Assignments (20% of course grade) **28 September 2026:** Submission of Practical Assignments (20%)		

MODULE 3: Satellite Image Processing and Analysis **MLO 1:** Understand the principles of digital image processing, spectral characteristics, and feature extraction from satellite imagery. **MLO 2:** Be able to process and classify satellite imagery using image classification techniques for environmental and sustainability applications. **MLO 3:** Be able to interpret satellite image classification results and apply time-series analysis and change detection for environmental monitoring.		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Basics of Image Processing: Spectral Indices and Feature Extraction	Dr. Uday Pimple (JGSEE, KMUTT)	September 28, 2026
LECTURE 2: Image Classification I: Unsupervised Classification and Introduction to Supervised Classification	Dr. Uday Pimple (JGSEE, KMUTT)	October 5, 2026
LECTURE 3: Image Classification II: Supervised Classification, Training and Validation of Classifiers	Dr. Uday Pimple (JGSEE, KMUTT)	October 12, 2026
LECTURE 4: Introduction to Time-Series Analysis and Change Detection	Dr. Uday Pimple (JGSEE, KMUTT)	October 19, 2026
Evaluation: Practical Assignments (10% of course grade) **26 October 2026:** Submission of Practical Assignments (10%) **19 October 2026:** Mid-term written examination followed by a short practical assessment (30%)		

MODULE 4: Environmental Applications and Integrated Geospatial Project

MLO 1: Understand the integration of remote sensing, GIS, and field observations for environmental monitoring and sustainability assessment.
MLO 2: Be able to design and implement a geospatial workflow using GIS and remote sensing techniques to address environmental problems.
MLO 3: Be able to communicate geospatial analysis results effectively through maps, reports, and oral presentations.

Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Field Survey Techniques, GPS Data Collection, and Ground Truthing	Dr. Uday Pimple (JGSEE, KMUTT) Dr. Asamaporn Sitthi (Srinakharinwirot University)	October 26, 2026
LECTURE 2: Introduction to JRC IMPACT Toolbox and Environmental Applications of GIS and Remote Sensing	Mr. Dario Simonetti Joint Research Center, European Commission, Italy (online) Dr. Uday Pimple (JGSEE, KMUTT)	November 2, 2026
LECTURE 4: • Satellite-Based Atmospheric Composition Monitoring and Climate Applications • Earth Observation for Environmental Decision Support	Dr. Agapol Junpen (JGSEE, KMUTT)	November 9, 2026
LECTURE 5: • Multi-Satellite Earth Observation for Wildfire Monitoring • Multi-Satellite Fire Observation Systems • Satellite-Based Biomass Burning Emission Estimation	Dr. Agapol Junpen (JGSEE, KMUTT)	November 16, 2026
LECTURE 3: Integration of Geospatial Information and Project Consultation	Dr. Savitri Garivait Dr. Uday Pimple Dr. Agapol Junpen Dr. Asamaporn Sitthi	November 23, 2026

Independent Mini Project (No formal lectures)		23 November-07 December 2026
LECTURE 6: Student Project Presentations and Discussion	Dr. Savitri Garivait Dr. Uday Pimple Dr. Agapol Junpen Dr. Asamaporn Sitthi	December 14, 2026
Evaluation: Individual Geospatial Mini-Project: 30% of course grade **December 14, 2026:** Submission of final mini project report and oral presentation (30%)		

8. Evaluation Methods

Module 1: Assessment of Practical Assignments: **10% of course grade**
31 August 2026: Submission of practical assignments (10%)

Module 2: Assessment of Practical Assignments: **20% of course grade**
28 September 2026: Submission of practical assignments (20%)

Module 3: 19 October 2026: Mid-term written examination followed by a short practical assessment (30%)
26 October 2026: Submission of Practical Assignments (10%)

Module 4: Assessment of Individual Geospatial Mini Project: **30% of course grade**
14 December 2026: Submission of final mini project report and oral presentation (30%)

9. Guided References/Resources

Core Textbooks

1. Bolstad, P. (2022). GIS Fundamentals: A First Text on Geographic Information Systems (7th ed.). Eider Press.
2. Campbell, J. B., & Wynne, R. H. (2011). Introduction to Remote Sensing (5th ed.). Guilford Press.
3. Jensen, J. R. (2015). Introductory Digital Image Processing: A Remote Sensing Perspective (4th ed.). Pearson Education.
4. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). Remote Sensing and Image Interpretation (7th ed.). John Wiley & Sons.
5. Richards, J. A. (2013). Remote Sensing Digital Image Analysis: An Introduction (5th ed.). Springer.
6. Cardille, J. A., Crowley, M. A., Saah, D., & Clinton, N. E. (Eds.). (2023). Cloud-Based Remote Sensing with Google Earth Engine: Fundamentals and Applications. Springer.

Software and Online Resources

7. QGIS Development Team. QGIS Geographic Information System: Official Documentation. https://docs.qgis.org/3.44/en/docs/user_manual/index.html
8. Google Earth Engine Developers. Google Earth Engine Documentation and Tutorials. https://developers.google.com/earth-engine

9. European Commission, Joint Research Centre (JRC). IMPACT: Portable GIS Toolbox for Image Processing and Land Cover Mapping. Simonetti, D., Marelli, A., & Eva, H. (2015). https://forobs.jrc.ec.europa.eu/IMPACT
10. United States Geological Survey (USGS). Landsat Missions Program. https://www.usgs.gov/landsat-missions
11. Copernicus Programme. *Sentinel Missions and Data Access.* https://www.copernicus.eu/en/access-data