Description of “Advanced Satellite Image Analysis”

Information			
Administering Department	**Remote Sensing**	**College**	**Remote Sensing & Geophysics College**
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Module Leader’s Acad. Title	**Professor**		
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Module Aims, Learning Outcomes and Indicative Contents	
Module Aims أ	Setting goals for teaching an Advanced Satellite Image Analysis course to master's students in the Remote Sensing Department involves a structured approach that aligns educational outcomes with the student's needs and the demands of the field. 1. Identify Learning Outcomes Establish clear, measurable learning outcomes reflecting theoretical knowledge and practical skills. These should include: - Understanding Remote Sensing Concepts: Students should grasp fundamental principles of remote sensing, including sensor types, data acquisition methods, and image processing techniques. - Practical Skills in Image Analysis: Students should be able to apply advanced image processing techniques, such as classification and change detection, using software tools commonly used in the industry (e.g., ArcGIS Pro., ENVI). - Application of Machine Learning: Incorporate machine learning methods for analyzing satellite imagery, focusing on both supervised and unsupervised learning techniques. 2. Curriculum Structure Design the course structure to facilitate progressive learning through modules that build upon each other. For example: - Module 1: Introduction to Remote Sensing: Cover basic concepts and tools.

	- Module 2: Advanced Image Processing Techniques: Focus on specific methodologies for image enhancement and feature extraction. - Module 3: Machine Learning Applications: Teach students how to implement ML algorithms for satellite data analysis. - Module 4: Case Studies and Practical Applications: Engage students with real-world projects that require them to apply their knowledge. 3. Assessment Strategies Develop assessment methods that evaluate both theoretical understanding and practical application: - Quizzes and Exams: Assess knowledge of core concepts. - Project Work: Require students to complete a project involving real satellite data analysis, demonstrating their ability to apply learned techniques. - Peer Reviews: Encourage collaborative learning by having students critique each other's work. 4. Integration of Technology Utilize modern tools and platforms for teaching: - Cloud-based Platforms: Implement cloud computing resources for large-scale data analysis, allowing students to work with significant datasets efficiently. - Augmented Reality Tools: Explore innovative teaching methods such as augmented reality to enhance engagement and understanding of complex concepts. 5. Alignment with Industry Needs Ensure that course content reflects current trends and technologies in remote sensing: - Collaborate with industry professionals to keep the curriculum relevant and up-to-date. - Include topics such as environmental monitoring, urban planning applications, and disaster management using satellite imagery. 6. Encourage Interdisciplinary Learning Promote connections between remote sensing and other fields such as environmental science, urban studies, and data science: - Integrate case studies that link satellite imagery analysis with real-world issues such as climate change or urban development [4][8]. - Foster discussions on the ethical implications of remote sensing technologies in society.
Module Learning Outcomes	For an Advanced Satellite Image Analysis Module aimed at master's students in the Remote Sensing Department, the most appropriate Learning Outcomes Module

	should encompass a comprehensive understanding of both theoretical concepts and practical applications. Here's a suggested framework based on current educational practices and trends in the field: Learning Outcomes Module 1. Understanding Remote Sensing Principles Outcome: Students will demonstrate a thorough understanding of remote sensing workflows, including image acquisition, processing, and analysis. Key Topics: Basics of remote sensing technologies and methodologies. Familiarity with satellite data sources, including the European Copernicus program. 2. Advanced Image Processing Techniques Outcome: Students will be able to apply advanced image processing techniques for satellite imagery analysis. Key Topics: Pixel-based image analysis methods such as classification and validation. Techniques for geometric correction, radiometric calibration, and noise reduction. 3. Machine Learning Applications Outcome: Students will utilize machine learning algorithms to enhance image classification and segmentation. Key Topics: Implementation of supervised learning methods (e.g., Support Vector Machines, Neural Networks). Exploration of unsupervised techniques (e.g., clustering algorithms) and their applications in hyperspectral image analysis. 4. Practical Application of Skills Outcome: Students will complete a project that applies learned techniques to real-world satellite data. Key Topics: Case studies involving disaster management, environmental monitoring, or urban planning using satellite imagery. Development of a project proposal that includes data acquisition, processing steps, and expected outcomes. 5. Critical Analysis and Evaluation Outcome: Students will critically evaluate the effectiveness of various image-

	processing techniques in different contexts. Key Topics: Assessment of data quality and accuracy in remote sensing applications. Comparison of traditional methods with modern approaches such as deep learning for satellite image analysis. 6. Ethical Considerations in Remote Sensing Outcome: Students will understand the ethical implications of satellite data usage.

Advanced Satellite Image Analysis Syllabus	
Week 1	**Image Acquisition and Handling** • Data sources and repositories (e.g., Copernicus, Landsat) • Lab 1: Accessing and downloading satellite data
Week 2	**Preprocessing Techniques** • Radiometric and geometric corrections • Lab 2: Applying corrections using software tools (e.g., ENVI, ArcGIS Pro.)
Week 3	**Image Enhancement Techniques** • Techniques for enhancing image quality (contrast stretching, filtering) • Lab 3: Radiometric enhancement exercise
Week 4	**NDVI (Normalized Difference Vegetation Index)** • Calculating agricultural drought involves various factors and indices that consider precipitation, temperature, soil moisture, and vegetation health over a period of time. • Lab 4: NDVI Anomaly calculation.
Week 5	**Thermal-IR Data in Remote Sensing** • Lab5: Computation of Land Surface Temperature Steps
Week 6	**Vegetation Index (Components)** • Lab6: EVI, SAVI, LAI calculation.
Week 7	**Spectral Geology Indices** • Lab7: Clay Minerals Ratio, Ferrous Minerals Ratio, and Iron Oxide Ratio calculation.

Week 8	**Spatial Filtering** • Lab8: Connectivity in Raster Analysis
Week 9	**Kernels and Convolution** • Lab9: Kernels and Convolution in Raster Analysis.
Week 10	**Texture filters** • Lab10: Texture filters in Raster Analysis.
Week 11	**Classification Methods** • Overview of classification algorithms (supervised vs. unsupervised) • Lab 11: Implementing unsupervised classification techniques
Week 12	**Advanced Classification Techniques** • Introduction to machine learning in image classification (e.g., Random Forests, SVM) • Lab 12: Supervised classification exercises
Week 13	**Project Proposal Development** • Guidelines for developing a final project proposal • Lab 13: Workshop on project proposal writing
Week 14	**Project Presentations**
Week 15	**Pre-final exam**

Learning and Teaching Resources		
	Text	**Available in the Library?**
Required Texts	de Jong, Steven M. and Freek D. van der Meer.(2006). Remote Sensing Image Analysis: Including the Spatial Domain (Remote Sensing and Digital Image Processing). Springer Publications.	Yes
Recommended Texts	Campbell, James B. & Randolph H. Wynne. (2011). Introduction to Remote Sensing. The Guilford Press. New York & London. 5th Edition.	No
Websites	https://www.youtube.com/channel/UCOOUW1LA5B93j5V0oNVYN6Q	