	Document Code	RG-712	Written by	Name	Dr. Waqas A. Qazi, Mr. Mirza Muhammad Waqar
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	Title	Advanced Remote Sensing & Digital Image Processing	Reviewed by	Name	
				Date	
	Credit Hours	3-0	Approved by	Name	
				Date	

INSTITUTE OF SPACE TECHNOLOGY

COURSE SYLLABUS

Program: RS & GISc
Department: Space Science (SS)
Course Code: RG-711
Course Name: Advanced Remote Sensing & Digital Image Processing
Credits: CR 3-0
Instructors: Dr. Waqas A. Qazi (WQ), Mr. Mirza M. Waqar (MW)
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Course Description:

This is a graduate-level course on remote sensing data processing. The primary focus of this course is optical and infrared remote sensing datasets. It presents an overview of remote sensing in the optical and infrared regime, image interpretation, major data pre-processing and processing modules, and discusses some specific applications as case studies.

The course lectures will be accompanied by regular lab work, with a lab being held nearly every week along with theory classes. Students are expected to master both theory and lab classes. It is expected that students will develop a quantitative understanding of remote sensing datasets and processing methods.

A course project will let students work on a remote sensing dataset and application of their choice, design the data processing flow according to their requirement and objective, and present their results to the class in the form of a presentation and project report. More details about the project will be provided during the course.

Prerequisites: Basic knowledge of mathematics and physics is required. Knowing basics of programming will help students to gain more from this course. Students who don't have the recommended skills should be prepared to work and study extra.

Reading/Reference Materials:

Recommended Textbooks:

- Lillesand & Kiefer (2007 6th ed. / 2003 5th ed.), Remote Sensing & Image Interpretation
- Gao (2009), Digital Analysis of Remotely Sensed Imagery

Supporting & Reference Books and Readings:

- Gonzalez & Woods (2002 2nd ed. / 2007 3rd ed.), Digital Image Processing
- Mather & Koch (2010, 4th ed.), Computer Processing of Remotely Sensed Images
- Jensen (2004, 3rd ed.), Introductory Digital Image Processing
- Campbell & Wynne (2011, 5th ed.), Introduction to Remote Sensing
- Sabins (2007, 3rd ed.), Remote Sensing
- Lectures
- Relevant papers
- Assigned readings

COURSE PLAN:

Week	Theory	Lab	Resource Persons
1	- Intro to Remote Sensing - Fundamentals of Remote Sensing (Lillesand Ch. 1) - Examples of RS Applications (case studies) - Remote Sensing Satellite Orbits - Resolutions: Spatial, Temporal, Radiometric, Spectral - Remote Sensing Image Storage Formats: BIL, BIP, BSQ - Remote Sensing Platforms: Along-Track, Across-Track - Spectral Signatures: Basis, Two examples (Vegetation, Landcover, etc.) - Visual Interpretation (Lillesand Ch. 2) - Major RS Softwares (Gao Ch. 4)	- Basic RS Software Functions - Deriving Spectral Signatures from Images - Stacking - Subsetting - Band Combinations and Feature Identification	WQ / MW
2	- Geometric errors and rectification (Gao Ch. 5)	- Image rectification	WQ / MW
3	- Orthorectification (Gao Ch. 5) - Use of DEM in orthorectification - Calibration - Atmospheric Correction	- Orthorectification - Calibration - Atmospheric Correction	WQ / MW
4	- Image Enhancement: Histogram Processing - Image Enhancement: Filtering - Image Filtering in the Spatial Domain	- Corresponding lab	WQ / MW

	- Low-pass Filters - High-pass Filters		
5	- Image Filtering in the Frequency Domain - Image Transformations: Log/dB Transformation, Band Ratios, Indices	- Corresponding lab	WQ / MW
6	- Image Transformations: PCA, IHS, MNF, Tesselated-Cap (Kauth-Thomas), Soil Line	- Corresponding lab	WQ / MW
7	***MIDTERM EXAM*** - Basics of Image Classification - Unsupervised Classification	- Unsupervised Classification	WQ / MW
8	- Supervised Classification: - Maximum Likelihood Algorithm - Training Set Selection & Refinement - Classification Step	- Training Set Selection & Refinement	WQ / MW
9	- Supervised Classification (continued): - Validation Set Generation - Post-classification - Accuracy Assessment	- Supervised Classification	WQ / MW
10	- Fuzzy Classifiers - Sub-pixel Classifiers	- Corresponding lab	WQ / MW
11	- Non-parametric Classifiers: - Object-oriented Classification - Neural networks	- Corresponding lab	WQ / MW
12	- Non-parametric Classifiers (continued): - Support Vector Machines - Decision-Trees - Expert Classifiers	- Corresponding lab	WQ / MW
13	- Spatial Analysis: - Texture - Context - Segmentation - Morphology	- Corresponding lab	WQ / MW
14	- Change Detection & Multitemporal Image Analysis (Gao Ch. 13)	- Corresponding lab	
15	- Batch Processing - Time-series Analysis - Extraction of Biophysical/Geophysical Information from Remote Sensing: - Case Study: Above-ground Biomass - Case Study: Phenological Curves	-	WQ / MW
16	- Student Course Project Presentations		
17	**Final Examination**		

TEACHING METHODOLOGY

The course will be taught using lectures, in-class discussions, homework assignments, lab work, and individual research projects.

ASSESMENT:

The general grading distribution is as follows (subject to change):

Assignments	15%
Course Project	15%
Quizzes	10%
Mid-term Exam	25%
Final Exam	35%
Total	100%

General Course Policies:

- Attendance is MANDATORY in both theory and lab classes
- IST follows a strict policy of 80 % overall attendance in the course. Any student below 80 % attendance will not be allowed to sit in the final exam.
- The Course Grading percentage distribution is loosely defined and may be changed by the end of the course. Students will be notified if such changes take place.
- The classroom environment shall preferably be active and open discussions are very much favored, but please try to stick to the topic under discussion.
- In assignments, any/all references must be PROPERLY quoted and cited and this must be STRICTLY followed. Marks will be deducted if this strict rule is not attended to.
- All graded work must be the original effort of the student. Plagiarism (either copying from another student or writing text without proper referencing) will NOT be tolerated. Severe grading loss may result, so please be careful. A quick search on Google will show you what plagiarism is and how to avoid it. It is your responsibility to avoid plagiarism.
- Do NOT take assignment deadlines lightly. If you have a problem, come to the instructor before the deadline, not after it. Deadlines will not be relaxed unless in case of an emergency. Marks will be deducted, as deemed suitable, for late submissions.