Lahore University of Management Sciences

EE568: Remote Sensing of the Environment

Spring 2022

Course Catalog Description
This course will cover the fundamental principles of remote sensing of the environment. Contemporary remote sensing techniques, softwares, and datasets will be discussed. Geographic and hydrometeorologic datasets will be used to study the application of the electromagnetic theory to retrieve information about the Earth's system via satellite constellations. The course is designed to help students develop a broad understanding of the importance of remote sensing in comprehending and monitoring our environment. The remote-sensing skills gained through this course could be easily applied to other fields as well.

Course Details	
Credit Hours	3
Core	-
Elective	Elective
Open for Student Category	Seniors and Graduate Students
Closed for Student Category	-

Course Prerequisite(s)/Co-Requisite(s)
Pre-requisites: Calculus, Numerical methods Co-requisites: Introductory programming skills (in MATLAB or Python) are preferred Note: Students do not need to have any prior knowledge of remote sensing or electromagnetic theory. The lectures will include all the basic information required to understand the important concepts.

Course Offering Details				
Credit Hours	3			
Lecture(s)	No. of Lec(s) Per Week	2	Duration	75 mins
Lab/Tutorial	Total in-class exercises	4	Duration	75 mins

Instructor	Dr. Jawairia Ahmad
Room No.	TBA
Office Hours	TBA
Email	jawairia.ahmad@lums.edu.pk
Secretary/TA	TBA
TA Office Hours	TBA
Course URL (if any)	TBA

Course Learning Outcomes	
EE568	The students should be able to:
CLO1:	Comprehend the fundamentals of remote sensing
CLO2:	Apply electromagnetic radiation principles to retrieve information about the environment
CLO3:	Gather, interpret, and analyze basic hydrometeorological data
CLO4:	Develop scientific conclusions from geographic and meteorological datasets
CLO5:	Select and modify suitable remote-sensing techniques based on the required application

Relation to EE Program Outcomes			
Related PLOs	Levels of Learning	Teaching Methods	CLO Attainment checked in
PL01	Cognitive (comprehension)	Lecture	Homework/Exams
PL02	Cognitive (application)	Lecture	Homework
PL03	Cognitive (analysis)	Lecture/Lab	Lab work
PL07	Cognitive (synthesis)	Lecture	Exam/Project
PL05	Psychomotor (adaption)	Lab	Project

Lahore University of Management Sciences

Grading Breakup and Policy		
Assessment Module	Number	Weightage (%)
Assignment(s)	7	30
Project	1	20
Midterm Examination	1	25
Final Examination	1	25

Course Overview			
Week No.	**Topics covered**	**Book Chapters/ Recommended Reading**	**Related CLOs & Additional Remarks**
1	▪ Remote sensing's role in the 21st century ▪ Introduction to electromagnetic radiations	Chapters 1, 2, and 4	CLO1
2	▪ Principles governing electromagnetic radiations ▪ Angular distribution of radiation ▪ Absorption and scattering by macroscopic particles ▪ Spectral signatures	Chapter 7	
3	**Lab tutorial** Multispectral remote sensing systems ▪ Digital image terminology ▪ Landsat multispectral scanner ▪ Landsat thematic mapper	Chapter 6	CLO2, CLO3
4	Thermal infrared remote sensing ▪ Thermal infrared atmospheric windows ▪ Thermal radiation laws ▪ Environmental considerations	Chapter 7	CLO2, CLO3
5	Active microwave remote sensing ▪ Important system components ▪ Radar backscatter ▪ Synthetic Aperture Radar (SAR)	Chapter 8	CLO2, CLO3
6	**Lab tutorial** Passive microwave remote sensing ▪ Radiometer components ▪ Brightness temperature ▪ Emissivity of surfaces	Chapter 8	CLO2, CLO3
7	LIDAR remote sensing ▪ Important system components ▪ Digital Elevation Model (DEM)	Chapter 9	CLO2, CLO3
8	Gravimetry-based remote sensing ▪ Gravimetric principles of remote sensing ▪ Gravity Recovery and Climate Experiment (GRACE) *Guest lecture on remote sensing applications*	Supplementary material	CLO2, CLO3
9	Mid-term Examination		
10	Remote sensing of vegetation ▪ Spectral characteristics of vegetation ▪ Bidirectional Reflectance Distribution Function (BRDF) ▪ Vegetation indices	Chapter 10	CLO3, CLO4, CLO5
11	Remote sensing of water ▪ Cloud formation ▪ Precipitation development ▪ Spectral characteristics of precipitation	Chapter 11	CLO3, CLO4, CLO5

12	**Lab tutorial** Remote sensing of water ▪ Spectral properties of snow ▪ Biophysical characteristics of surface water ▪ El Nino and La Nina	Chapter 11	CLO3, CLO4, CLO5
13	Remote sensing of water ▪ Dielectric constant- real and imaginary components ▪ Fresnel equations ▪ Soil moisture retrieval using cosmic rays **Lab tutorial**	Chapter 11	CLO3, CLO4, CLO5
14	Remote sensing of landscape ▪ Topography mapping ▪ Slope and azimuth ▪ NASA Shuttle Radar Topography Mission (SRTM) *Guest lecture on remote sensing applications*	Chapter 13	CLO3, CLO4, CLO5
15	Project Presentations		CLO4
16	Final-term Examination		

Textbook(s)/Supplementary Readings
Text book: The textbooks are not mandatory as open source material relevant to the lecture topics will also be shared. In addition, the lectures are designed to be self-sufficient. 1. Jensen, J.R., (2009). Remote sensing of the environment: An earth resource perspective 2/e. Pearson Education. 2. Qihao Weng. (2012). An Introduction to Contemporary Remote Sensing, 1stEd, McGraw-Hill, U. K. 3. Margulis, Steven A. (2017). Introduction to Hydrology. Including a MATLAB-Based Modular Distributed Watershed Educational Toolbox (MOD-WET). Supplementary Reading: Weekly readings will be assigned prior to each lecture

Examination Detail	
Midterm Examination	Yes/No: Yes Combine Separate: N/A Duration: 1 hrs Exam Specifications: N/A
Final Examination	Yes/No: Yes Combine Separate: N/A Duration: 2 hrs Exam Specifications: N/A

Prepared and Revised by:	**Jawairia Ahmad**
Revision Date:	**2nd November 2021**