Course Outline

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NGLC516	Remote Sensing and GIS	3	0	0	3

Course Objective

This course provides fundamentals and working knowledge in the fields of optical, aerial, thermal, and microwave remote sensing, image processing, and GIS.

Learning Outcomes

Upon completion of the course, students will be able to:

- Understand the basic working principles of optical, aerial, thermal, and radar remote sensing.
- Critically assess the strengths and weaknesses of imaging sensors and image data processing techniques for a variety of application scenarios.
- Acquire knowledge and critical thinking skills regarding the use and interpretation of remote sensing data.
- Understand the process of integration of data from various sources into GIS.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	**Introduction to Remote Sensing**: Historical perspectives, basic principles, scope and potential, advantages and limitations, recent developments, applications, active and passive remote sensing.	2	Understand the basic principles of remote sensing and its applications.
2.	**Electromagnetic Radiation:** Basic laws, EM spectrum and their applications, Wave/particle model, Terrain energy-matter interactions, scattering, absorption and reflection of EM radiation, atmospheric windows, sSpectral bands and reflectance curves; interaction of EMR with atmosphere, rocks, minerals and soil, vegetation and water.	5	Understand the basic concept of electromagnetic radiation.
3.	**Sensor systems and platforms:** Sensor systems, platforms, resolutions, orbits and swath characteristics, Earth observation satellites; major satellite remote sensing: LANDSAT, SPOT, Worldview and IRS systems.	5	Learn about sensor systems and data collection
4.	**Introduction to digital image processing**; Digital image, raster and vector data formats, image enhancement, pan sharpening, image filter, image math, image fusion, image classification with examples. Brief introduction to applications in earth science studies.	13	Learn about basics of remotely sensed image data, handling, and processing.
5.	**Aerial Photography:** Aerial photography and properties of aerial photographs; Cameras, Films, Filters, geometry, parallax effect, photogrammetric measurements, Elements of image interpretation; Interpretation of geographical, geomorphological, structural and lithological features from aerial photographs	3	Understand the basic concept of aerial photography and its interpretation.
6.	**Thermal Infrared remote sensing:** Thermal infrared radiation principles, radiant energy flux, Thermal radiation laws, Emissivity, thermal properties of terrain, advantages and limitations.	3	Explain the concept of thermal remote sensing, advantages and limitations.
7.	**Active microwave (RADAR) remote sensing:** RADAR system components, image geometry, nomenclature, resolution, polarization, relief, surface roughness and electrical characteristics, RAR/SAR systems, advantages and limitations.	3	Understand microwave remote sensing and its applications.
8.	**Introduction to Geographic Information System (GIS):** Introduction and definitions, components of GIS, coordinate systems (geographic and projected), map projections, types, datum, basics of GPS.	4	Acquire working knowledge of GIS, its applications, advantages and limitations.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
9.	**Remote Sensing and GIS Data processing:** Digitization and map composition, database, basic data processing, overlay, query building, spatial operations, map integration; joining spatial and attribute data, steps in a GIS project: objectives, database, integration, analysis, report generation. Capabilities and developments in GIS. Introduction to commonly used GIS software. Application of artificial intelligence (AI) and machine learning (ML).	4	Acquire knowledge and critical thinking skills to solve a real-world problems.
	Total Classes	42	

Text Books:

1. Jensen, J. R. (2013). Remote Sensing of the Environment: Pearson New International Edition: An Earth Resource Perspective. United Kingdom: Pearson Education Limited.

Reference Books:

2. Jensen, J. R. (2016). Introductory Digital Image Processing: A Remote Sensing Perspective. United Kingdom: Pearson Education, Incorporated.
3. Koch, M., Mather, P. M. (2011). Computer Processing of Remotely-Sensed Images: An Introduction. Germany: Wiley.
4. Lillesand, T., Chipman, J., Kiefer, R. W. (2015). Remote Sensing and Image Interpretation. United Kingdom: Wiley.
5. Wynne, R. H., Campbell, J. B. (2011). Introduction to Remote Sensing, Fifth Edition. Ukraine: Guilford Publications.
6. McDonnell, R. A., McDonnell, R., Lloyd, C. D., Burrough, P. A. (2015). Principles of Geographical Information Systems. United Kingdom: OUP Oxford.
7. Richards, J. A. (2013). Remote Sensing Digital Image Analysis: An Introduction. Germany: Springer Berlin Heidelberg.
8. Gupta, R. P. (2013). Remote Sensing Geology. Germany: Springer Berlin Heidelberg.
9. Drury, S. A., Drury, S. A. (2001). Image Interpretation in Geology. Ireland: Nelson Thornes.
10. Sabins, F.F. (2007), Remote Sensing: Principles and Applications, Third Edition, Waveland Press.
11. Liu, J.G., and Mason, P. (2013), Essential Image Processing and GIS for Remote Sensing, John Wiley & Sons.
12. Campbell, lB. and Wynne, RH. (2011), Introduction to Remote Sensing, Guilford Press.