Course Outline

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NGLD507	Image Processingand Data Analysis	3	0	0	3

Course Objective
The primary objective of the course is to provide knowledge about basic principles and fundamental aspects of digital image processing and its applications, especially in geosciences.
Learning Outcomes
Upon completion of the course, students will be able to understand: • Basic principles of digital image processing • Understand and implement basic image processing algorithms • Apply advanced image processing algorithms and classification techniques • Understand and apply georeferencing to remotely sensed images • Practical applications of image processing

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Digital image, human perception of color, image display, lookup tables, resampling, data formats, pseudo color, and color composites.	4	Understand fundamental aspects related to images
2.	Image analysis and interpretation, software formats, raster and vector, color space, band ratios, image sharpening, principal components, image stretching, and transformation.	6	Learn various aspects of image analysis and commonly used techniques
3.	Image enhancement techniques, histograms & stretching, image math, masking, mosaicking, spatial and spectral subsets, rotate/flip data, pre-processing & calibration, image normalization, gain and offset, destriping, and indexes.	6	Know basic image processing tasks
4.	Image convolution, kernels, and image filters, Fourier filtering, morphological filters, texture filters, and user-defined filter kernels.	6	Understand and implement filters to solve complex problems
5.	Image fusion techniques. Spectral libraries, usage, and interpretation. Spectral analysis tools, endmember spectra, spectral unmixing.	4	Basic knowledge of merging datasets and extraction of information.
6.	Image classification, class statistics, supervised and unsupervised classifications, post-classification tools, confusion matrix, and accuracy assessment. Application of artificial intelligence (AI) and machine learning (ML).	6	Classify images and assessment of accuracy of classes
7.	Lidar data sampling, cloud points processing and analysis, 2D and 3d modeling using LIDAR scanner and GPS.	2	Processing and applications using lidar systems
8.	Georeferencing and map projections, registration & rectification, ground control points, ortho-rectification, warping. Best practices in map projection, convert map projection, convert coordinates among projections.	6	Correctly apply, assign or transform georeferencing to remote sensing images.
9.	Near real-time Direct Satellite Broadcast System and near-realtime data processing to derive major parameters related to earth's atmosphere, land, ocean, and biosphere.	2	Automated and near-realtime processing of images captured by satellite systems
	Total Classes	**42**	

Text Books:

1. R. C. Gonzalez, *Digital Image Processing*. Pearson Education, 2009 (or latest 4th edition).

Reference Books:

1. J. C. Russ, *The Image Processing Handbook*. CRC Press, 2006.
2. S. E. Umbaugh, *Digital Image Processing and Analysis: Applications with MATLAB and CVIPtools*. CRC Press, 2017.
3. J. M. Kinser, *Image Operators: Image Processing in Python*. CRC Press, 2018.
4. M. Wang and C. H. Lai, *A Concise Introduction to Image Processing using C++*. CRC Press, 2016.