Course title: Digital Image Processing and Information Extraction

Course code: NRG 172	**No. of credits:** 4	**L-T-P:** 30-10-32	**Learning hours:** 56

Pre-requisite course code and title (if any): NRG 178 Principles of remote sensing

Department: Natural Resources

Course coordinator: Dr Chander Kumar Singh	**Course instructor:** Dr Chander Kumar Singh

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Course type: Core	**Course offered in:** Semester 2

Course Description

This course will introduce fundamental technologies for digital image, compression, analysis, and processing. Students will gain understanding of algorithm, analytical tools, and practical Implementations of various digital image applications.

Course objectives

1. Fundamental technologies for digital image, compression, analysis, and processing
2. Gain understanding of algorithm, analytical tools, and practical implementations of various digital image applications

Course content

Module	Topic	L	T	P
1.	Introduction to Digital Image Processing & Information Extraction	2		
2.	Digital Data Formats; Image data storage and retrieval; Concepts about digital image and its characteristics, Spectral, Spatial, Radiometric and Temporal resolution,	2		
3.	Types of image displays, Colour port and spectral band, B/W image, Grey Image, True/Pseudo Image and Standard FCC.	2		
4.	Radiometric and Geometric correction technique, Atmospheric correction	2	2	
5.	Interpolation methods – linear and nor linear transformation for geometric corrections. Spatial and Spectral interpolation	2		
6.	Look-up Tables (LUT) and Image display, Radiometric enhancement techniques, Spatial profile and Spectral profile, Spatial enhancement techniques,	2	2	
7.	Contrast stretching: Linear and non-linear methods.	2	2	
8.	Low pass filtering: Image smoothing, High pass filtering: Edge enhancement and Edge detection, Gradient filters, Directional and non-directional filtering.	4		
9.	Band ratio, NDVI, NDBI, VCI, EVI, SAVI, NDSI etc, TCA	2		
10.	Principal component analyses; Texture analysis	2	2	
11.	Concept of pattern recognition, Multi-spectral pattern recognition; Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers	2		
12.	Unsupervised classification methods, Supervised classification techniques, Limitations of standard classifiers	2		
13.	Artificial intelligence, Fuzzy logic, Neural networks, Expert systems	2		
14.	Accuracy Assessment: User and Producer accuracy, Kappa accuracy.	2	2	

	List of Experiment			
	Lab 1. Study of the various contrast enhancement techniques			2
	Lab 2. Haze and Noise reduction			2
	Lab 3. Stacking, Mosaic and Subset of imagery, geometric and radiometric correction			4
	Lab 4. Perform the various band ratio calculation			2
	Lab 5. Low Pass Filter: Compression of the high frequency component and enhancement of the low frequency component			2
	Lab 6. High Pass Filter: Compression of the low frequency component and enhancement of the high frequency component			2
	Lab 7. Data compression techniques			1
	Lab 8. Resolution merging			1
	Lab 9. Supervised classification			3
	Lab 10. Unsupervised classification			3
	Lab 11 Knowledge base classification			6
	Lab 12. Accuracy Assessment			3
	Lab 13. Visualisation and presentation			1
	Total Hours	**30**	**10**	**32**

Evaluation criteria

- Test 1: 10% (Learning outcomes 1) [Module no.s 1, 2, 3, 4] ___% [End of 4th week]
- Test 2: 10% (Learning outcomes 1) [Module no.s 5, 6, 7, 8, 9]___% [End of 10th week]
- Test 3: 40% (Learning outcomes 1 and 2) [Module no.s 10, 11, 12, 13, 14] ___% [End of 16th week]
- Practical: 40% (Learning outcomes 1 and 2) [End of 16th week]

Learning outcomes

1. Gain knowledge and practical experience in digital image processing [Module 1-7]
2. Learn practical skills and analytical background for information extraction from digital data and its application [Module 8-14]

Pedagogical approach

The course will be delivered through class lectures, lab exercise and tutorials.

Materials

Required text

[All Modules]

1. Jensen J.R. (2016) Introductory Digital Image Processing: Remote Sensing Perspective New Jersey, Prentice Hall.

[All Modules]

2. Umbaugh S.E. (2005) Computer Imaging: Digital Image Analysis and Processing.

[All Modules]

3. Schowengerdt R.A. (2007) Remote Sensing: Models and Methods for Image Processing, Academic Press, Elsevier

Suggested readings

1. Bart M.R. (2003) Front-End Vision and Multi-Scale Image Analysis.
2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
3. Lillesand T.M. Kiefer R.W. and Chipman J.W. (2003) Remote Sensing and Image Interpretation, 5th ed., Wiley.
4. William K.P. (1978) Digital Image Processing.

Case studies
Websites
Journals

1. International Journal of Applied Earth Observation and Geoinformation
2. ISPRS Journal of Photogrammetry and Remote Sensing
3. Remote Sensing of Environment

Additional information (if any)
Magazines

1. Coordinates
2. GIS World
3. GIS@development
4. Geospatial today

Student responsibilities
Attendance, feedback, discipline, guest lecture etc

Course Reviewer:

- Prof. Javed Mallick, King Khalid University, Saudi Arabia
- Prof. Saumitra Mukherjee, Jawaharlal Nehru University