

SEE4215: REMOTE SENSING AND DIGITAL IMAGE PROCESSING

Effective Term

Semester A 2024/25

Part I Course Overview

Course Title

Remote Sensing and Digital Image Processing

Subject Code

SEE - School of Energy and Environment

Course Number

4215

Academic Unit

School of Energy and Environment (E2)

College/School

School of Energy and Environment (E2)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

SEE3201 Atmospheric Science – An Introductory Survey

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

Human beings perceive most of the information about their environment through their visual sense. Visual observation also plays a vital role in many aspects of science. To process photographic images, spectral images, videos and even 3-D visualizations, modern technology offers a range of multimedia soft- and hardware with applications in science and industry.

This course aims to lay down the basic knowledge of techniques used to acquire, process, analyze, and understand complex, high-dimensional data from the environment for scientific and technical exploration. This course provides the students with insights in spectral imaging systems, i.e. measurement systems that use two or more dimensions and different wavelengths (e.g. besides colour cameras also satellite measurements, radar instruments, etc.), and enables the student to process this kind of data sets to retrieve information for practical applications (e.g. tracking clouds in a satellite image sequence).

This course also aims at promoting students' skills in team work and project management through hands-on experience in a small group environment.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Design, set up and perform measurements using spectral imaging instruments	35		x	
2	Apply computational methods for analyzing digital imaging data	45		x	
3	Demonstrate and apply the acquired knowledge of digital image processing in a group environment to solve engineering problems in a team effort	20		x	x

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

LTAs		Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Explain key concepts, such as theories related to remote sensing and digital image processing system	1, 2	2
2	Tutorials	Students solidify their concepts through practice and tutorials.	1, 2	0.5

3	Mini-Project related activities	The mini-project involves a small programming task, such as programming robots, that students can collaboratively solve in small teams consisting of 2-5 students.	3	0.5
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Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Project related tasks to enhance students' understanding and more	1, 2, 3	30	
2	Tutorial questions to stimulate classroom discussion and offers students the opportunities to take a more active role in learning	1, 2, 3	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs

Percentage of continuous assessment, examination, etc.: 50% by continuous assessment; 50% by exam

To pass a course, a student must do ALL of the following:

- 1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
- 2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and
- 3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)**Assessment Task**

1. Project related tasks

Criterion

Ability to analyse questions related to programming robots

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

2. Tutorial questions

Criterion

Ability to evaluate and analyse questions related to remote sensing and digital image processing system

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

3. Examination

Criterion

Ability to evaluate and analyse questions related to remote sensing and digital image processing system

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Imaging systems
 - Comparison of human vision and machine vision
 - Component of a imaging system (radiation source, camera, sensor, processing unit, actors)
 - Multispectral and hyperspectral imaging
- Digital processing of multidimensional images
 - Image representation and filtering
 - Pixel processing and interpolation
 - Edge detection and pattern recognition
 - Motion detection and object tracking
 - Segmentation and classification
- Applications in Environmental Sciences
 - Satellite data processing
 - Radar and Lidar systems and other atmospheric monitoring instruments using imaging techniques
 - Flow measurements and particle tracking
 - Tracking clouds, dust, emission plumes, storms etc. in satellite or radar images
 - Analyzing oceanic air bubbles
 - Analysing air-sea interaction with thermography
 - Fluorescence imaging
 - Multicolor classification of astronomical objects

Reading List

Compulsory Readings

Title	
1	Digital Image Processing, B Jaehne, Springer, 5th edition, 2002

Additional Readings

Title	
1	Computer Vision and Applications: a Guide for Students and Practitioners, B Jähne and H Haußäcker Academic Press, London, 2000.