SEE4215: REMOTE SENSING AND DIGITAL IMAGE PROCESSING

Effective Term
Semester A 2022/23

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	Use computational methods for analyzing digital imaging data	45		x	
3	Apply their 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.

Teaching and Learning Activities (TLAs)

	TLAs	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	Solidify students' concepts with practice	1, 2	0.5

3	Mini-Project related activities	The mini-project will be a small programming project (e.g. programming robots) which the students can solve in a team effort (small groups with 2-5 students).	3	0.5

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Project related tasks	1, 2, 3	30	
2	Tutorial questions	1, 2, 3	20	

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs
Percentage of coursework, examination, etc.: 50% by coursework; 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 coursework (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.