GE1338: IMAGING STRATEGIES IN SCIENCE AND TECHNOLOGY

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Imaging Strategies in Science and Technology

Subject Code
GE - Gateway Education
Course Number
1338

Academic Unit
Materials Science and Engineering (MSE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
A1, A2 - Associate Degree
B1, B2, B3, B4 - Bachelor's Degree

GE Area (Primary)
Area 3 - Science and Technology

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The student will explore the basics and fundamentals of image formation and how science and technology is used to expand the way we study and interpret the world around us. The course first addresses the nature of light and image formation which is followed by an exploration on innovative strategies using other forms of energy – from sound used to form the sonogram of an unborn baby to the energetic gravitational waves originating from the collision of distant black holes sending ripples through space-time across the universe. The basic features of image formation and interpretation will be discussed as powerful motivators for student innovation; this will include selected examples of applications in materials science, physics, biology, and generative AI. The student will discover ways in which images shape our understanding of the universe from the nanoworld to the cosmos.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe and explain the physical principles involved in image formation and scientific visualization		x	x	
2	Identify the principal processes necessary for image formation, perception, and interpretation		x	x	
3	Discover ways in which images shape our life and provide innovative assessments on how to use, or modify, the way we see/explore our world in scientific and technological contexts		x		x
4	Demonstrate the capacity for critical self-directed learning on topics related to imaging and visualization in science and technology				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 and theories.	1, 2, 3, 4	2
2	Tutorials	Provide additional explanations and examples. Provide guidance for the project	1, 2, 3, 4	1

3	Project	Practice the ability to engage in long term self-directed learning, demonstrate and communicate the results of critical thinking, and teamwork	1, 2, 3, 4	3 hrs/week for 3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes	1, 2	30	Demonstrate basic scientific knowledge related to seeing including understanding of image formation, scientific visualization, and interpretation
2	Report assignment	3, 4	20	Assess the ability for critical reading and informed appreciation of scientific imaging and technical visualization
3	Project++	1, 2, 3, 4	50	Demonstrate capacity for (1) self-directed learning, (2) produce structured and fluent text, and (3) presentation skills in public

Continuous Assessment (%)

100

Examination (%)

0

Assessment Rubrics (AR)

Assessment Task

Quizzes

Criterion

The student can thoroughly identify and explain main theories and ideas associated with scientific imaging and visualization

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)
Not reaching marginal level

Assessment Task
Report assignment

Criterion
Ability to sustain an informed discussion, demonstrate critical thinking skills to defend and present own ideas and position

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
Project

Criterion
Capacity for self-directed learning and ability to explain key findings, theories, and concepts related to the subject of study

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

- Waves and particles from classical and modern physics perspective
- Properties of light: superposition, polarization diffraction, and interference
- Principles of image formation, optical instrumentation, imaging in science.
- Optical illusions, visual perception, visual effects
- Seeing or perceiving? Basic use of images, symmetry, and perspective in mathematics, art, creative media, biology, or other sciences.

Reading List

Compulsory Readings

	Title
1	Graham Saxby. "The science of imaging: an introduction" 2nd Ed. Bristol; Philadelphia : Institute of Physics Pub., c2011.

Additional Readings

	Title
1	Hoffman, Donald D., "Visual intelligence: how we create what we see" New York : W.W. Norton, c1998.
2	Zenon W Pylyshyn "Seeing and visualizing: it's not what you think", Cambridge, Mass. MIT Press, c2003
3	Michael F. Land and Dan-Eric Nilsson, "Animal eyes" Oxford ; New York : Oxford University Press, 2012. 2nd ed.
4	Edwin Abbott, "Flatland: a romance of many dimensions" Oxford; New York: Oxford University Press, 2006.
5	Felipe Cucker, "Manifold mirrors : the crossing paths of the arts and mathematics" Cambridge University Press, 2013.

Annex (for GE courses only)

A. Please specify the Gateway Education Programme Intended Learning Outcomes (PILOs) that the course is aligned to and relate them to the CILOs stated in Part II, Section 2 of this form:

Please indicate which CILO(s) is/are related to this PILO, if any (can be more than one CILOs in each PILO)

PILO 1: Demonstrate the capacity for self-directed learning

1, 2, 3, 4

PILO 2: Explain the basic methodologies and techniques of inquiry of the arts and humanities, social sciences, business, and science and technology

1, 2, 3

PILO 3: Demonstrate critical thinking skills

4

PILO 4: Interpret information and numerical data

1, 2, 3, 4

PILO 7: Demonstrate an ability to work effectively in a team

1, 2, 3, 4

PILO 10: Demonstrate the attitude and/or ability to accomplish discovery and/or innovation

4

B. Please select an assessment task for collecting evidence of student achievement for quality assurance purposes. Please retain at least one sample of student achievement across a period of three years.

Selected Assessment Task

Project (pdf of group presentation) - Related CILO(s): 1, 2, 3, 4

Related GE PILO(s): 1, 2, 3, 4, 7, 10