GE1349: MANIFOLD MIRRORS: THE CROSSING PATHS OF THE ARTS AND MATHEMATICS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Manifold Mirrors: The Crossing Paths of the Arts and Mathematics

Subject Code
GE - Gateway Education
Course Number
1349

Academic Unit
Mathematics (MA)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
3

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

GE Area (Primary)
Area 3 - Science and Technology

GE Area (Secondary)
Area 1 - Arts and Humanities

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses

MA1005

Part II Course Details

Abstract

This course recounts some relationships between art and mathematics. These relationships arise from the fact that many works of art, whether visual, musical or literary, are created subject to a set of constraints and that in many cases these constraints have a mathematical form. In the course we additionally limit our considerations to geometric constraints. We informally describe the development of geometry and the ways the different stages in this development materialize in various art forms both in Asian and Western art.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Formulate basic mathematical concepts which occur in artistic creation	20	x	x	x
2	Identify the presence of mathematical structure in diverse art forms	40	x	x	
3	Develop a personal view on how geometry evolved and how it influenced, and was influenced by, the history of art	40	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	Lecture and discussion	Appetizers (brief analysis of selected art pieces). Basics on Geometry. Motions of the plane.	1, 3	6 hrs (week #1, 2)
2	Lecture and discussion	Symmetries of planar objects.	1, 3	4 hrs (week #3, 4)
3	Lecture and discussion symmetry.	Examples of various art pieces with perfect symmetry.	2	2 hrs (week #4)
4	Lecture and discussion	Aesthetic and psychological issues related to symmetry.	3	3 hrs (week #5)

5	Lecture and discussion	Examples of various art pieces with imperfect symmetry.	2	3 hrs (week #6)
6	Lecture and discussion	Similarities and affinities. Affine geometry. Conics and Baroque art.	1, 2, 3	3 hrs (week #7)
7	Lecture and discussion	Elements of music. The Musical Offering of J.S. Bach. Symmetry and repetition in music.	2, 3	3 hrs (week #8)
8	Lecture and discussion	Perspective and projective geometry	1, 2, 3	4 hrs (week #9,10)
9	Lecture and discussion	Drawing systems.	2, 3	5 hrs (week #10,11)
10	Lecture and discussion	The vicissitudes of perspective.	1, 2, 3	4 hrs (week #12, 13)
11	Lecture and discussion	Rules and constraints in artistic creation.	3	2 hrs (week #13)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Three tests distributed along the 13 weeks.	1, 2, 3	70	
2	Group project with presentation	1, 2, 3	30	

Continuous Assessment (%)

100

Examination (%)

0

Assessment Rubrics (AR)

Assessment Task

1. Tests

Criterion

Capacity to show an understanding of the major concepts in the course

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. Group Project and Presentation

Criterion
Ability to discover in existing art pieces several forms of mathematical structure

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
Elements of Geometry, motions of the plane, symmetry (mathematical and perceptual features, aesthetic considerations), affinities of the plane, conics, mathematical structure in musical composition, perspective and projective geometry.

Reading List

Compulsory Readings

	Title
1	Manifold Mirrors: The Crossing Paths of the Arts and Mathematics. Felipe Cucker. Cambridge Univ. Press, 2013.

Additional Readings

	Title
1	Math and Art: An Introduction to Visual Mathematics. Sasho Kalajdzievski. Chapman and Hall, 2008.
2	The Visual Mind: Art and Mathematics. Vols 1 and 2. Michele Emmer (Ed.), MIT Press, 1993 and 2005.

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
2, 3

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

3

PILO 3: Demonstrate critical thinking skills

1, 2, 3

PILO 4: Interpret information and numerical data

2

PILO 5: Produce structured, well-organised and fluent text

1, 2, 3

PILO 6: Demonstrate effective oral communication skills

1, 3

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

1, 2

PILO 8: Recognise important characteristics of their own culture(s) and at least one other culture, and their impact on global issues

2, 3

PILO 9: Value ethical and socially responsible actions

3

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

1, 2, 3

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

Nil