

**Florida International University**  
**Department of Mathematics & Statistics**  
**IDS 4174 Mathematics and Philosophy in Arts**

**Contact Information**

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**Catalog Description**

The course is presenting a panorama and a study of the global interrelation of mathematics, philosophy, and visual arts with emphasis on the evolution of the role of geometry in depicting the perspective.

**Course Objectives (students' learning outcomes)**

- Global Awareness

The students will be able to recognize the use of perspective in the visual arts; they will be able to identify the influence of different cultures and philosophical systems in creating a piece of art;

- Global Perspective

The students will be able to analyze a piece of art from multiple viewpoints including geometry (the role of the perspective, shapes, forms, numbers), philosophy (interrelation and influence of different philosophical systems in creating the piece of art), theory of Art, psychology (how do we see the piece as beautiful, how do we decide what is beautiful);

- Global Engagement

The students will demonstrate a willingness to engage, in teams or alone, in discussing, analyzing, and assessing a piece of visual art; they will be able to demonstrate abilities to create a piece of visual art by choosing the composition based on philosophical background, and by using basic techniques of perspective, ways of expressing shapes and forms.

**Course Description**

The modern world is a conglomerate of many different societies which, although geographically remote, have lives related in a variety of ways. This interrelation has become so intense, the influence so strong, that we observe today how the world is gradually developing into one global society. The culture as an aspect of a society's life is most mobile, transcends boundaries the easiest, and influences other societies most aggressively. Art, sciences, and philosophy, having

developed within a society, interact on a regional and global levels, and, undergoing changes, coexist more or less peacefully, forming unique and rich mixtures. These developments and interactions are in the focus of this course's attention.

More specifically, the course begins with a panorama of the European tradition in theory of art, philosophy of beauty, and how mathematics (via numbers and figures) was used in attempt to explain the latter. We thoroughly discuss the interaction Geometry - Visual Arts during the Renaissance with emphasis on the linear perspective as a means to depict the real world, and how this influenced back the development of Geometry leading to the discovery of new areas in it. We point out limitations in the use of linear perspective, and cover a wide range of topics related to other types of perspective. The role of (some) numbers since ancient till modern times in explaining the beauty is discussed as well. The course continues studying the development of perspective in visual arts of the modern times following the interaction between the Eastern (India, China, Japan) and Western Philosophies. A special attention in the course is paid to the fractals: their importance in mathematics and psychology, and use in computer graphic and design. The course concludes with an overview of the modern art theories and the aesthetics of the 20<sup>th</sup> Century.

### **Learning Strategies**

The content of the course allows different approaches in the teaching/learning process. The purely mathematical component (Euclidean geometry, elementary Number Theory, and related topics), as well as the Philosophical, components of the course are planned to follow the classical in-class lecturing format. The component of application of geometry and philosophy to realistically depicting and expressing objects on a drawing or a painting allows, and suggests, active discussion in the class: stating and defending points of view on the part of the students. The Philosophy component of the course will serve not only to understand the way the art is used by different cultures, but also to resolve emotional, and aesthetic "clashes" in the different depictions of the reality in visual arts. The evolution in understanding the reality through arts in modern times will be taught with the help of in-class discussions as well.

The teaching approaches and the discussions will be geared also toward helping the students choose topics for their projects for the class. Ideally, as a result of the learning process, the students have to be having the taste for, and to be able to actively choose these topics.

### **Students Background for the course (prerequisites, co-requisites)**

No formal prerequisites or co-requisites are imposed for this course. It is designed for students with little or no systematic knowledge in geometry, arithmetic, and philosophy. Most of the material included is accessible for students with elementary geometric intuition at Middle and High School level (points, lines, polygons, circles, straight edge, and compass). Some general acquaintance with (Greek) Philosophy, Architecture, and Visual Arts could be beneficial, but is not necessary either: the needed facts and concepts are introduced in the course of the lectures/seminar discussions.

## Justification of the course as a Global learning course

The gradual transformation of the world into a global one requires new approaches in dealing with problems arising along the way. Finding diplomatic solutions to those comes to replace the old-fashioned using military force approach. This is why understanding, respecting, and using the cultural background of the peoples in the world in solving political problems become the basis of the modern relationship between those peoples. Science, Philosophy, and Arts are fundamental aspects of the cultural background: the influences each one has on the rest shapes that background both mono- and poly-culturally. The purpose of the course is to give a broad panoramic view toward the interrelation of these aspects of culture, and to initiate and foster critical thinking about and understanding thereof. The emphasis will be put in this on the role of mathematics and philosophy in shaping the ways of depicting the physical reality, and expressing authors thoughts in visual arts. The goal is - through particular examples from the visual arts, math, and philosophy - to teach the students how to perceive, appreciate, and accept cultural differences, and as a result – how to make effective bridges between such differences.

## Readings (some of it)

- 1) D. Pedoe, *Geometry and the Liberal Arts*
- 2) E. Burger, M. Starbird, *The Heart of Mathematics*
- 3) K. Clark, *Civilization: a personal view*
- 4) H. Janson, *History of Art* (two volumes)
- 5) M. Frantz and A. Crannell, *Viewpoints: Mathematical Perspective and Fractal Geometry in Art*

## Assessing Students' Knowledge (Grading Policy)

The participants in the course will complete (up to three, depending on how fast the course goes) projects on different aspects of the interrelation of mathematics, philosophy, and visual arts. The students will be encouraged to do that working in groups showing this way willingness and ability to discuss, analyze, and explain what their thoughts are in diverse groups. Enough variety of possible projects will be offered during the course, but the students will be encouraged to choose topics on their own (these have to be approved by the Instructor as well).

The overall grade will be decided on the quality and the strength of the defense of the projects, as well as on the participation of the students in the in-class discussions on the topics covered in the course. Special lecture periods will be devoted to the project defenses. In them, the students will be allowed to actively discuss the presentations by asking the defenders questions on the presented works. Peer assessment will be a part of the whole assessment process. For this, the students will be asked to fill out the assessment rubrics for the corresponding presentations.

## Academic Misconduct

All students in this class are expected to abide by the university's Code of Academic Integrity, which states:

Florida International University is a community dedicated to generating and imparting knowledge through excellent teaching and research, the rigorous and respectful exchange of ideas, and community service. All students should respect the right of others to have an equitable opportunity to learn and honestly to demonstrate the quality of their learning. Therefore, all students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of Florida International University.

As a student of this university:

- I will be honest in my academic endeavors.
- I will not represent someone else's work as my own.
- I will not cheat, nor will I aid in another's cheating

All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

## Topics to be covered in the course

The topics listed below differ by size and content, based on which a variety of different organizations of the course are possible.

1) The School of Pythagoreans and the role of numbers and geometric figures in the philosophy of ancient Greece. The concept of beautiful based on that. About "the gems in Mathematics": the golden ratio.

2) Plato on Beauty, the Theory of Forms.

3) The Mimetic Theory and the Formalism in the Art (Aristotle and later). Parallel development of Mathematics influencing and influenced by those theories: the axiomatic method in Mathematics (Euclid, Archimedes).

4) The metaphysical aspect of the Platonic solids. Semi-regular solids of Archimedes.

5) The Roman Era. The Ten Books of Architecture by Vitruvius, and the role of Geometry in it.

6) The theory of perspective in the visual arts; projections in the space; the projective plane. Vanishing points and view points in one, two, and three point perspective.

7) The works of Albrecht Durer.

8) The mathematical background in the paintings of Leonardo.

9) Pre-linear perspective time drawings: the perceptual perspective versus the geometric (linear) perspective. The reverse (Byzantine) perspective.

10) The Expressive Theory and the Romantic Theory of Arts. The Fine Arts.

- 11) Multiple view point perspective, more about the perceptual perspective. The Ajanta cave paintings.
- 12) The Theory of Perception.
- 13) Taste and Beauty – a scientific approach to Aesthetics. Ramachandran's principles of Art.
- 14) Influence of Chinese and Japanese arts to forming the modern European art. Cubism, the art of Mark Chagall, more examples.
- 15) The form in Architecture: from ancient time to the modern days.
- 16) The Anamorphic Art.
- 17) Fractals – introduction and applications. Art-related examples from the East.
- 18) Fractals – applications to visual arts: computer graphics applications.
- 19) Modern Art Theories, and the Aesthetic of the Twentieth Century.

### Suggested Syllabus

#### Week one

- Pythagoras and his school; the concept of beautiful based on numbers and math figures; the golden ratio;
- Plato on beauty, the theory of forms;

#### Week two

- The Mimetic theory and the Formalism in arts (Aristotle);
- The axiomatic method in math (Euclid, Archimedes) influencing and influenced by the above theories;

#### Week three

- The Roman Era: The Ten Books of Architecture by Vitruvius, and the role of Geometry in it.

#### Week four

- The theory of perspective in the visual arts; one point perspective.
- Development of Geometry: projections in the space; the projective plane.

#### Week five

- Vanishing points and viewpoints in two- and three-point perspective.
- Planes, spheres, the geometry of the triangle.

#### Week six

- Practical sessions on linear perspective

#### Week seven

- The works of Albrecht Durer.
- The mathematical background in the paintings of Leonardo.

#### Week eight

- Reflections on Durer, Leonardo, and their contemporary artists.

#### Week nine

- Pre-linear perspective time drawings: the perceptual perspective versus the geometric (linear) perspective.
- The reverse (Byzantine) perspective.

#### Week ten

- The Expressive Theory and the Romantic Theory of Arts. The Fine Arts.
- The Theory of Perception.

#### Week eleven

- Multiple viewpoint perspective, more about the perceptual perspective. The Ajanta cave paintings.

#### Week twelve

- Taste and Beauty – a scientific approach to Aesthetics.
- Ramachandran's principles of Art.

#### Week thirteen

- Influence of Chinese and Japanese arts to forming the modern European art.
- Cubism, the art of Mark Chagall, more examples.

#### Week fourteen

- Modern Art Theories, and the Aesthetic of the Twentieth Century.

### Topics for projects

- 1) Perspective in abstract v/s perspective in concrete

This is a project about the interaction between the idea and its realization in the particular case of visual arts (say, paintings). On particular examples, the students have to analyze and discuss

- how the story line of the painting determines the arts instruments (color, technique of drawing, arrangement of the objects in the painting) used to depict it
- the role the (abstract, visual arts') perspective plays in the painting as compared to the concrete perspective (the moral point of view) of the artist toward the depicted objects and events
- the aesthetic of the author of the painting in the context of the political and historical environment and the major philosophical theories of the time the piece of art was made
- the possible influences on the discussed painting by other artists as well as of the piece on other artists and their work

The selection of paintings discussed in the project depends on the preference of the students, and may represent one art school at a certain historic period as well as several schools distanced

geographically and in time. The students have to show competence in noticing the used painting techniques, cultural (aesthetics) background of the author, the influence of other art schools and philosophical systems as well as recognizing the effect of these on the discussed works.

## 2) Ideal Mathematical world in concrete artistic work

This project is about the influence Mathematics has had on the work of visual artists. Particular topics here may include

- Geometry and Architecture
- Numerology in the arts
- The realistic fantasy world of Escher
- The ubiquity of the golden ratio and its artistic appearances
- The mathematical world of Dali

The students have to be able to detect the mathematics behind the corresponding arts' work, discuss the interrelation of math and arts (in general, as well as its appearance in the works in consideration), and recognize the synthesis Math & Arts as a powerful expressive force.

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