SEMESTER AT SEA COURSE SYLLABUS

**Voyage: Fall 2014**
**Discipline: Math**
**MATH 2559: Mathematics and the Arts**
**Lower Division**
**Faculty Name: Stephen R. Wassell**

**Pre-requisites**: None.

**COURSE DESCRIPTION AND OBJECTIVES:**
Mathematical concepts such as geometry, proportion, and symmetry often arise in analyses of artwork, and many prominent artists explicitly incorporate mathematical ideas into their designs. This course explores the relationships between math and art, from ancient times through the present. We will discuss how mathematics has been used as a tool by artists throughout history. The focus is on the visual arts, especially architecture, but the role of proportions in music is also included. Other topics include the development of perspective and its influences, the Platonic solids and other polyhedra, and fractals. The course has sufficient mathematical content that it could transfer as an introductory college-level math course for students from programs that have such requirements, but the level of math is understandable for students of all majors.

**REQUIRED TEXTBOOK**
AUTHOR: Paul A. Calter
TITLE: *Squaring the Circle: Geometry in Art and Architecture*
PUBLISHER: John Wiley & Sons
ISBN #: 0-470-41212-7
DATE/EDITION: 2008 / 1st edition

**TOPICAL OUTLINE OF COURSE**

| Date | Topics | Work due |
|------|--------|----------|
| Depart Southampton- Aug 23 | | |
| **A1- Aug 25** | Chapter 1 Music of the Spheres | |
| **A2- Aug 27** | Chapter 1 Music of the Spheres | |
| St. Petersburg: Aug 29- Sept 2 | | |
| **A3- Sept 3** | Chapter 2 The Golden Ratio | **Homework 1** (Chapter 1) p. 13: 2c, 4cd, 5 p. 20: 2a, 3a, 7, 10 p. 33: 4 p. 35: 20b (and read 20a) |
| **A4- Sept 5** | Chapter 2 The Golden Ratio | |
| Hamburg: Sept 7-11 | | |
| **A5- Sept 12** | Chapter 3 The Triangle | **Field Work Assignment 1** |

| | | |
|---|---|---|
| Antwerp: Sept 14-16<br>Le Havre: Sept 17-19 | | |
| **A6-Sept 20** | Chapter 4<br>Ad Quadratum and the Sacred Cut | **Homework 2** (Chapter 2)<br>pp. 44-45: 2, 7 (see 6), 11<br>p. 49: 3<br>p. 57: 2<br>p. 60: 26 (or 27, if you prefer!) |
| **A7- Sept 22** | Chapter 4<br>Ad Quadratum and the Sacred Cut | |
| Dublin: Sept 24-27 | | |
| **A8- Sept 28** | Special Topic 1<br>The Engineering Aesthetic in Architecture | **Homework 3** (Chapter 3)<br>p. 66: 2, 4<br>pp. 73-74: 4 (see 6), 8, 15, 16<br>p. 77: 4, 5, 11<br>pp. 89-91: 41, 48, 49 |
| **A9- Sept 30** | Special Topic 2<br>The Geometry of Modern Architecture | |
| Lisbon: Oct 1-2 Field lab in Lisbon, Oct 1?<br>In transit: Oct 3<br>Cádiz: Oct 4-5 | | |
| **A10- Oct 7** | Chapter 5<br>Polygons, Tilings, and Sacred Geometry | **Homework 4** (Chapter 4)<br>p. 97: 3b<br>p. 100: 3, 5<br>p. 102: 2<br>p. 127: 42, 46 (but note that this is independent of the golden ratio!) |
| Casablanca: Oct 8-11 | | |
| **A11-Oct 13** | Chapter 6<br>The Circle | |
| **A12- Oct 15** | Chapter 7<br>Circular Designs in Architecture<br>(already partially covered in Special Topic 1) | **Homework 5** (Chapters 5 and 6)<br>p. 135: 6, 8, 9<br>pp. 171-172: 2, 13, 14, 22<br>p. 175: 14<br>p. 177: 6<br>p. 190: 24 |
| Dakar: Oct 16-19 | | |
| **A13- Oct 21** | Chapter 8<br>Squaring the Circle | |
| **A14- Oct 23** | **Midterm Exam** | |
| Takoradi: Oct 25-26<br>Tema: Oct 27-28 | | |
| **A15- Oct 29** | Chapter 9<br>The Ellipse and the Spiral | |
| **A16- Oct 31** | Chapter 10<br>The Solids | **Field Lab Report** |
| Study Day: Nov 2 | | |
| **A17-Nov 3** | Special Topic 3<br>Modern Architecture in Brazil | |
| **A18- Nov 5** | Chapter 11<br>The Sphere and Celestial Themes<br>in Art and Architecture | **Homework 6** (Chapters 7, 8, and 9)<br>pp. 200-201: 6, 28, 29, 31<br>p. 223: 31<br>pp. 242-243: 14[*] (see note below table), 19<br>pp. 258-259: 6, 9, 15<br>p. 275: 40 |

| Rio de Janeiro: Nov 7-9 Field lab in Rio de Janeiro, Nov 7? In-transit: Nov 10-11 Salvador: Nov 12-14 | | |
|---|---|---|
| **A19- Nov 15** | Chapter 11 The Sphere and Celestial Themes in Art and Architecture | |
| **A20- Nov 17** | Chapter 12 Brunelleschi's Peepshow and the Origins of Perspective | **Homework 7** (Chapters 10 and 11) p. 289: 11 p. 292: 4, 5 p. 295: 1, 5 p. 301: 14 p. 314: 31 |
| Study Day: Nov 19 | | |
| **A21-Nov 20** | Chapter 12 Brunelleschi's Peepshow and the Origins of Perspective | **Field Work Final Report** |
| Bridgetown: Nov 22-24 | | |
| **A22-Nov 25** | Chapter 13 Fractals | |
| **A23- Nov 27** | Open Discussion Observations from the Semester | **Homework 8** (Chapters 12 and 13) p. 389: 5, 6, 7 p. 399: 4b p. 402: 4, 6 (see Errata) p. 409: 3 |
| Havana: Nov 29- Dec 2 Study Day- Dec 3 | | |
| **A24-Dec 4** | **Final Exam** | |

[*]In Chapter 8, #14, no need to "write a short paper"; just explain what this passage implies about the value of pi.


**FIELD WORK**

Field lab attendance is mandatory for all students enrolled in this course. Please do not book individual travel plans or a Semester at Sea sponsored trip on the day of our field lab. One of these options will be finalized and required.

**Option 1 - Lisbon:** The field lab will be a walking/subway tour of Lisbon to see some of its most significant works of art and architecture. We will spend a couple of hours at the Calouste Gulbenkian Museum, a world-class museum that has an eclectic collection of art from Egypt, Greece, Rome, the Middle East, the Far East, and Europe, and the building itself is notable for its design. Other works of architecture will include three works by Álvaro Siza Vieira, a Pritzker Prize winner and one of the most celebrated architects of Portugal: Pavilion of Portugal, Terraços de Bragança, and the Baixa-Chiado Metro Station; Gare do Oriente Station by Santiago Calatrava, a premier Spanish architect; and Pavilhão Atlântico by Regino Cruz, Skidmore Owings & Merrill.

**Option 2 - Rio de Janeiro:** The field lab will be a walking/subway/ferry tour of Rio de Janeiro to see some of its most significant works of art and architecture. We will spend a couple of hours at the Niterói Contemporary Art Museum, designed by internationally renowned architect Oscar Niemeyer, a Pritzker Prize winner. We will then tour the central district on foot to see such highlights as the Museum of Modern Art (another Neimeyer design), the National Ministry of Education (designed by a team including Neimeyer and Le Corbusier, a Swiss architect who is

widely viewed as the most important architect of the 20$^{th}$ century), Rio de Janeiro Cathedral, Candelária Church, Theatro Municipal, Petrobras Headquarters, and the Arcos da Lapa. If time permits, we will travel to the southwest district of Rio de Janeiro to see the Cidade das Artes (City of Arts), designed by the French architect Christian de Portzamparc, another Pritzker Prize winner.

Field lab date and time are subject to change.


**METHODS OF EVALUATION / GRADING RUBRIC**
Participation: 10%
Homework: 25%
Midterm Exam: 20%
Field Work: 20%
Final Exam: 25%


### Participation (10%)
Your attendance and active participation in class will contribute to your learning and are also important factors in determining your grade. The instructor will monitor student participation on a daily basis. Students are expected to arrive to class on time. Being late to class counts as half an absence. A-level participation means actively participating as well as respecting classmates by not speaking when they are speaking and by not dominating discussions. Points will also be deducted for using electronic devices, packing up early, etc.


### Homework (25%)
All homework is due at the beginning of the class meeting indicated on the syllabus. Late homework will not be accepted, except in the case of medical illness or extraordinary circumstances.


### Midterm Exam (20%)
The midterm exam will be half math and half art. The math portion will consist of problems similar to those found in the homework assignments. The art portion will consist of identifications of works of art and architecture. A review sheet will be provided for the information that the students are responsible for knowing.


### Field Work (20%)
The field work in this class has two different components.

1. A **Field Lab Report (10%)** based on the class visit to Lisbon/Rio de Janeiro on October 1/November 7. The field lab report will consist of:
   a. A significant number of images (the student's photos and/or drawings) of works of art and architecture from Lisbon/Rio de Janeiro that exemplify topics discussed in the course, each accompanied by an analysis. The analyses can be written (as short as a couple of sentences or as long as a couple of paragraphs) or mathematical (of whatever length is necessary to convey the intended math ideas).
   b. A written statement describing the student's overall perceptions of Lisbon/Rio de Janeiro from the standpoint of topics discussed in the course.
As a guideline, the total length of the field lab report, apart from the images, should be the

equivalent of 1000–1500 words.

2. A **Field Work Final Report (10%)** that will consist of:
   a.  A significant number of images (the student's photos and/or drawings) of works of art and architecture *from ports other than Lisbon/Rio de Janeiro* that exemplify topics discussed in the course, each accompanied by an analysis. The analyses can be written (as short as a couple of sentences or as long as a couple of paragraphs) or mathematical (of whatever length is necessary to convey the intended math ideas). A first submission, **Field Work Assignment 1**, of just a couple of images and analyses, is due early in the semester, in order for the students to get feedback; these may be included (modified as necessary) in the final report.
   b.  A written statement describing the student's overall perceptions of their visits, *including Lisbon/Rio de Janeiro*, from the standpoint of topics discussed in the course. It is expected that the student's perceptions of similarities and differences between the various countries' works of art and architecture will be included in the final report, as well as the ways in which the student's perceptions of mathematics in the arts have changed during the semester.

As a guideline, the total length of the final report, apart from the images, should be the equivalent of 1000–1500 words.

The different components of the field work will be evaluated according to the rubric in the class intranet folder.

**Final Exam (25%)**

The cumulative final exam will be half math and half art. The math portion will consist of problems similar to those found in the homework assignments. The art portion will consist of identifications of works of art and architecture. A review sheet will be provided for the information, subsequent to the Midterm Exam, that the students are responsible for knowing.

**RESERVE LIBRARY LIST**
AUTHOR: Jay Kappraff
TITLE: *Connections: The Geometric Bridge Between Art and Science*
PUBLISHER: World Scientific Pub Co
ISBN #: 9810245866
DATE/EDITION: 2001 / 2nd edition

**ELECTRONIC COURSE MATERIALS**
Additional materials will be made available to students via the intranet for this course.

**COURSE POLICIES**
**Honor Code.** Semester at Sea students enroll in an academic program administered by the University of Virginia, and thus bind themselves to the University's honor code. The code prohibits all acts of lying, cheating, and stealing. Please consult the Voyager's Handbook for further explanation of what constitutes an honor offense.

Each written assignment for this course must be pledged by the student as follows: "On my honor as a student, I pledge that I have neither given nor received aid on this assignment." The pledge must be signed, or, in the case of an electronic file, signed "[signed]."

**Electronics:** No laptops, no cell phones or other electronic devices will be used in class unless advised by the professor. Failure to comply may result in dismissal from the class period and, consequently, an absence.