Catalog Description:
Prerequisite: acceptance to the University Honors Program, or consent of instructor and Director of Honors.

This course will explore how the development of mathematics is inextricably connected with the development of other areas of culture. For this reason the course will be interdisciplinary in the truest sense of the word. We will need to read and understand ideas from philosophy, theology, biology, astronomy, art, music, political sciences, etc. in order to establish and clarify in which sense mathematics and culture come together. Specific topics to be discussed include: Axiomatic Systems in mathematics, physics, logic, and politics; elementary number theory and the just temperament; projective geometry from the Renaissance to Computer Graphics; Islamic mathematics and the rise of accounting; the loss of certainty, and the crisis of the axiomatic system; data sciences and agnostic science.

(Offered as needed.) 3 credits.

Course Learning Outcomes:
1. Develop an understanding of how mathematical ideas arise and develop within a larger cultural background.
2. Learn about axiomatic systems and in particular about Euclidean and non-Euclidean geometries. Models, independence, consistency.
3. Learn the fundamental aspects of projective geometry; learn how to use homogeneous coordinate systems. Learn about the projective plane, points and line at infinity, and conics within the projective plane.
4. Learn mathematical foundations of harmony.
5. Learn about methods of solution of polynomial equations of degrees one through four. Learn about the unsolvability of higher degree equations.

Honors Program Learning Outcomes:
Upon completing a course in the University Honors Program students will have:
a. Obtained a starting point for integrative exploration of the development of cultures and intellectual achievements through a variety of disciplinary and interdisciplinary perspectives;
b. Sharpened their ability to critically analyze and synthesize a broad range of knowledge through the study of primary texts and through engagement in active learning with fellow students, faculty, and texts (broadly understood);
c. Understood how to apply more integrative and interdisciplinary forms of understanding in the advancement of knowledge and in addressing complex challenges shaping the world;
d. Developed effective communication skills, specifically in the areas of written and oral exposition and analysis.

Content:

After an introduction designed to emphasize how mathematics grows out of the intellectual and cultural humus of a given moment in space and time (geography and history), we will look at several specific examples.

Part 1 of the course will be devoted to the introduction by Euclid of the axiomatic method, and it will explore ways in which this method was used outside mathematics. We will discuss issues of independence and consistency, which will lead us to consider models for axiomatic systems. We will review basic Euclidean geometry, but we will also introduce and discuss in some detail models for hyperbolic and elliptical geometries.

Part 2 of the course will explore Renaissance painting, and the birth of projective geometry. Not only we will explore specific techniques used in the Renaissance, but we will use this as an opportunity to study in detail the method of homogeneous coordinates to study projective geometry in the plane (and some ideas on how this extends to the space). We will pay significant attention to conics, and their classification in the affine and projective settings.

Part 3 of the course will discuss the intersection between music and mathematics. We will begin with a detailed analysis of the hidden musical ideas in Plato’s dialogues (mostly Timaeus and Republic), and we will use those to learn about the mathematical foundations for musical harmony.

Part 4 of the course will take us to the beginning of commerce in medieval Italy, and the birth of algebra. We will discuss ideas from Islamic mathematics, and we will learn how to solve equations of degree three and four, as well as why no general solutions are available for higher degree.

Current Required Texts:

I am in the process of writing a book on this topic, and I will share with the students the drafts of four or five chapters in my book. I will also post on blackboard additional reading materials, as well as a series of videos that offer quick introductions to the topics to be discussed in class.
Instructional Strategies:

I will attempt to offer this class with a ‘flipped’ methodology. I have prepared several short videos (15-20 minutes each) as well as several handouts (including full length draft chapters for a forthcoming book). I will assign readings and viewings in advance of my classes, in order to then devote the class to a seminar style discussion and deepening of the themes discussed in the videos and the viewings.

Methods of Evaluation:

Every class (or almost every class) will begin with a ten minute quiz designed to ensure that everybody is reading the materials and is viewing the required videos.

The quizzes will be graded, and will be part of the final grade. I will also have a test on each of the four parts of the course, and two papers on topics discussed in class.

Quizzes will be 20% of the final grade, each test will be 15% of the final grade, and each paper will be 20% of the final grade.

Chapman University Academic Integrity Policy:

Chapman University is a community of scholars which emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work, and academic dishonesty of any kind will not be tolerated anywhere in the university.

Students with Disabilities Policy:

In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to inform the instructor at the beginning of the term. The University, through the Center for Academic Success, will work with the appropriate faculty member who is asked to provide the accommodations for a student in determining what accommodations are suitable based on the documentation and the individual student needs. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course.

Equity and Diversity:

Chapman University is committed to ensuring equality and valuing diversity. Students and professors are reminded to show respect at all times as outlined in Chapman’s Harassment and Discrimination Policy: http://tinyurl.com/CUHarassment-Discrimination. Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.