Math E-6: Quantitative Reasoning
Mathematics and the Greeks
Spring 2020
(online option)

Draft syllabus

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Class: Tuesdays, 8 – 10 pm, 1 Story Street, room 304. First class January 28.

Review: Optional live-streamed weekly session, time and place TBA.

Required Texts: "A History of Greek Mathematics" by Sir Thomas Heath, Dover, 1981. (volumes one and two). Other readings will be posted on the website.

Other materials: Lecture notes and assignments posted on the website
Straightedge and compasses (for geometry lectures and assignments)
Sandbox, stick, and pebbles (just kidding)

Recommended: "Journey through Genius" by William Dunham, Penguin Books, 1990. This is a fascinating and well-written account of some of the most significant mathematical discoveries throughout the centuries, from Pythagoras and Euclid up to Cantor and the concept of "multiple infinities." Each chapter provides some intriguing historical background, complete with eccentric behavioral quirks, and concludes with a "Great Theorem" – an easy to understand but profound mathematical discovery which has had a lasting influence, both on the study of mathematics itself, and on fields beyond. In addition, Dunham has a sense of humor, whereas Heath's, if it exists at all, is heavily disguised – some might say it has been surgically removed.

Suggested Extra Reading:

"A History of Mathematics" by Carl B. Boyer, John Wiley & Sons, 2nd ed., 1991. This is an excellent history of mathematics, starting with the very beginnings of mathematics and taking the reader right into the 20th century. For our purposes chapters 4 – 8 are particularly relevant, covering Greek mathematicians from Thales to Archimedes. Some of the material may be somewhat challenging to follow, but it is well worth a thoughtful perusal.

NOTE: MATH E-6 is offered with an online option. Students can attend classes in person, watch lectures live via "Zoom in the Room," or watch online "on demand" videos of lectures within 48 hours of presentation. See below for details on how homework assignments should be submitted, as well as how exams are to be taken.

Zoom in the Room: in order to be prepared for the first class, go to the home page for MATH E-6, and click on the "Lecture Video" button on the top left of the screen. You'll see on the right, in red, two buttons to click on; look first at the one with instructions and tips. Then right before the first class, click on the red button that says "Zoom in the Room Lecture."

Course Description:

The purpose of this course is to explore one of the great contributions of the Greeks, namely their mathematics. Although other earlier civilizations had significant achievements in mathematics, for example, the Egyptians, Mesopotamians and Indians (the relative dating of some mathematical discoveries, and whether they actually preceded those of the Greeks, is still debated), our focus will be on the peculiarly Greek way of using and thinking about mathematics. Therefore a regular part of our course will involve reading short selections from Greek philosophers and mathematicians, seeking to understand what is being said, and then working to solve a variety of mathematical problems, naturally without any of the modern technological tools such as calculators. Assignments will generally include 2 sections: **a)** a reading to be commented upon, and **b)** a set of problems to be solved. Some problems will involve the construction of geometrical figures by drawing, others will be concerned with finding a numerical answer to a question, and still others will require the writing out of a proof - constructing an argument by means of a set of logical steps.

Some of you will have already taken one or more courses in other aspects of ancient Greek culture, such as literature, archeology, or history, and I hope this course will help to broaden your views of Greek thought and civilization as a whole. A course looking at the mathematical achievements of the Greeks lends itself to discussion of many related questions. What discoveries actually are due to previous civilizations such as the Egyptians or Babylonians? How does philosophy relate to mathematics? What are some of the mystical and religious features of some of the early Greek mathematicians? How could the same people who believed that mathematics was a way of understanding reality also believe in Zeus, Athena and Aphrodite? While all these questions are interesting and important, and we may discuss some of them briefly during the course, we will try and keep our focus upon the way the Greeks did mathematics - how they thought about numbers, how they did calculations, how they drew geometrical shapes, and how they used mathematics to help them understand the real world. However I hope that you will be inspired to seek answers for some of these other related questions as well, since any search into such issues is bound to be rewarding.

Canvas, Homework, Lectures and Exams:

We are using the **Canvas** platform. All course-related documents will be posted there; you will also be able to keep track of your assignment and quiz grades on Canvas. To access the course website, you will go to "Canvas.harvard.edu" and our course MATH E-6 should appear. We'll explain more as the course proceeds.

There will be weekly assignments, posted on the Canvas website and due the following Tuesday. Homeworks should be submitted via Canvas; they'll also be graded on Canvas, where you can see your graded assignment with feedback. More details to come about this.

The review session, which is optional, can be used for questions about the assignment, as well as discussion about lecture topics, and perhaps examination of one or more readings relating to the class material. There will be two one-hour tests ("quizzes") during the semester, dates as below. These will include one or more short passages for comment, plus a selection of problems to be solved. There will also be a final exam, date and time given below.

Quiz/exam info (more details to follow). The two quizzes will be online.

Quiz #1: **Mid March.**
Quiz #2: **Mid April.**
Final exam: **Tuesday May 12. Proctored for distance students.**

Make-up quizzes:
There are no make-ups for the 2 quizzes; make-ups for the final exam as below:

The date of the **FINAL EXAM** is fixed by the Extension school. If you cannot take the Final Exam at the scheduled time and date, **YOU MUST** contact the Extension School Registrar. The Registrar will determine if you are eligible for a make-up exam.

The **FINAL EXAM** will be held on **Tuesday May 12, 2019**

DISTANCE STUDENTS: You will need to arrange proctors for the final exam. See the following link for information about course videos and taking the procedure for taking proctored exams**:**

http://www.extension.harvard.edu/distance-education/how-distance-education-works/academic-policy-exam-proctoring

NOTE: Distance students do have the option of coming to campus to take the final exam in person, even if you never attend classes. You are even welcome to fly in from overseas to take the final if you wish!

Grading:

The course grade will be assigned as follows:
Homework – **30%**; two quizzes – **20%** each; final exam – **30%**.

Graduate credit students:

Those taking MATH E-6 for Graduate credit have some additional assignments, including a final project, as outlined below. For the final project, a brief proposal should be turned in to me by Spring Break, with the completed project due by the date of the final exam. If you have questions about any details please don't hesitate to ask me. More details to follow.

Options will include either a teaching-related project, including two sets of lesson plans for a particular topic, or a research paper.

Some assignments may also include extra questions for graduate credit students.

E-6 COURSE OUTLINE

Weekly topics (subject to modification):

1. Introduction; mathematics before the Greeks; the first Greek mathematician; the Greek alphabet and its use in representing numbers; basic operations

2. The second Greek mathematician; numbers and music; classification of numbers: odd, even, oblong, triangular, square, prime, composite

3. "Special" numbers: perfect, amicable; the infinity of prime numbers

4. Means: arithmetic, harmonic, geometric, et al; proportions; GCF, LCM

5. Geometry I: construction of lines, angles, squares, triangles, circles

6. Geometry II: polygons within a circle; the pentagon; the "Golden Section";

7. Geometry III: Triangles and the Pythagorean theorem

8. Irrational numbers: the "incommensurability" of $\sqrt{2}$ and $\sqrt{5}$; Plato's Meno

9. Approximations to the number π - Archimedes

10. Geometry IV: The five "Platonic solids"

11. Volumes of spheres, cylinders, and cones

12. Problems and paradoxes relating to infinity

13. Euclid's "Parallel Postulate" - the possibility of non-Euclidean geometry

NOTE: students with some knowledge of ancient Greek language will be have the option of reading short selected passages from Plato, Aristotle, Euclid, Archimedes and other Greek authors. No extra credit, but the experience of reading these texts in the original language.

Other topics may be included depending on student interest.

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