Spring 2015

MATH 105--History of Mathematics

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General description.
We will explore some major themes in mathematics--calculation, number, geometry, algebra, infinity, formalism--and their historical development in various civilizations, ranging from the antiquity of Babylonia and Egypt through classical Greece, the Middle and Far East, and on to modern Europe. We will see how the earlier civilizations influenced or failed to influence later ones and how the concepts evolved in these various civilizations.
The earliest civilizations have left only archaeological and limited historical evidence that requires substantial interpretation. We have many mathematical treatises from the later civilizations, but these are usually in a completed form which leave out the development of the concepts and the purposes for which the mathematics was developed. Thus, we will have to analyze the arguments given by historians of mathematics for their objectivity and completeness.

Catalog text from Clark’s Academic Catalog
Explores major themes—calculation, number, geometry, algebra, infinity—and their historical development in civilizations ranging from the antiquity of Babylonia and Egypt through classical Greece, the Middle and Far East and then modern Europe. Analyzes the tension between applications of mathematics and the tendency toward formalism. Emphasizes presentations and discussions. Fulfills the Historical Perspective.

Course prerequisite: The prerequisite for this course is an intense interest in mathematics. There are no other prerequisites for it other than a familiarity with plane geometry and algebra. Our study will reach just to the beginnings of calculus since we won't have time in one semester for more.

Course goals
Content goals:
follow the development of mathematics from early number systems to the invention of calculus,
read and understand some historical mathematics,
survey the development and use of methods of computation, some of which involve tools such as the abacus, and
study the mathematics of various different civilizations, their conception and use of mathematics, and how the historical conditions of those civilizations affected and were affected by mathematics
Historical perspective goals:
develop your capacity to understand the contemporary world in the larger
framework of tradition and history,
focus on the problems of interpreting the past and can also deal with the
relationship between past and present, and
introduce students to the ways scholars think critically about the past, present and
future
Other goals:
develop your ability to present mathematics and history in spoken and written
forms,
help you practice research skills, and
satisfy, in part, your curiosity of how mathematics developed and how it fits into
culture

Course objectives
When you have finished this course you should be able to:

describe the development of various areas of mathematics within and across various
civilizations,
describe the changing character of mathematics over time and recognize the
distinction between formal and intuitive mathematics,
give examples of significant applications of mathematics to commerce, science, and
general life, past and present,
understand that history includes the interpretation the past, not just facts, and
better research historical questions and present your conclusions to others

Course Hours. The class meets MWF 10:00–10:50 and M 12:00–12:50. It’s scheduled in
Sacker Science building room S321 for the 10:00 meetings and S311 for the 12:00
meeting. S321 the newer part of the science building at the Jonas Clark end of the
building on the third floor. We'll meet four hours a week so that there will be enough
meeting times during the semester for all the students to give April class presentations in
class.

Textbook. A History of Mathematics, an Introduction by Victor J. Katz, Addison-

Assignments, tests, and presentation/paper. You will do assignments every week or
two from the text, and you'll take two tests (midterm and final). You will select, research,
and present a topic of your choice. Your presentation will be a 15 to 20 minute class
presentation accompanied by a 10 to 20 page paper.

Course grade. 1/7 for assignments, 2/7 for each test, 2/7 for the presentation/paper.
Syllabus

Course overview

Egypt and Mesopotamia
- Egypt: number system, multiplication and division, unit fractions, the Egyptian 2/n table, linear equations and the method of false position, geometry.
- Mesopotamia: sexagesimal (base 60) system and cuneiform notation, arithmetic, Babylonian multiplication table, Babylonian reciprocal table, elementary geometry, the Pythagorean theorem, Plimpton 322 tablet, square roots, quadratic equations, tokens of preliterate Mesopotamia.

The beginnings of mathematics in Greece
- The earliest Greek mathematics: various Greek numerals, Thales, Pythagoras and the Pythagoreans, difficult construction problems
- Plato and Aristotle: logic, magnitudes, Zeno's paradoxes

Euclid's Elements
See [http://www.clarku.edu/~djoyce/elements/elements.html](http://www.clarku.edu/~djoyce/elements/elements.html), and a quick trip of the Elements
- Book I: Basic plane geometry through the Pythagorean theorem
- Book II: Geometric algebra and related constructions
- Book III: Intermediate plane geometry and the study of circles
- Book IV: Constructions of regular polygons
- Book V: The theory of ratio and proportions of magnitudes
- Book VI: Similar plane figures
- Books VII–IX: Number theory
- Book X: The theory of irrational magnitudes
- Books XI–XIII: Solid geometry, the method of exhaustion, constructions of regular polyhedral

Archimedes
- The law of the lever, approximation of pi, sums of series
- Rational approximations to irrationals

Mathematical methods in Hellenistic times
- Astronomy before Ptolemy, Cosmology and astronomy
- Early trigonometry, History of Trigonometry
- Ptolemy and the Almagest
- Practical mathematics, Heron, Ptolemy's Geography

The final chapters of Greek mathematics
- Diophantus and Greek algebra, Pappus and analysis
Ancient and medieval China
   Number symbols, rod numerals, fractions
   Geometry: areas and volumes, the Pythagorean theorem, similar triangles
   Algebra: simultaneous linear equations, arithmetic triangle, solving polynomial equations.
   Indeterminate analysis and the Chinese remainder theorem finding one

Ancient and medieval India
   The Hindu-Arabic place-value system and arithmetic
   Geometry
   Equations and indeterminate analysis
   Combinatorics
   Trigonometry, Aryabhata's trig table

The mathematics of Islam
   Decimal arithmetic
   Algebra: quadratic equations, powers of the unknown, arithmetic triangle, cubic equations
   Combinatorics
   Geometry: parallel postulate, trigonometry

Mathematics in medieval Europe
   Translations from Arabic into Latin in the 12th and 13th centuries
   Summary of early mathematics in western Europe
   Combinatorics
   The mathematics of kinematics: velocity, the Merton theorem, Oresme's fundamental theorem of calculus

Mathematics around the world
   Mathematics at the turn of the fourteenth century
   Mathematics in America, Africa, and the Pacific

Algebra in the renaissance
   The Italian abacists, algebra in France, Germany, England, and Portugal
   The solution of the cubic equation
   Early development of symbolic algebra: Viéte and Stevin

Mathematical methods in the renaissance
   Perspective, geography and navigation, astronomy and trigonometry, logarithms, kinematics

Geometry, algebra, and probability in the seventeenth century
   The theory of equations
   Analytic geometry: coordinates, equations of curves
   Elementary probability
   Number theory
   Projective geometry
The beginnings of calculus
   Tangents and extrema, areas and volumes, power series, rectification of curves and the fundamental theorem of calculus

Newton and Leibniz
   Isaac Newton, Gottfried Leibniz, and the first calculus texts

There is more information on the course web page
http://aleph0.clarku.edu/~djoyce/ma105/