Spring 2015

MATH 105--History of Mathematics

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Math 105, History of Mathematics

Course web page http://aleph0.clarku.edu/~djoyce/ma105/

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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-Wesley, third edition, 2009. Addison-Wesley. Cloth, 992 pp. ISBN-10: 0321387007, ISBN-13: 9780321387004.

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, 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
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