Class Syllabus

MATH 6367, History of Advanced Mathematics

Dr. Ken W. Smith, Sam Houston State University

Spring 2018, Section 01 (CRN 21392)

Online

Catalogue description: This course examines the history of the development of modern mathematics, from the discovery of calculus, through the industrial revolution, into the modern age of computers and digital technology. Emphasis will be placed on the applications of calculus and the abstraction of geometry, analysis, and algebra which followed.

Textbook: We will use portions of two different textbooks:

1. Howard Eves, An Introduction to the History of Mathematics (6th edition)
2. David Burton, History of Mathematics, An Introduction (7th edition).

I will provide pdf files of the appropriate chapters from these two books.

1 An exciting subject!

Welcome to a course in the history of mathematics!

> *Mathematics without history is mathematics stripped of its greatness: for, like the other arts – and mathematics is one of the supreme arts of civilization – it derives its grandeur from the fact of being a human creation.*[1]

Most of us have assumptions about mathematics and how it developed. In those assumptions, we lose track of the excitement, the creativity – and the confusion – involved in the development of mathematics. And so we lose sight of the beauty and structure of mathematics!

Anyone interested in teaching mathematics should understand how mathematics developed. The stages of development give insight into the common difficulties in learning the various levels of mathematics. Primitive societies knew what our third graders know; the Greeks knew our "high school" mathematics, yet it took over a thousand years for human society to progress from Euclid's "geometry" to Newtons "calculus"! But when the calculus was introduced, the world changed!

In this class we will examine the broad panorama of mathematics beginning briefly with primitive times and the Greek Age and ending with the abstraction of mathematics in the nineteenth century.

2 Professional expectations

This class is designed for individuals who intend to use mathematics professionally, applying it in industry or teaching it in secondary or tertiary education.

Students in this class are expected to view themselves as *professionals*, with a professional curiosity about the subject and a professional pride in their work. Student involvement in the lectures and discussions is a critical component in this course. Students must be actively involved in the learning process during the lecture/discussion period.

Please view this class as you would any other *professional* responsibility!

[1] G. F. Simmons, in Differential Equation with Applications and Historical notes, 1991, quoted in the November 1997 issue of the American Mathematical Monthly.

3 Grades

Grades will be based on class involvement and examinations. Class involvement includes written homework, including some material posted on Blackboard. There is a midterm exam and a comprehensive final exam.

The knowledge base for this class is a mixture of mathematics and history and so problems will include mathematical computations and essay questions about mathematics and its development.

An *A* grade in the class is about 85% or higher on the total points. A *B* grade is about 75% or higher on the total points. (Students with a professional attitude who meet the prerequisites for this class should be able to achieve at least a B grade.) A passing grade (*C*) requires at least 50%.

Homework. Written work is due Mondays, at 4:30 pm, beginning Monday, January 29. Homework should be written up with professional care and pride. The homework will be made available on Blackboard at least one week before it is due. Please discuss the homework with others, *far in advance* of its submission. I will attempt to set up discussion boards on Blackboard to facilitate this.

Calculators. We will be studying the development of mathematics from about 600 BC to about 1900 AD. Since calculators were not developed until the 1980s (!) most of work will *not* involve calculators.

Calculators are not allowed on any classwork. (Almost nothing we do requires a calculator; every topic is from a period long before the invention of the calculator!)

Exams. There is a midterm exam and a final exam. These exams are face-to-face.

1. The Midterm Exam is **Monday, March 19**, 5-7 pm on campus **OR Tuesday, March 20**, 5-7 pm at The Woodlands Center.
2. The Final Exam is **Monday, May 7**, 5-8 pm on campus **OR Tuesday, May 8**, 5-8 pm at The Woodlands Center. It is comprehensive.

Blackboard & other communications. Class material will be posted on Blackboard. Students should have a Blackboard email address and read that address regularly. Syllabi, notes, quiz solutions and other material will often be provided by email, as pdf files. (These files can be opened by Adobe Reader; see http://get.adobe.com/reader/ for a free copy of that software.) Student participation in discussion is important; please participate in discussions on Blackboard.

Your are welcome to contribute to a math history Facebook page: @MathHistorySHSU.

My e-mail address is KenWSmith@shsu.edu. I read my e-mail daily.

No magic! The power of mathematics is in its *concepts*; *understanding* concepts is much more important than mechanical procedures!

Some view mathematics as a collection of "magical" formulae, understood only by wizards and thoughtlessly memorized by everyone else. This view of mathematics, as "magical" formulas to be memorized, is harmful to learning math! Professional mathematicians must confront this view of mathematics and focus on learning the concepts.

In this class we will avoid "magic"! We will avoid mechanical memorized formulas and thoughtless procedures.

4 A comment on writing

Professional mathematicians do a great deal of writing about the subject. As you write, practice good mathematical grammar and exposition.

Any writing submitted by a student (including daily homework) must either be the student's creation or must be a quotation. Quotations must be submitted within appropriate quotation marks and must

be appropriately cited. Quotations should not exceed more than 10 percent of the submitted writing. All other writing – that is, work which is not within quotation marks – must be the personal creation of the student author. Submitted work that is not within quotation marks, but which is not the creation of the student author, is considered plagiarism. (If you are unsure whether your submission might be considered plagiarism, please speak to me. I am an experienced writer and an experienced teacher and I would like to help.)

Express yourself in your writing; explore your topic! Write creatively. Enjoy your work!

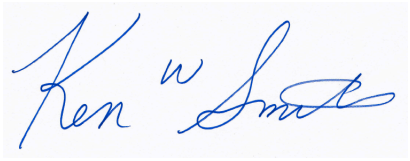
The format of electronic submissions should either be in one of the following formats: LaTeX, Word, or pdf. Electronic submission in LaTeXis encouraged.[2] When a piece is submitted electronically, it should include the students last name on both the files filename and also on the top line of the internal document.[3]

5 My commitment

This is an exciting course with exceptional material. I want you to succeed and do well! You may discover that this class is one of the most significant and exciting courses in your professional career – that is my hope!

Please feel free to talk to me. I want you to enjoy this class and I want you to do well!

A tentative schedule is attached, as an appendix.



Dr. Ken W. Smith,
Wednesday, January 17, 2018

[2] See http://en.wikibooks.org/wiki/LaTeX or http://www.tug.org/texlive for descriptions of Tex/LaTex.

[3] For example, I might submit a paper with filename `Smith_EulerBiography` and would write "Ken W. Smith" on the first line of the term paper.

MATH 6367 Schedule

Spring 2018 (Tentative)

The numbering system on the left margin follows Ken's lecture notes.

1-3. Mathematics Prior to the Renaissance

1 **Monday, January 22**, Before the Greeks
(Primitive mathematics; the mathematics of Babylon and Egypt)
Eves, chapters 1 and 2, Burton, chapters 1 and 2

2.1-2.2 **Wednesday, January 24**, The Greeks Before Euclid
(The Pythagoreans and the philosophers)
Eves, chapters 3 and 4, Burton, chapter 3

2.3-2.4 **Monday, January 29**, Euclid
(Euclid's *Elements*)
Eves, chapter 5, Burton, chapter 4

2.5 **Wednesday, January 31**, Euclid's number theory
(Modular arithmetic and the Euclidean algorithm)
Eves, chapter 5, Burton, 4.3

2.6-2.8 **Monday, February 5**, The Conclusion of the Greek Age
(Conics, circles, the commentators)
Eves, chapter 6, Burton, chapter 5

3.1-3.3 **Wednesday, February 7**, Mathematics of India, China and Arabia
(The Chinese Remainder Theorem, algebra, a cubic equation)
Eves, chapter 7, Burton, 5.5

3.4 **Monday, February 12**, Medieval Europe
(Lost mathematics and its recovery)
Eves, chapter 8, sections 8.1-8.2, Burton, 6.1

3.5 **Wednesday, February 14**, Fibonacci
(The beginnings of algebra and the slow awakening of Europe)
Eves, chapter 8, 8.1-8.6, Burton, 6.1, 7.1, 7.2

4. The Mathematics of the Renaissance

4.1 **Monday, February 19**, Solving the Cubic
(Italy in the sixteenth century)
Eves, chapter 8, 8.7-8.10, Burton, 7.3, 7.4

4.2 **Wednesday, February 21**, Analytic Geometry
(Merging algebra and geometry)
Eves, 10.1, 11.7, 11.8, Burton, 8.1, 8.2

4.3 **Monday, February 26**, Perspective and projective geometry
(Two-dimensional projective geometry, Renaissance art)
Eves, 9.8, 9.9, 14.4, 14.5

4.4 **Wednesday, February 28**, Fermat's Number Theory
(Towards modern number theory)
Eves, 10.3, Burton, chapter 10

4.5 **Monday, March 5**, Almost Calculus
(Tangent circles, tangent lines and limits)
Eves, chapter 11, Burton, 8.1, 8.2

5. The Discovery of Calculus

5.1 **Wednesday, March 7**, Newton & Leibniz and the beginnings of calculus
("Ghosts of departed quantities")
Eves, chapter 11, Burton, 8.3, 8.4

$\Longrightarrow$ **Monday, March 12-Friday, March 16, Spring Break Holiday**

$\Longrightarrow$ **Midterm Exam**, Monday, March 19, on campus, 5-7 pm.,
OR
Tuesday, March 20, at The Woodlands Center, 5-7 pm.

5.2 **Wednesday, March 21**, The Bernoullis and the exploitation of calculus
(Derivatives and integrals explain the universe!)

5.3 **Monday, March 26**, Infinite Series
(Taylor series and polynomials, Fourier series and trig functions)

5.4 **Wednesday, March 28**, Differential Equations
(The ordinary differential equations of Euler and the Bernoullis)

5.5 **Monday, April 2**, Euler
(1000 articles, contributions to *every* area of mathematics!)

5.6 **Wednesday, April 4**, The history of probability and statistics
(Pascal, deMoivre, Bayes, Gauss)
Burton, chapter 9

$\Longrightarrow$ **Friday, April 6, is the last day to drop a class with a Q grade.**

6. Gauss and the Age of Uncertainty

Monday, April 9 - Wednesday, May 2 (8 class days)

$\Longrightarrow$ **Comprehensive Final Exam**, Monday, May 7, on campus, 5-8 pm.,
OR
Tuesday, May 8, at The Woodlands Center, 5-8 pm.