Department of Mathematics September 2016
Millersville University

SYLLABUS
MATH 301 – HISTORY OF MATHEMATICS
(3 credits)

Course Description
This course covers the progression of mathematical concepts, in the context of the thought and civilization of the time, from the Babylonians to the 20th century. The focus on the contributions of the Hellenic and Alexandrian Greeks is a point of departure for the evolution of geometry, number theory, algebra, and analysis (i.e. calculus). Proofs of some of the great theorems are explored. Offered in fall and spring.

Prerequisites: ENGL 110, COMM 100, Calculus I (MATH 161 or MATH 163 or MATH 151) and 60 credits.

General Education: This course is a perspectives (P) course.

Course Objectives: During this course, the student will

a) Integrate knowledge acquired in previous course work and life
b) Make independent and responsible value judgments and decisions
c) Apply analytical and critical thinking abilities to the course content
d) Demonstrate how different areas of knowledge relate and can be used in complementary ways
e) Begin to understand and trace the historical development of various mathematical processes, thought, areas, and topics including causes and effects
f) When possible be able to separate fact from folklore and speculation regarding the historical development of mathematics
g) Understand the roles that various people and cultures have played in the historical development of mathematics
h) Compare and contrast competing theories regarding the historical development of mathematics
i) Identify and explain how specific mathematical developments changed a given society
j) Identify and explain how various societies developed and used mathematics to solve problems they encountered
k) Identify and analyze recurring themes and critical turning points in the historical development of mathematics
l) Learn the importance of avoiding the imposition of modern views of mathematics and society on the development and use of earlier mathematics

Course Textbooks: a) *Journey Through Genius* by William Dunham; Penguin Books; New York; 1991
b) *Math Through the Ages* by William Berlinghoff and Fernando Gouvea*;* Oxton House Publishing; Farmington, ME; 2014

Course Outline:

I. Evidence of Ancient Number Systems and Mathematics
   A. Egyptian mathematics (*Ahmes Papyrus*, *Moscow Papyrus*; base 10 additive system)
   B. Babylonian mathematics (*Plimpton 322* and other clay tablets; base 60 place value system)

II. Ancient Greek Mathematics
   A. Thales, Pythagoras, Hippocrates, Zeno
      1. Proofs of the Pythagorean Theorem in various cultures and centuries
      2. The Tunnel of Samos
      3. Geometric constructions with compass and unmarked straightedge
      4. The four classical construction problems
         a. Doubling the cube
         b. Trisecting angles
         c. Squaring the circle
         d. Constructing regular polygons
   B. Euclid and his *Elements*
      1. The rise of the axiomatic system in geometry
         a. Method of Exhaustion by Eudoxus
         b. The five Platonic solids
      2. Early number theory including but not limited to
         a. Infinitely many primes
         b. Perfect numbers and Mersenne primes
   C. Archimedes
      1. Contributions to the welfare of Syracuse
      2. Contributions to mechanics
      3. Contribution to pure mathematics
      4. The Palimpsest
   D. Later Greek Mathematicians
      1. Eratosthenes and his sieve for prime numbers
      2. Apollonius and his *Conics*
      3. Heron and his machines and his formula for the area of a triangle
      4. Ptolemy and his *Almagest*
      5. Diophantus and his *Arithmetica*
      6. Hypatia, the first well-known female mathematician
   E. Indian and Hindu Mathematicians and their accomplishments
      1. The Bakhshali Manuscript and the number zero
      2. Aryabhata
      3. Brahmagupta
      4. Mahavira
      5. Bhascara
   F. Middle Eastern and Arab and Islamic mathematicians and their accomplishments
      1. Muhammad ibn Al'Khwarizmi
      2. Tabit ibn Qurra

3. Abu L-Hasan Al-Uqlidisi
4. Umar al'Khayyami (Omar Khayyam)
5. Ghiyath al-Din Jamshid ibn Mas'ud al'Kashi

G. Chinese mathematics
1. The Chinese Rod system and the possible origin of the base 10 place-value system
2. Liu Hui
3. *Nine Chapters on the Mathematical Art*
4. *Sea Island Mathematical Manual*
5. The Arithmetic Triangle (Pascal's Triangle)

H. European Mathematicians (1200 – 1500)
1. Fibonacci and his *Liber Abaci* and the rise of the Hindu-Arabic Number System in Europe
2. Nicole Oresme
3. Piero della Francesca

I. European Mathematicians and Mathematics (1500 – 1650)
1. The Quest for the Cubic and the rise of complex numbers
   a. Luca Pacioli
   b. Scipione del Ferro and Antonio Fiore
   c. Niccolo Fontana (Tartaglia)
   d. Girolama Cardano and his *Ars Magna*
   e. Ludovico Ferrari
   f. Rafael Bombelli
2. The rise of algebraic notation
   a. Francois Viete and his *Analytic Art*
   b. Rene Descartes and his *La Geometrie* including analytic geometry
3. The development of logarithms (John Napier and Joost Burgi)
4. Pierre de Fermat
   a. Number theory and Fermat's Last Theorem
   b. Early calculus problems
   c. Analytic geometry
5. Blaise Pascal

J. European Mathematicians and Mathematics (1650 – 1725)
1. The development and early uses of calculus
   a. Newton
   b. Leibniz
   c. The Bernoulli brothers
   d. L'Hôpital

K. Mathematicians and Mathematics (1725 – 2000)
1. Leonhard Euler and his vast accomplishments
2. Carl Gauss and his vast accomplishments
3. The development of Non-Euclidean geometry (Bolyai, Lobachevski, Gauss)
4. The Prime Number Theorem from conjecture to proof

5. Evariste Galois and Neils Abel
6. The Four Color Theorem from conjecture to proof
7. Georg Cantor
    a. the non-denumerabilty of the real numbers
    b. the denumerabilty of the rational numbers
8. Benoit Mandelbrot and the discovery of fractals

L. A timeline for the number π
M. Some famous women in mathematics (1700 – 1935)

Course Assessments: The objectives of this course will be assessed using a variety of methods including but not limited to:

a) Calculations or other activities based on historical methods
b) Short answer questions based on assigned readings
c) Short essays that reflect critical thinking based on assigned readings
d) Individual or group research projects and presentations to the class on a topic in the history of mathematics
e) Written comparisons of two articles on the same topic in the history of mathematics
f) Written daily comments that make connections between the current topic and past topics
g) Class discussions based on assigned readings
h) Final exam

Last Revised: September 17, 2016