Miami Dade College

Course Description

MHF4404 | History of Mathematics | 3.00 Credits

A study of the development of mathematics from ancient civilizations to the present time. Prerequisite: MAC2312 or approval of department.

Course Competencies:

Competency 1: The student will demonstrate an understanding of the value of knowing the history of mathematics and the importance of recognizing that mathematics is everywhere by:

1. Identifying three "coordinates" of mathematical history: time, the mathematical subject, and the culture/ place
2. Classifying the main events in mathematical history as related to number or numeration, space and geometry, symbols and algebra, analysis and calculus, probability and statistics, and logic and set theory
3. Discuss how small children develop simple mathematics, how geometry occurs in nature, and how mathematics is part of daily life

Competency 2: The student will demonstrate an understanding of how mathematics developed around the world in different cultures/geographic areas and how these different cultures/geographic areas have used mathematics by:

1. Identifying ethnomathematics as the art or technique of understanding, explaining, learning about, coping with, and managing the natural, social, and political environment using mathematics; identifying current leaders in ethnomathematics (e.g., UbiritanD'Ambrosio)
2. Identifying Eurocentrism in mathematics and the mathematicians typically studied in most of our schools today
3. Identify conflicts arising from different views concerning the teaching and learning of mathematics (e.g., using ethnomathematics to teach in diverse classrooms, the "Math wars,"etc)
4. Discuss the beginnings of formalized mathematics and its relationship with religion in India, BCE, and the contributions of Indian mathematicians (e.g., Srinivasa Ramanajun) throughout the ages
5. Discussing the development of formalized mathematics in China, centuries BCE, through their encounter with Western mathematics in the 16th century; identifying Chinese influence on the mathematics of Japan and Korea
6. Discussing the mathematics developed and applied in Egypt since approximately 2000 BCE, its merging with Greek mathematics during the Hellenistic period, and its integration into the more extensive mathematics of the Muslim culture
7. Discuss the mathematics of Mesopotamia centuries BCE, including the earliest use of a symbol for zero.
8. Identifying the mathematical development of the Mesoamericans (Mayans, Aztecs, others) and their applications to numeration (e.g., the Mayans' use of zero), astronomy, and the calendar
9. Identifying the mathematical development of the Incas and their invention of the quipu
10. Discussing the early mathematics of the Greeks and the Romans, with their connections to the mathematics of other earlier cultures and their relationship to philosophy; identifying the contributions of Plutarch, Thales, Socrates and Plato, Euclid, Archimedes, Apollonius, Ptolemy, Diaphantus, Pappus, others
11. Identify the early mathematics of the Muslims, especially as it related to science and art, during the eighth century and beyond; discuss contributions from the Muslim world by individual mathematicians
12. Discuss the mathematical developments in Europe through the Middle Ages and beyond
13. Discuss the mathematical developments in North America, including contributions of mathematicians of different ethnic groups from Canada, the United States (e.g., Benjamin Banneker), and Mexico, during the last three centuries
14. Discuss the Hebrew mathematical contributions and traditions

Competency 3: The student will demonstrate an understanding of the contributions of women to mathematics by:

1. Identifying obstacles women mathematicians have encountered throughout the ages
2. Identifying contributions of women mathematicians in Ancient times (e.g., Hypatia)
3. Identifying contributions modern women (such as Agnesi, the Marquise du Chatelet, and others) have made to mathematics

4. Discussing issues women face today in mathematics

Competency 4: The student will demonstrate knowledge of the historical development of number and number systems, including contributions from diverse cultures by:

1. Discuss different numeration systems and their characteristics (e.g., number of symbols used, place or other value, etc.)
2. Identifying the emergence of zero in different cultures and its importance
3. Identifying different number systems (natural numbers, integers, rationales and irrationals, reals and complex, cardinal and ordinal arithmetic in set theory)
4. Identifying the contributions of Fibonacci (Leonardo de Pisa) in introducing the Hindu-Arabic numeration system to Europe
5. Identifying other "methods of counting" (e.g., combinatorial) and the contributions of modern mathematicians (Fermat, Euler, Lagrange, Legendre, Gauss, Dirichlet, Riemann, Descartes, Dedekind, others)
6. Discussing the development of logarithms and the contributions of Napier to the concept
7. Identifying the challenge of "infinite" numbers in several cultures and the contribution of mathematicians from different cultures (e.g., Cantor) to this area of mathematics

Competency 5: The student will demonstrate knowledge of the historical development of measurement and measurement systems and Euclidean and non-Euclidean geometries, including contributions from diverse cultures by:

1. Discuss similarities across cultures in the use of geometric shapes
2. Different cultures take different approaches to specific measurements and concepts (for example, the approximation of the value of pi)
3. Identifying the use of geometry and measurement by the Egyptians, BCE, in agriculture, building, etc.
4. Identifying the Mesopotamians' use of geometry and measurement, including their use of what was later named the Pythagorean theorem
5. Identifying the use of geometry and measurement by the Chinese, especially in the early centuries CE, in the computation of areas, volumes, and astronomy
6. Identifying the use of geometry and measurement by the Indians, including their approximation of pi and the use of formulas for area and volume, in the early centuries CE
7. Identifying the interconnection of Hebrew theology and geometry in medieval times, with theological topics (e.g., infinity) being discussed through a geometrical context
8. Identifying the different periods of Greek mathematics as it relates to Geometry, and the mathematical events of significance in geometry: Before 400 BCE, when they acquired geometry from Egypt and Mesopotamia and began transforming it into a field of logic and proofs. Beginning in the 4th century BCE, with Plato and Aristotle, and the combination of philosophy and mathematics. Beginning in the 3rd century CE, when geometry was expounded in Euclid's Elements. After that time, with a decline in originality in geometry developments
9. Identifying the contributions of Ancient Greeks to geometry: Thales (eclipse prediction, calculating heights, constructions). Pythagoras and the Pythagoreans (his philosophy, the Pythagorean theorem, paradoxes of the time—including Zeno's paradox). Aristotle and Plato (philosophy and mathematics). Euclid (The Elements). Archimides (equilibrium of planets, principle of the lever, volume of the sphere)
10. Describing the three classical problems in Greek mathematics: Squaring the circle, doubling the cube, and trisecting an angle
11. Discussing the developments in post- Euclidean geometry, including the emergence of non- Euclidean geometries, which involved Saccheri, Gauss, Lobachevski, Bolyai, and Riemann
12. Discussing the emergence of analytic and algebraic geometry, with the contributions of Fermat, Descartes, and Newton
13. Discussing the emergence of projective and descriptive geometry and their use in art, including the contributions of Pascal, Newton, Mobius, and others
14. Discuss the development of differential geometry, its relationship to differential calculus, and the contributions of Newton, Leibniz, Gauss, and others
15. Discussing the development of topology, including combinatorial topology and point-set. Topology and Euler's formula relating the number of faces, vertices, and edges of polyhedral

Competency 6: demonstrate knowledge of the historical development of algebra, including contributions from diverse cultures by:

1. Identify three stages of the development of algebra: Situations that require a process to be followed or an analysis of the data to obtain an answer. Equations are being investigated as independent objects of interest, and techniques are being developed to solve them. Modern algebra (the study of groups, rings, and fields)
2. Identifying events and accomplishments of the first stage in the development of algebra: The beginnings of algebra and problems dealing with proportion in Egypt. The solutions of linear and quadratic problems by the Mesopotamians. Problems leading to algebra by the Indians and the Chinese
3. Identifying events and accomplishments of the second stage in the development of algebra: The Arithmetic of Diophantus. China's approach of approximations to solve equations. Contributions from Japan, including the invention of determinants. Hindu algebra is the use of words. Contributions came from the Muslims who used algebra in the ninth century and brought algebra to Europe. Development of algebra in Europe in the 12th century and beyond, including the introduction of symbols (=, -, +, etc.) instead of words in the statement of mathematical problems
4. Identifying events and accomplishments of the third stage in the development of algebra (Modern Algebra): Solution of equations of degree 4 and higher. Girard and the fundamental theorem of algebra. Contributions of Newton, Leibniz, and Bernoullis. Contributions of Euler, d'Alembert, and Lagrange. Gauss and the fundamental theorem of algebra. Contributions of Ruffini, Cauchy, and Galois in solving higher-degree equations. Algebraic Structures: Groups, rings, and fields

Competency 7: The student will demonstrate knowledge of the historical development of calculus, including contributions from diverse cultures by:

1. Identifying the importance of the invention of calculus: as the synthesis of all the algebra and geometry that existed before. as the basis for many other areas of mathematics
2. Identifying the infinitesimal concept, which is the basis for calculus, and how this concept of infinite exists in calculus in three forms: the derivative, the integral, and the power series
3. Discussing the contributions of Cavalieri, Newton, Leibniz, Bernoulli, L'Hospital, Laplace, and Taylor to calculus
4. Discussing the development of ordinary differential equations, partial differential equations, and calculus of variation
5. Discuss the differences between real and complex analysis and the development of the associated concepts (algebraic integrals, Fourier series, functions, and integrals, completeness of real numbers, uniform convergence and continuity, general integrals, and discontinuous functions)

Competency 8: The student will demonstrate knowledge of the historical development of discrete mathematics, including contributions from diverse cultures by:

1. Discussing Leibniz's concept of creating an artificial language to express propositions
2. Discussing de Morgan's ideas related to symbols, meanings of terms, and logic, and his probability theory.
3. Discussing Boole's Mathematical Analysis of Logic and Laws of Thought
4. Discussing Venn's contributions to set theory, including the Venn diagram
5. Identify Georg Cantor as the founder of set theory and discuss his work on cardinal and ordinal numbers

Competency 9: The student will demonstrate knowledge of the historical development of statistics and probability, including contributions from diverse cultures by:

1. Identifying the reasons why different groups have used probability
2. Discussing how probability theory is pure mathematics, statistics is a science that applies probability to life and life events
3. Discussing the systematic mathematization of probability by Cardano
4. Discussing the contributions of Fermat, Pascal, Huygens, and Leibniz
5. Discussing the contributions of Bernoulli to the theory of probability in his extending the use of the theory into real life and natural phenomena
6. Identifying the contributions of De Moivre to probability theory
7. Discussing the development of statistics and its applications in various fields

Learning Outcomes:

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Demonstrate knowledge of diverse cultures, including global and historical perspectives
- Create strategies that can be used to fulfill personal, civic, and social responsibilities
- Use computer and emerging technologies effectively
- Demonstrate an appreciation for aesthetics and creative activities