

**BOROUGH OF MANHATTAN COMMUNITY COLLEGE**  
City University of New York

**Department of Mathematics**

**History of Mathematics**

**MAT 505**  
**Semester:**  
**Classrooms:**

**Credits: 3**  
**Class hours: 3**

**Instructor:**  
**Office Room:**  
**Office Hours:**  
**Email:**  
**Phone #:**

**Course Description**

Mathematics, like other subjects, is an intellectual product of culture, society, and creative people. This course will discuss the characteristics of the Western mathematics, Islamic, Indian, and the Chinese ones. The development of algebra in the Medieval and the Renaissance, and the formation of the differential and integral calculus will also be discussed. The general trends of mathematics in the eighteenth and nineteenth centuries, and the first half of the twentieth century will be outlined. It will also explore how culture-centered different mathematics merged into a universal modern one.

**What makes this course a Writing Intensive Course?**

This is a Writing Intensive course that fulfills the WI requirement for graduation. Writing intensive courses pay special attention to developing critical reading, writing, and analytic skills to prepare students for the CPE and college-level coursework in general. Both informal and formal writing will be designed to maximize your understanding of the subject matter. Formal writing assignments, at least 10-12 pages total, account for the largest portion of your grade and will include opportunities for revision.

**Prerequisites/Co-requisites**

Students must have taken (or been exempt from) MAT 206, MAT301, MAT302.

**Student Learning Outcomes and Assessment:**

<b>Course Student Learning Outcomes</b>	<b>Measurements</b>
1. Student will be able to complete (a) formal writing assignment(s) of at least 10-12 pages in length that has/have gone through the revision process (e.g. research paper, content-related report, essay).	1. Examples of student papers
2. Student will be able to generate pieces of informal writing in response to a variety of prompts, concepts, situations or reading assignments.	2. Examples of student writing
3. Student will be able to compare characteristics of Babylonian, Egyptian, Greek, Chinese, Indian, and Muslim mathematics.	3. Examples of students writing or oral presentation
4. Students will be able to determine the development of algebra in the Middle Ages and the Renaissance.	4. Examples of students writing or oral presentation

5. Students will be able to identify the major steps in the formation of the calculus.	5. Examples of students writing or oral presentation
6. Students will be exposed to the general trends of mathematics in the 19 <sup>th</sup> and the first half of the 20 <sup>th</sup> centuries.	6. Oral presentation

### General Education Outcomes and Assessment:

General Education Learning Outcomes	Measurements
<b>Communication Skills-</b> Students will be able to write, read, listen and speak critically and effectively.	Oral presentation, informal and formal writing.
<b>Quantitative Reasoning-</b> Students will be able to use quantitative skills and the concepts and methods of mathematics to interpret historical issues.	Oral presentation, informal and formal writing.
<b>Information &amp; Technology Literacy-</b> Students will be able to collect, evaluate and interpret information and effectively use information technologies.	Oral presentation, informal and formal writing.

### Required Text & Readings

*A Contextual History of Mathematics* by Ronald Calinger. Upper Saddle River, New Jersey: Prentice Hall, 1999.

### Evaluation & Requirements of Students

This course is labeled as Written Intensive. As a result, students are required to do THREE 5-minute oral presentations and to write FOUR 2-page informal essays (double space) and ONE 5-page formal essay (also double space). For those who do honor research projects or S-STEM or S-STEP scholarship research projects, they may just write FOUR 2-page informal essays and ONE 12-page research paper for the two purposes.

Arriving late or leaving early will be treated as lateness on the attendance roster. During class time 1) all cell phones MUST be powered off or set into vibration mode; 2) headphones, walkman, CD players, PSP, and iPod, are NOT allowed in the classroom; 3) all children or non-enrolled persons are not permitted to attend class.

The final grade will be defined in the following manner:

Attendance and Class Participations 15%

Oral Presentations 15%

Informal Essays 40%

Formal Essay 30%

Index of the Grade Definitions:

93 – 100 % A

90 – 92 % A-

87 – 89 % B+

83 – 86 % B

80 – 82 % B-

77 – 79 % C+

73 – 76 % C

70 – 72 % C-

67 – 69 % D+  
 63 – 66 % D  
 60 – 62 % D  
 Below 60 % F

### **College Attendance Policy**

At BMCC, the maximum number of absences is limited to one more hour than the number of hours a class meets in one week. For example, you may be enrolled in a three-hour class. In that class, you would be allowed 4 hours of absence (not 4 days). In the case of excessive absences, the instructor has the option to lower the grade or assign an F or WU grade.

### **Academic Adjustments for Students with Disabilities**

Students with disabilities who require reasonable accommodations or academic adjustments for this course must contact the Office of Services for Students with Disabilities. BMCC is committed to providing equal access to all programs and curricula to all students.

### **BMCC Policy on Plagiarism and Academic Integrity Statement**

Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism.

Students who are unsure how and when to provide documentation are advised to consult with the instructor. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's website, [www.bmcc.cuny.edu](http://www.bmcc.cuny.edu). For further information on integrity and behavior, please consult the college bulletin (also available online).

### **Outline of Topics**

<b>I: Before the Advent of Civilization</b>	1
Nature of Mathematics	
1: Origins of Number and Culture	2
<b>II: Antiquity: From Protomathematics to Theoretical Mathematics</b>	17
2.2 Mathematical Achievements in Ancient Mesopotamia	23
2.4 The Mathematical Record in Ancient Egypt	42
<b>3: Beginnings of Theoretical Mathematics in Pre-Socratic Greece</b>	56
3.1 Ancient Greece from 1200 to 600 BCE	56
3.2 The Ionian Nascence and Deductive Reasoning	61
3.3 Seeds of Theoretical Mathematics in Archaic and Classical Greece Sources	63
3.4 Mid-Fifth to the fourth Century BCE	85
3.5 Athens, the School of Hellas	93
<b>4. Theoretical Mathematics Established in Fourth-Century Greece</b>	96
4.1 The Glory That Was Greece: Fourth-Century Athens	97
4.2 The Theory of Irrationals	98
4.3 Plato's Circle	101
4.4 Menaedhmus: Conic Sections and the Method of Analysis and Synthesis	116
<b>5: Ancient Mathematical Zenith in the Hellenistic 3<sup>rd</sup> Century BCE</b>	119

5.1 The Hellenistic Age	120
5.2 The Alexandrian Bridge	124
5.3 Euclid: A Conjectural Life	130
5.4 <i>The Elements</i>	132
5.5 Remainder of the Euclidean Corpus	147
<b>6: Archimedes to Diocles</b>	150
6.1 Archimedes: Life and Work in Outline	150
6.2 Archimedes's Writings	156
6.3 Eratosthenes, Apollonius, and Diocles	170
<b>7: Mathematics in Roman and Later Antiquity, Centering in Alexandria</b>	184
7.1 Early Roman Civilization and Mathematics	185
7.2 Crucial First-Century Changes Affecting Mathematics	192
7.3 Alexandria to 200: Trigonometry, Mensuration, and Arithmetic	194
7.4 Revival and Demise of Ancient Alexandrian Mathematics	208
<b>8: Mathematics in Traditional China from the Late Shang Dynasty to the Mid-17<sup>th</sup> Century</b>	
8.1 Ancient Chinese Civilization to 220	224
8.2 Numeration and Major Literary Sources	226
8.3 Civilization in Imperial China, 220-1644	237
8.4 Mathematics in China, 220-1653	239
<b>9: Indian Mathematics: From Harappan to Keralan Times</b>	259
9.1 The Nature and Sources of Ancient and Medieval Indian Mathematics	259
9.2 The Harappan, Vedic, and Jaina Periods	262
9.3 India's Classical Period	237
9.4 medieval Indian Mathematics	275
9.4 Medieval Indian Mathematics	275
III The Islamic World, Latin West, and Maya America from the Middle to ca. 1500	285
<b>10: Mathematics in the Service of Religion</b>	286
10.1 Early Medieval Europe	286
10.2 A Note on Maya Mathematics and Calendrics	299
<b>11: The Ear of Arabic Primacy and a Persian Flourish</b>	307
11.1 Muhammad, the <i>Qur'an</i> , and Early Medieval Islam	308
11.2 Bayt al-Hikmah: Reception of Foreign Knowledge and Translations	313
11.3 Mathematics at the House of Wisdom and Its Medieval Influence	318
11.4 Mathematics in Medieval Islam after 1055	340
<b>12: Recovery and Expansion in Old Europe, 1000-1500</b>	357
12.1 Political Stabilization and Economic Development	357
12.2 Role of Interactive Learning and Piety	362
12.3 Two Original Medieval Latin Mathematicians	367
12.4 The Rise of Universities and Scholasticism	372
12.5 Style and Applications of Late medieval Mathematical Thought	378
12.6 The Merton School and the School of Paris	381
12.7 The 14 <sup>th</sup> Century Crisis and Recovery	385
12.8 Late 14 <sup>th</sup> and 15 <sup>th</sup> Century Mathematics	390

<b>IV The Transition to Modern Mathematics in Europe</b>	395
<b>13: The First Phase of the Scientific Revolution, ca. 1450-1600</b>	396
13.1 Practical mathematics in High Renaissance and Reformation Europe	397
13.2 A Northern Renaissance and the Early Scientific Revolution	407
13.3 Algebra: Solutions for 3 <sup>rd</sup> - and 4 <sup>th</sup> -Degree Equations	414
13.4 Cardano and Bombelli: Lives and Works	424
13.5 Algebra outside Italy and Cossic Arithmetic during the 16 <sup>th</sup> Century	429
13.6 Viète on the Three Classical Problems and Gregorian Calendar Reform	438
13.7 Theoretical Geometry from 1500 to 1600	440
<b>14: Transformation of Mathematics, ca. 1600-1660: I</b>	447
14.1 Crises and State Making: A Synopsis	449
14.2 Early Baroque Art and Thought	452
14.3 A Second Phase of the Scientific Revolution	455
14.4 Computational Arithmetic in Western Europe from 1570 to 1630	477
14.5 Early 17 <sup>th</sup> -Century Algebra	492
<b>15: Transformation of Mathematics, ca. 1600-1660: II</b>	496
15.1 A New Pentecost	496
15.2 The Invention of Projective Geometry	519
15.3 Quadratures in Retrospect: Multiple Roots of Integral Calculus	523
15.4 A Cornucopia of Curves, the Helen of Geometers, and Rectification	536
15.5 Number: Love and Theory	540
15.6 The Formation of Classical Probability	548
<b>16: The Apex of the Scientific Revolution I</b>	555
16.1 An Age of Absolutism	556
16.2 The Visual Arts, Literature, and Method	561
16.3 Enhanced Organization Base and New Journals	569
16.4 Selective, Transmuting Synthesis and Genius: Highlights	573
<b>17: The Apex of the Scientific Revolution II</b>	598
17.1 Major Sources in Britain after 1650	599
17.2 Newton's Forging of Fluxional Calculus	607
17.3 The Creation of Leibniz's Differential Calculus	615
17.4 The Bernoullis of Basel	627
17.5 More Quarrels and Early Articulation	635
17.6 Algebra and Analytic Number Theory	644
17.7 Classical Probability	649
<b>Outlines of the general trends of mathematics in the eighteenth Century</b>	
<b>Outlines of the general trends of mathematics in the nineteenth Century</b>	
<b>Outlines of the general trends of mathematics in the first half of the twentieth Century</b>	

### Writing Assignments:

- 1) *The class is divided into three groups, one argues for the Babylonians, the other for the Egyptians, and another for the Greeks. Please pick one of them, and write 2 pages arguing the most important mathematical contributions your "people" made for the development of mathematics as well as their lasting impact on our current life.*

- 2) *Music and mathematics are often said to be universal languages. People can communicate with each other through them. Like using different musical instruments to make music, ancient peoples had used different methods to do mathematical calculations. Please write a paper in 2 pages explaining to your younger brother or sister the different approaches to certain topics, for instance, numeration systems, multiplications, square roots extractions, solutions for system of linear equations, and proofs of the Pythagorean theorem, by the Ancient Greeks, Chinese, or the Indians.*
- 3) *Algebra is an important mathematical subject. Everyone who graduates from high school had studied elementary algebra in one way or another. Suppose you are requested to write a blog addressing the development of algebra down to the 16<sup>th</sup> century, please argue why certain mathematicians or mathematical books are important.*
- 4) *Suppose a math-major BMCC freshman sends you a letter asking you what the calculus is? where it comes from? and why he or she has to take it in order to graduate? Please reply the letter answering the raised questions.*
- 5) *Pick one of the previous four assignments, and enlarge it to a 5-page formal thesis.*