

# Syllabus: Course Policies and Procedures

## Contact Information

**Instructor:**

**Email:**

**Phone:**

**Office Hours:**

## Course Information

**Course Titles:** Topics in Mathematics with Integrated Support

**Course Number:** MATH154

**Semester:**

**Class Meetings:**

**Classroom:**

## Course Description and Prerequisite

This course is provided for students who wish to know what mathematics is all about but who do not wish to be mathematicians. Possible topics are: elementary logic, set theory, number systems, mathematical systems, number theory, voting coalitions, geometry, mathematics of finance, topology, linear programming, game theory, and cryptography. A selection of three or more such topics are offered each semester. Prerequisite: waiver by placement testing results; or departmental approval.

## Required Materials

- For this course we will use the following textbook: Angel, Abbot, and Runde, *A Survey of Mathematics With Applications*, 12<sup>th</sup> edition, Pearson, 18-week MyMathLab Code: 9780138306519.
- A scientific calculator is required for this course. I recommend the Texas Instruments TI-30XIIS.

## Instructional Objectives/Student Learning Outcomes

*MATH154 Topics in Mathematics:*

| COURSE OUTCOMES                                                                                                                                                                                      | OUTCOMES ACTIVITIES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| Upon successful completion of this course students should:                                                                                                                                           | To achieve these outcomes students may engage in the following activities:                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Demonstrate an understanding of the language and basic definitions of set theory in order to apply them to solve related problems involving set operations.                                          | <ol style="list-style-type: none"> <li>1. Use set notation.</li> <li>2. Indicate a set using description, roster, and set-builder notation.</li> <li>3. Distinguish between 'is an element of' and 'is a subset of.'</li> <li>4. Identify the empty set.</li> <li>5. Identify the universal set for a given problem.</li> <li>6. Distinguish between subset and proper subset.</li> <li>7. Determine the number of distinct subsets of a set.</li> </ol>                                                                  |
| Solve problems using basic set operations and Venn diagrams to develop the skills needed to solve related problems in this and other courses.                                                        | <ol style="list-style-type: none"> <li>1. Identify a compound statement as a negation, conjunction, disjunction, conditional, or biconditional.</li> <li>2. Translate statements from symbolic logic to English and from English to symbolic logic.</li> <li>3. Use DeMorgan's Laws.</li> <li>4. Write the converse, inverse, and contrapositive of a statement.</li> <li>5. Translate arguments into symbolic form.</li> <li>6. Write the negation of statements involving all, some, some ... not, and none.</li> </ol> |
| Construct truth tables in order to use them to solve related problems                                                                                                                                | <ol style="list-style-type: none"> <li>1. Determine the basic truth tables for negation, conjunction, disjunction, conditional, and biconditional.</li> <li>2. Construct truth tables for compound statements.</li> <li>3. Use truth tables to determine if compound statements are equivalent.</li> <li>4. Determine the truth value of a compound statement.</li> <li>5. Use truth tables and comparison to standard forms to determine the validity of an argument.</li> </ol>                                         |
| Demonstrate an understanding of additive, multiplicative, positional, and ciphered systems of numeration in order to gain an appreciation for numeration systems other than the Hindu-Arabic system. | <ol style="list-style-type: none"> <li>1. Convert back and forth between an additive system, such as the Egyptian or Roman numeration system, and the Hindu-Arabic system of numeration.</li> <li>2. Convert back and forth between a multiplicative system, such as the traditional</li> </ol>                                                                                                                                                                                                                           |

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|                                                                                                                                                                                        | <p>Chinese numeration system, and the Hindu-Arabic system of numeration.</p> <ol style="list-style-type: none"> <li>Convert back and forth between a positional system, such as the Babylonian or Mayan numeration system, and the Hindu-Arabic system of numeration.</li> <li>Convert back and forth between a ciphered system, such as the classical Greek numeration system, and the Hindu-Arabic system of numeration.</li> <li>Add and subtract in some or all of the numeration systems mentioned above.</li> </ol>                                                                                                                                                                                          |
| Perform conversions within base ten and between base ten and other bases and perform computations in other bases in order to better understand the Hindu-Arabic system of numeration.  | <ol style="list-style-type: none"> <li>Convert among standard form, expanded form, and written form.</li> <li>Multiply using some or all of the following methods: <ol style="list-style-type: none"> <li>Successive duplication,</li> <li>Mediation and duplication,</li> <li>Lattice method,</li> <li>Napier's rods.</li> </ol> </li> <li>Convert between base ten and other bases,</li> <li>Add, subtract, multiply, and divide in bases other than ten.</li> </ol>                                                                                                                                                                                                                                             |
| Determine which properties of a mathematical system are satisfied in a given system in order to better understand these properties as they apply to the Hindu-Arabic numeration system | <ol style="list-style-type: none"> <li>Identify the set of elements and the binary operations of a given mathematical system.</li> <li>Perform calculations using a binary operation defined by a table.</li> <li>Determine whether or not the following properties are satisfied in either a given finite or a given infinite mathematical system: <ol style="list-style-type: none"> <li>Closure property,</li> <li>Commutative property,</li> <li>Associative property,</li> <li>Identity property,</li> <li>Inverse property,</li> <li>Distributive property for a system with two binary operations.</li> </ol> </li> <li>Determine if a given mathematical system is a group or an abelian group.</li> </ol> |
| Perform calculations, solve problems, and analyze properties of modulo systems in order to better understand finite mathematical systems.                                              | <ol style="list-style-type: none"> <li>Determine if two numbers are congruent modulo <math>m</math>.</li> <li>Add, subtract, and multiply modulo <math>m</math>.</li> <li>Solve linear equations in modulo systems.</li> <li>Determine whether or not a given modulo system is an abelian group.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                        |

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|                                                                                                                                                                               | 5. Solve applications problems involving modulo systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Demonstrate an understanding of some of the basic results in number theory in order to gain an appreciation of number and numeracy.                                           | <ol style="list-style-type: none"> <li>1. Apply the rules of divisibility.</li> <li>2. Find all the divisors of a given number.</li> <li>3. Determine if a given number is prime or composite.</li> <li>4. Write the prime factorization of a given composite number.</li> <li>5. Find the greatest common divisor of two numbers.</li> <li>6. Find the least common multiple of two numbers.</li> <li>7. Determine if a number is abundant, deficient, or perfect.</li> <li>8. Determine if two numbers are friendly numbers.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Demonstrate an understanding of sequences in order to gain an appreciation of number and numeracy.                                                                            | <ol style="list-style-type: none"> <li>1. Determine the next term of a given sequence.</li> <li>2. Determine if a given sequence is arithmetic, geometric, Fibonacci, or neither.</li> <li>3. For an arithmetic sequence whose first term and common difference are known, find <ol style="list-style-type: none"> <li>a. The next several terms,</li> <li>b. The general term,</li> <li>c. The sum of the first <math>n</math> terms.</li> </ol> </li> <li>4. For a geometric sequence whose first term and common ratio are known, find <ol style="list-style-type: none"> <li>a. The next several terms,</li> <li>b. The general term,</li> <li>c. The sum of the first <math>n</math> terms.</li> </ol> </li> <li>5. For a Fibonacci sequence whose first two terms are known, <ol style="list-style-type: none"> <li>a. Find the next several terms,</li> <li>b. Find the ratios of successive terms and compare this sequence of ratios with the 'golden ratio.'</li> </ol> </li> </ol> |
| Demonstrate an understanding of various voting methods and various apportionment methods in order to gain an appreciation of these methods as seen in real-life applications. | <ol style="list-style-type: none"> <li>1. Solve election problems using the plurality method, the Borda count method, the plurality with elimination method, the pairwise comparison method, the sequential pairwise comparison method, and/or the approval voting method.</li> <li>2. Determine if a given voting method violates the majority criterion, the Condorcet criterion, the monotonicity criterion, and/or the independence of irrelevant alternatives method.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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|                                                                                                                                                     | <ol style="list-style-type: none"> <li>3. Explain Arrow's Impossibility Theorem.</li> <li>4. Solve apportionment problems using the Hamilton method, the Jefferson method, and the Webster method.</li> <li>5. Explain the quota rule, the Alabama paradox, the population paradox, and the new states paradox.</li> <li>6. Verify that a specified paradox occurs for a given apportionment scenario.</li> <li>7. Explain the Balinski and Young Impossibility Theorem.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Demonstrate an understanding of basic definitions and properties of Euclidean geometry and measurement formulas in order to solve related problems. | <ol style="list-style-type: none"> <li>1. Correctly identify lines, rays, half-lines, and line segments.</li> <li>2. Correctly identify acute angles, right angles, obtuse angles, and straight angles.</li> <li>3. Correctly identify triangles as obtuse, right, or obtuse, and as scalene, isosceles, or equilateral.</li> <li>4. Correctly identify a given quadrilateral as a trapezoid, parallelogram, rhombus, rectangle, or square.</li> <li>5. Correctly identify a polygon by the number of its sides.</li> <li>6. Solve problems involving vertical angles, complementary angles, and supplementary angles.</li> <li>7. Solve problems involving parallel lines cut by a transversal.</li> <li>8. Solve problems involving the sum of the angles in a polygon.</li> <li>9. Solve problems involving similar triangles and congruent triangles.</li> <li>10. Solve problems involving right triangles and the Pythagorean Theorem.</li> <li>11. Use measurement formulas to find <ol style="list-style-type: none"> <li>a. Perimeter of polygons,</li> <li>b. Area of triangles and quadrilaterals,</li> <li>c. Circumference and area of circles,</li> <li>d. Volume of rectangular solids, pyramids, cylinders, cones, and spheres,</li> <li>e. Surface area of three-dimensional objects.</li> </ol> </li> </ol> |
| Use simple and compound interest formulas in order to solve applications problems involving interest rates.                                         | <ol style="list-style-type: none"> <li>1. Calculate simple interest and maturity value.</li> <li>2. Calculate compound interest and maturity value.</li> <li>3. Calculate present value.</li> <li>4. Understand and compute effective annual yield.</li> <li>5. Find the value of an annuity.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| Use formulas involved in installment buying in order to make informed decisions in real-life situations involving buying on credit.                                                                                                  | <ol style="list-style-type: none"> <li>1. Determine the amount financed, the installment price, and the finance charge for a fixed loan.</li> <li>2. Determine the APR.</li> <li>3. Compute unearned interest and the payoff amount for a loan paid off early.</li> <li>4. Find the interest, the balance due, and the minimum monthly payment for credit card loans.</li> <li>5. Calculate interest on credit cards using the unpaid balance method, the previous balance method and/or the average daily balance method.</li> </ol>                                                                                                                    |
| Examine the cost of home ownership in order to make decisions as an educated consumer.                                                                                                                                               | <ol style="list-style-type: none"> <li>1. Compare and contrast fixed-rate mortgages and variable-rate mortgages.</li> <li>2. Given information on income and monthly payments due, determine the maximum mortgage amount a given home buyer is qualified to borrow.</li> <li>3. Compute interest costs for a fixed-rate mortgage.</li> <li>4. Compute the down payment.</li> <li>5. Prepare a partial loan amortization schedule for a fixed-rate mortgage.</li> <li>6. Compute closing costs.</li> </ol>                                                                                                                                                |
| Demonstrate an understanding of investing in stocks, bonds, and mutual funds in order to make decisions as an educated consumer.                                                                                                     | <ol style="list-style-type: none"> <li>1. Compare and contrast stocks, bonds, and mutual funds as investments.</li> <li>2. Get information from stock tables.</li> <li>3. Calculate the basic cost for a given number of shares of a specific stock using stock tables.</li> <li>4. Calculate broker fees.</li> <li>5. For a given investment scenario, find the total purchase price, the total dividend amount, the capital gain or loss, the total return, and the percentage return.</li> <li>6. Find the total return earned by a given bond investment.</li> <li>7. Find the effective rate of return for a given mutual fund scenario.</li> </ol> |
| Demonstrate an understanding of the basic definitions and properties of network theory, topology, hyperbolic geometry, elliptic geometry, and fractals in order to develop an appreciation for the nature of non-Euclidean geometry. | <ol style="list-style-type: none"> <li>1. In a given network determine which vertices are even and which are odd.</li> <li>2. Determine if a given network is traversable or not.</li> <li>3. Find a path that traces a traversable network.</li> <li>4. Solve related network problems.</li> <li>5. Identify the genus of an object.</li> </ol>                                                                                                                                                                                                                                                                                                         |

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|                                                                                                                                                                                              | <ol style="list-style-type: none"> <li>6. Determine if two objects are topologically equivalent.</li> <li>7. For hyperbolic and elliptic geometry <ol style="list-style-type: none"> <li>a. Identify at least one mathematician responsible for its development.</li> <li>b. Identify the surface required for this type of geometry.</li> <li>c. Explain how Euclid's parallel postulate is changed.</li> <li>d. Explain why the sum of the measures of the angles in a triangle is not <math>180^\circ</math>.</li> </ol> </li> <li>8. Describe what a fractal is.</li> <li>9. Use iteration techniques to demonstrate the construction of a fractal.</li> </ol> |
| Use linear programming methods in order to solve maximum and minimum problems.                                                                                                               | <ol style="list-style-type: none"> <li>1. Solve a linear programming problem by <ol style="list-style-type: none"> <li>a. Writing the appropriate inequalities subject to the given restrictions or constraints and the objective equation.</li> <li>b. Graphing the inequalities to find the region of feasible solutions.</li> <li>c. Determine the corner points of the feasible region.</li> <li>d. Use the objective equation to determine which of these points gives a maximum or minimum value.</li> </ol> </li> <li>2. Solve related applications problems.</li> </ol>                                                                                    |
| Demonstrate an understanding of the basic definitions and rules of game theory in order to gain an appreciation of the applications of game theory in business, economics, and the sciences. | <ol style="list-style-type: none"> <li>1. Construct the game matrix for a given two-person game.</li> <li>2. Determine whether or not a game matrix represents a strictly determined game.</li> <li>3. Given the matrix for a strictly determined game, identify the saddle point, find the optimal pure strategy for each player, and the value of the game.</li> <li>4. Given the matrix for a game that is not strictly determined, find the optimal mixed strategy and the value of the game for the row player.</li> <li>5. Solve related application problems.</li> </ol>                                                                                    |
| To strengthen Core Competencies** in order to increase success in this and other courses and in the workplace.                                                                               | Referenced above                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## Teaching Procedures

This course will be taught in a lecture/discussion format with ample opportunity for student questions. Generally, class will begin with a question and answer session on the most recent homework assignment. New material will then be presented in a lecture format and homework be assigned to reinforce the topics covered in class.

## Course Topics, Assignments, and Readings

|                                                                    |
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| <b>Topics</b>                                                      |
| 3.1 Statements and Logical Connectives                             |
| 3.2 Truth Tables for Negation, Conjunction, and Disjunction        |
| 3.3 Truth Tables for the Conditional and Biconditional             |
| 3.4 Equivalent Statements                                          |
| 3.5 Symbolic Arguments                                             |
| <b>Exam 1</b>                                                      |
| 10.1 Percent                                                       |
| 10.2 Personal Loans and Simple Interest                            |
| 10.3 Compound Interest                                             |
| 10.4 Installment Buying                                            |
| 10.5 Buying a House with a Mortgage                                |
| 10.6 Ordinary Annuities, Sinking Funds, and Retirement Investments |
| <b>Exam 2</b>                                                      |
| 14.1 Voting Methods                                                |
| 14.2 Flaws of Voting Methods                                       |
| 14.3 Apportionment Methods                                         |
| 14.4 Flaws of Apportionment Methods                                |
| <b>Exam 3</b>                                                      |

## Tentative Test Schedule

- Exam 1:
- Exam 2:
- Exam 3:

## Basis for Student Grading

Grades for these courses will be assigned as follows based on the percentages. You will be assigned the same grade for both courses.

|    |            |
|----|------------|
| A  | 93% - 100% |
| A- | 90% - 92%  |
| B+ | 87% - 89%  |
| B  | 83% - 86%  |
| B- | 80% - 82%  |

|    |           |
|----|-----------|
| D+ | 67% - 69% |
| D  | 63% - 66% |
| D- | 60% - 62% |
| F  | 0% - 59%  |

|    |           |
|----|-----------|
| C+ | 77% - 79% |
| C  | 73% - 76% |
| C- | 70% - 72% |

## Basis for Evaluating Student Performance

The grade for this course will be determined by the percentage of points earned to total points available, based on the following categories:

- Exams (100%): There will be three in-class exams given during the semester. Each exam will account for 33% of your final grade.

## Attendance Policy

Attendance for this course is mandatory and students are expected to attend all class meetings.

## Academic Dishonesty

Academic Dishonesty is defined in the Massasoit Student Code of Conduct to include cheating, falsification of information, working on assignments with classmates without permission, plagiarism, purchasing or submitting assignments from others, or theft of materials. If there is information that academic dishonesty occurred, a faculty member may choose to act as outlined in the course syllabus, including issuing a failing grade for the assignment or the course.

Students may also be referred to the Dean of Students Office for disciplinary action under the Massasoit Student Code of Conduct. If the student believes that there is substantial evidence of error or injustice associated with a failing grade issued because of academic dishonesty, the student may file a grievance under the Grade Appeal Process.

Where the issuance of a failing grade by a faculty member for academic dishonesty will result in a student's dismissal from a program (for example in nursing and other health care programs), the charge of academic dishonesty shall be directly referred to the Dean of Students Office for administration under the Student Code of Conduct.

## Access & Disability Resources

The Office of Access & Disability Resources (ADR) is committed to ensuring that students with disabilities have equal, effective, and meaningful access to all academic programs, community events, goods, and services provided by the College in compliance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act. Students with disabilities interested in establishing eligibility for services and/or academic accommodations will need to voluntarily disclose their disability to ADR, submit qualifying documentation and complete an ADR Intake meeting. During the meeting reasonable and appropriate academic accommodations will be determined. Visit the [Office of Access and Disability Services website](#) for more information and to begin the process to establish eligibility.

ADR uses a platform called Accommodate to manage the accommodation process. To make an initial accommodation request, please [submit a request through Accommodate to ADR](#).

Returning students with accommodations previously approved can request updated Accommodation Letters by accessing the ADR card in the MyMassasoit student portal. Log into Accommodate and click on Semester Request.

Students are expected to check in with faculty regarding approved accommodations. Communication between students, faculty, and ADR is key to successful accommodation implementation.

Students can contact ADR at 508-588-9100 x1807 or by email at [adr@massasoit.mass.edu](mailto:adr@massasoit.mass.edu).