

**Course: Advanced Mathematics**

**Instructor:** Mrs. Gillingham

**Academic year:** 2008 - 2009

**Course philosophy:** Welcome to my class! Mathematics is an extremely interesting and exciting pursuit. In this course, you have the opportunity to reinforce and extend your understanding of concepts learned in previous mathematics courses as well as to learn more sophisticated skills. Throughout the course, emphasis is placed on the processes used to find solutions, not on the solutions themselves. It is necessary to learn different problem solving strategies and to be able to explain the methods used to find solutions to problems both in oral and written form. Mathematics is a skill that requires practice, practice, practice. Also, you have opportunities to apply your mathematical knowledge and skills to real life situations via word problems. In addition, technology is used in a variety of ways to enhance learning.

**Materials required:** Texts  
Graphing calculator (TI-84 Plus)  
Notebook for homework

**Classroom expectations:**

1. Come to class on time.
2. Come to class prepared. Bring all the required materials and completed homework to class each day.
3. When you arrive in class, immediately get out your homework and begin work on the indicated warm-up exercise. Do not wait for me to start class.
4. You are responsible for any material covered or announcements made during your absence.
5. Respect yourself and others. Dishonest and inappropriate behaviors are not acceptable.
6. Finally, give each task your best effort and remain positive. You may find some of the concepts and problems quite challenging, but do not give up. There is great satisfaction found in persevering until a concept is mastered! Mathematics is an extremely interesting and exciting subject to explore!

**Homework policies:**

Mathematics is a skill, and, like all skills, it must be practiced. Homework is an important part of the learning process and is assigned almost every night. All homework should be done in pencil and kept in a notebook. It must be labeled with the page number and problem numbers. You must include the work for each problem, not just the answer. Most assignments are due at the beginning of the next class period. The maximum amount of focused, uninterrupted time spent on math homework should be 30 minutes/night for a regular course and 40 minutes/night for an honors course.

**Grading procedure:**

Grades are determined by points earned out of points possible. Major tests are cumulative and are always announced; quizzes may or may not be announced. Weighting factors are as follows:

tests and quizzes 90%  
homework 10%

**Additional information:**

The SAT 2 Math Level 2 Subject Test may be taken in May, but it is not required.

**Tentative Adv. Mathematics Schedule Text: Algebra and Trigonometry  
Structure and Method Book 2  
(Brown, Dolciani, Sorgenfrey & Kane, 2000)  
Text: Stats Modeling the World  
(Bock, Velleman & De Veaux, 2004)**

Week Chapters Sections Topics

1 12 All Triangle trigonometry  
2 12 All Triangle trigonometry  
3 12 All Triangle trigonometry  
4 12 All Triangle trigonometry  
5 13 All Trigonometric graphs; identities  
6 13 All Trigonometric graphs; identities  
7 13 All Trigonometric graphs; identities  
8 13 All Trigonometric graphs; identities  
9 14 All Trigonometric applications  
10 14 All Trigonometric applications  
11 14 All Trigonometric applications  
12 Review and exam

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13 9 All Analytic geometry  
14 9 All Analytic geometry  
15 9 All Analytic geometry  
16 16 All Matrices and determinants  
17 16 All Matrices and determinants  
18 16 All Matrices and determinants  
19 11 All Sequences and series  
20 11 All Sequences and series  
21 11 All Sequences and series  
22 1, 2 Data  
23 3 Displaying and describing categorical data

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24	4	Displaying quantitative data
25	5	Describing distributions numerically
26	6	Standard deviation and the normal model
27	6	Standard deviation and the normal model
28	7	Scatterplots, association, and correlation
29	8	Linear regression
30	8	Linear regression
31	14	Probability
32	15	Probability
33	15	Probability
34		Review
35		Final exam

## **Advanced Mathematics Outline**

### **I. Triangle trigonometry**

#### A. Trigonometric functions

1. Degree, minute, second
2. Angles
  - a. Directed
  - b. Quadrantal
    - c. Coterminal
3. Definitions
  - a. Sine
  - b. Cosine
  - c. Tangent
  - d. Cotangent
  - e. Secant
  - f. Cosecant
4. Cofunctions
5. Reference triangles
6. Finding values of trigonometric functions

#### B. Solving right triangles

1. Finding sides and angles
2. Angle of elevation; angle of depression
3. Law of Cosines
4. Law of Sines

#### C. Solving general triangles

1. SSS
2. SAS
3. SSA
4. ASA and AAS

#### D. Applying triangle area formulas

## II. Trigonometric graphs and identities

### A. Circular functions

#### 1. Radian measure

- a. Converting from degrees to radians and vice versa
  - b. Finding arc length
  - c. Finding area of a sector
- #### 2. Trigonometric functions defined as circular functions
- #### 3. The 16-point unit circle

### B. Graphs of trigonometric functions

#### 1. Periodicity

#### 2. Symmetry

##### a. Even

##### b. Odd

#### 3. Amplitude

#### 4. Asymptotes

#### 5. Transformations of graphs

##### a. Horizontal and vertical translations

##### b. Reflections over the $x$ - and $y$ -axes

##### c. Horizontal and vertical stretches and shrinks

### C. Identities

#### 1. Reciprocal identities

#### 2. Cofunction identities

#### 3. Pythagorean identities

#### 4. Strategies for proving identities

#### 5. Addition formulas

#### 6. Double-angle formulas

#### 7. Half-angle formulas

## III. Trigonometric applications

### A. Vectors

#### 1. Definition

#### 2. Equivalent vectors

#### 3. Vector addition

#### 4. Scalar multiplication

#### 5. Norm of a vector

#### 6. Unit vector

#### 7. Bearing of a vector

#### 8. Component form

#### 9. Dot product

#### 10. Orthogonal vectors

### B. Polar coordinates

#### 1. Definition

2. Converting from polar to rectangular coordinates and vice versa
- C. Complex numbers
  1. Plotting complex numbers in the complex plane
  2. Trigonometric form of a complex number
  3. Modulus or absolute value
  4. Amplitude or argument
  5. De Moivre's Theorem
- D. Inverse trigonometric functions
- E. Solving trigonometric equations

#### **IV. Analytic geometry**

- A. Distance and midpoint formulas
- B. Conic sections
  1. Circles
    - a. Definition
    - b. Radius and center
    - b. Standard equation
    - d. Translation
  2. Parabolas
    - a. Definition
    - b. Focus, directrix, vertex, axis of symmetry
    - c. Equation in completed square form
    - d. Direction of opening (up, down, left, right)
  3. Ellipses
    - a. Definition
    - b. Center, foci, vertices, major axis, minor axis, Pythagorean relation
    - c. Standard equation
  4. Hyperbolas
    - a. Definition
    - b. Center, foci, vertices, Pythagorean relation, asymptotes
    - c. Standard equation
- C. Systems of equations
  1. Geometry of quadratic systems
  2. Using algebraic methods to find solutions of quadratic systems
  3. Solving systems of linear equations in three variables

#### **V. Matrices and determinants**

- A. Definition of terms
  1. Matrix
    - a. Elements
    - b. Rows
    - c. Columns

- d. Dimensions
- 2. Types of matrices
  - a. Row matrix
  - b. Column matrix
  - c. Square matrix
  - d. Zero matrix
  - e. Identity matrix
  - f. Inverse matrices
- B. Operations with matrices
  - 1. Addition and subtraction of matrices
    - a. Definition
    - b. Properties of addition of matrices
  - 2. Scalar multiplication
    - a. Definition
    - b. Properties of scalar multiplication
  - 3. Matrix multiplication
    - a. Definition
    - b. Properties of matrix multiplication
- C. Applications of matrices
  - 1. Communication matrix
  - 2. Dominance relation
- D. Determinants
  - 1. Finding determinants
    - a. Of a  $2 \times 2$  matrix
    - b. Of a  $3 \times 3$  matrix
  - 2. Finding the inverse of a matrix
  - 3. Evaluating third-order determinants using expansion by minors
  - 4. Properties of determinants
  - 5. Cramer's Rule: solving systems of equations using determinants

## **VI. Sequences and series**

- A. Arithmetic
  - 1. Definition
  - 2. Common difference
  - 3. Finding a formula for the  $n$ th term
  - 4. Finding specified terms
  - 5. Arithmetic means
- B. Geometric
  - 1. Definition
  - 2. Common ratio
  - 3. Finding a formula for the  $n$ th term
  - 4. Finding specified terms

- 5. Geometric means
- C. Applications (word problems)
  - D. Series and sigma notation
- E. Sums of finite arithmetic and geometric series
- F. Infinite geometric series
- G. Binomial expansions

## **VII. Statistics**

- A. Data
  - 1. Who, what, where, when, why, and how of data
  - 2. Types of data
    - a. Categorical
    - b. Quantitative
- B. Displaying and describing categorical data
  - 1. Distribution
    - a. Marginal
    - b. Conditional
  - 2. Types of displays
    - a. Frequency tables
    - b. Bar chart
    - c. Pie chart
    - d. Contingency table
  - 3. Area principle
  - 4. Independent variables
  - 5. Simpson's paradox
- C. Displaying quantitative data
  - 1. Types of displays
    - a. Histogram
    - b. Stem-and-leaf plot
    - c. Dotplot
    - d. Timeplot
  - 2. Shape of a distribution
    - a. Single vs. multiple modes
    - b. Symmetry vs. skewness
    - c. Outliers, cluster, or gaps
- D. Describing distributions numerically
  - 1. Measures of center
    - a. Mean
    - b. Median
  - 2. Measures of spread
    - a. Standard deviation
    - b. Interquartile range
    - c. Range
    - d. Variance

- 3. Percentile
- 4. Five-number summary
  - a. Consists of minimum, Q1, median, Q3, maximum
  - b. Display by using boxplots
- E. Standard normal model
  - 1. Benefits of standardizing
  - 2.  $z$ - scores
  - 3. The 68-95-99.7 Rule
- F. Scatterplots
- G. Correlation
  - 1. Conditions
  - 2. Properties
  - 3. Tables
  - 4. Difference between association and correlation
- H. Linear regression and residuals

## **VIII. Probability**

- A. Trials, outcomes, and sample space
- B. Events
  - 1. Independent
  - 2. Disjoint (mutually exclusive)
- C. Rules
  - 1. Law of large numbers
  - 2. Complement Rule
  - 3. Addition Rule
  - 4. Multiplication Rule
  - 5. General Addition Rule
  - 6. General Multiplication Rule
- D. Conditional probability