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Course Outline for MATH 47

MATHEMATICS FOR LIBERAL ARTS

Effective: Fall 2019

I. CATALOG DESCRIPTION:
MATH 47 — MATHEMATICS FOR LIBERAL ARTS — 3.00 units

An introduction to a variety of mathematical concepts for students interested in liberal arts. Intended to cultivate an appreciation of the significance of mathematics in daily life and help develop students' mathematical reasoning. Topics include personal finance, logic, and exponential growth.

3.00 Units Lecture

Prerequisite
MATH 55 - Intermediate Algebra for BSTEM
with a minimum grade of C
or

MATH 55B - Intermediate Algebra for STEM B
with a minimum grade of C
or

MATH 50 - Intermediate Algebra for SLAM
with a minimum grade of C
or

NMAT 250 - Intermediate Algebra for SLAM
with a minimum grade of C
or

NMAT 255 - Intermediate Algebra for BSTEM
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:
- Mathematics

	MIN
Lecture Hours:	54.00
Expected Outside of Class Hours:	108.00
No Unit Value Lab	18.00
Total Hours:	180.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. MATH55
1. Recognize and determine the distinctions between relations and functions, numerically, graphically, symbolically, and verbally;
2. Given a function, determine the domain and range and express them in interval notation;
3. Solve polynomial, rational, absolute value, radical, linear, exponential, and logarithmic equations;
4. Apply basic operations on functions, including composition of functions and finding inverse functions;
5. Develop and use equations or function models to analyze and solve applied problems involving linear, quadratic, rational, radical, exponential or logarithmic expressions. Topics should minimally include growth, decay, geometry, optimization and uniform motion.
6. Factor polynomials, including using the sum and difference of cubes;

7. Use the properties of radicals, complex numbers, exponents and logarithms;

B. MATH55B
1. Solve polynomial, rational, absolute value, radical, linear, exponential, and logarithmic equations;
2. Apply basic operations on functions, including composition of functions and finding inverse functions;
3. Develop and use equations or function models to analyze and solve applied problems involving linear, quadratic, rational, radical, exponential or logarithmic expressions. Topics should minimally include growth, decay, geometry, optimization and uniform motion.
4. Use the properties of radicals, complex numbers, exponents and logarithms;

C. MATH50
1. Explain and/or justify the solution process orally or in writing
2. Use algebraic operations to simplify polynomial, rational and radical expressions
3. Simplify radicals and use properties of exponents to simplify expressions with integer or rational exponents
4. Create equations in one variable and use them to solve problems. (Include equations arising from polynomial functions, and simple rational, radical, exponential and logarithmic functions.)
5. Solve a formula for a specified variable
6. Determine whether a mathematical structure is a relation or function, find the domain and range and express them in interval, inequality or set notation (includes: polynomial, radical, rational, exponential, and logarithmic functions)
7. Represent functions verbally, symbolically, numerically and graphically and use function notation
8. Perform operations with functions, including composition of functions (includes: polynomial, radical, rational, exponential, and logarithmic functions)
9. Solve applied problems with functions (includes: polynomial, radical, rational, exponential, and logarithmic functions)
10. Construct, use and interpret mathematical models (includes: polynomial, radical, rational, exponential, and logarithmic functions)
11. Compare linear, quadratic and exponential change
12. Construct and interpret data charts, tables and graphs with appropriate labels and scales
13. Calculate the probability of an event using the equally likely probability formula, the properties of probability, the sum rule, the product rule or a tree diagram
14. Find and use a probability distribution

D. NMAT250
1. Explain and/or justify the solution process orally or in writing
2. Use algebraic operations to simplify polynomial, rational and radical expressions
3. Simplify radicals and use properties of exponents to simplify expressions with integer or rational exponents
4. Create equations in one variable and use them to solve problems. (Include equations arising from polynomial functions, and simple rational, radical, exponential and logarithmic functions.)
5. Solve a formula for a specified variable
6. Determine whether a mathematical structure is a relation or function, find the domain and range and express them in interval, inequality or set notation (includes: polynomial, radical, rational, exponential, and logarithmic functions)
7. Represent functions verbally, symbolically, numerically and graphically and use function notation
8. Perform operations with functions, including composition of functions (includes: polynomial, radical, rational, exponential, and logarithmic functions)
9. Solve applied problems with functions (includes: polynomial, radical, rational, exponential, and logarithmic functions)
10. Construct, use and interpret mathematical models (includes: polynomial, radical, rational, exponential, and logarithmic functions)
11. Compare linear, quadratic and exponential change
12. Construct and interpret data charts, tables and graphs with appropriate labels and scales
13. Calculate the probability of an event using the equally likely probability formula, the properties of probability, the sum rule, the product rule or a tree diagram
14. Find and use a probability distribution

E. NMAT255
1. Recognize and determine the distinctions between relations and functions, numerically, graphically, symbolically, and verbally;
2. Given a function, determine the domain and range and express them in interval notation;
3. Solve polynomial, rational, absolute value, radical, linear, exponential, and logarithmic equations;
4. Apply basic operations on functions, including composition of functions and finding inverse functions;
5. Develop and use equations or function models to analyze and solve applied problems involving linear, quadratic, rational, radical, exponential or logarithmic expressions. Topics should minimally include growth, decay, geometry, optimization and uniform motion.
6. Factor polynomials, including using the sum and difference of cubes;
7. Use the properties of radicals, complex numbers, exponents and logarithms;

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. Find unions, intersections and complements of sets;
B. Use Venn diagrams to solve problems
C. Solve applied problems involving simple and compound interest
D. Solve applied problems involving annuities, sinking funds and amortization
E. Construct truth tables to determine validity of an argument
F. Identify logically equivalent statements
G. Translate an English statement into symbolic notation
H. Develop an appropriate (linear or exponential) model for a real-world problem
I. Problem solve, model, use multiple representations of, and communicate clearly through a variety of mathematical concepts such as: Counting, Probability, Statistics, Voting, Apportionment, Graph Theory, Number Systems, Modular Arithmetic, Mathematics and Art, and History of Mathematics.

V. CONTENT:

A. Logic
1. Concepts of Set Theory
    a. Subsets, set equality, union, intersection, complement
    b. DeMorgan's Laws
    c. Venn Diagrams
2. Simple and Compound Statements
    a. Tautologies, contradictions
    b. Negations
    c. Conditional, converse, inverse, contrapositive
3. Connectives
4. Symbolic Notation
5. Validity of an Argument
6. Truth Tables

B. Finance
    1. Simple and compound interest
    2. Future value and present value
    3. Annuities, sinking funds and amortization
C. Exponential growth and linear growth
    1. Linear Functions
        a. Slope and rate of change
        b. Applications and models
    2. Exponential Functions
        a. Applications and models
        b. Logarithms
D. At least three topics to be chosen by the instructor. Topics to be selected from the following list:
    1. Probability
        a. Basics of probability
        b. Complement and union of events
        c. Conditional probability
    2. Counting Techniques
        a. Fundamental Counting Principle
        b. Permutations
        c. Combinations
    3. Statistics
        a. Organizing and visualizing data
            1. Frequency Distributions
            2. Histograms
            3. Bar graphs, circle graphs, line graphs
        b. Measures of central tendency
            1. Mean
            2. Median
            3. Mode
            4. Five-number summary
            5. Boxplot
        c. Measures of variation
            1. Range
            2. Standard Deviation
            3. Variance
            4. Coefficient of variation
        d. Normal Distribution
    4. Graph Theory
        a. Basic Concepts
            1. Walks, paths, circuits
            2. complete graphs
        b. Special Graphs
            1. Euler circuits
            2. Hamilton circuits
            3. Trees
        c. Graph Algorithms
            1. Fleury
            2. Nearest Neighbor
            3. Brute Force
        d. Traveling Salesman Problem
    5. Voting and Apportionment
        a. Hunting-Hill Apportionment Principle
        b. Paradoxes
        c. Voting Methods and their defects
        d. Weighted Voting Systems
    6. Number and Mathematical Systems
        a. Early Numeration Systems
        b. Place-Value Systems
        c. Arithmetic in Different Base Systems
        d. Modular Arithmetic
    7. Mathematics and Art
        a. Tesselations
        b. Fractals
        c. Fibonacci and other sequences
        d. Geometry
    8. History of Mathematics
        a. Concepts and history of specific branches of mathematics, such as Calculus
        b. Profile of famous mathematicians in history
        c. Survey of mathematics in different cultures

VI. METHODS OF INSTRUCTION:

A. Laboratory assignments
B. Homework
C. Group and individual activities in class
D. Assigned readings in the text
E. Lecture and classroom discussion

VII. TYPICAL ASSIGNMENTS:

A. Homework
    1. Problems from the text should be assigned for each section covered. The number of problems assigned may vary from section to section and from instructor to instructor, but the homework assignments should include a sufficient number and variety of problems to develop both skill and conceptual understanding. A typical assignment should take an average student 1 to 2 hours for each hour in class.
    2. The majority of the problems assigned should be those for which answers are readily available (e.g., from the answer appendix in the text), so that students may obtain immediate feedback on their work.
    3. Homework assignments may include reading the text. Students may be asked to read sections in advance of the lecture and then to re-read them after the lecture to reinforce important concepts and skills. An instructor may require written work in conjunction with the reading assignments (e.g, have students complete a Q & A sheet related to the assigned reading).
B. Laboratory

1. Lab assignments can be used to reinforce fundamental concepts and skills or to explore certain concepts in more depth than is possible in class. They may be designated for individual or group work.
2. Sample lab assignment: Find the website for a candidate or initiative (for or against) in an upcoming or recent election. Study the arguments given on the site, looking for examples of fallacies. Write a brief summary of the fallacies. Overall, does the site make a strong or weak case for its candidate or position? Explain.

C. In-Class
1. Collaborative learning, done in small groups of 2-4 students, can be used to introduce new concepts, build skills, or teach problem-solving. Students can be asked to present their results on the board.
2. Sample collaborative learning assignment: (Traveling Salesman Problem) Given a set of 7 cities and their distances from each other, in your group, determine the shortest route connecting all 7 cities and returning to the starting city. Then as a class, determine the shortest route by considering each group's answer. Is it possible to find a shorter route?

VIII. EVALUATION:

Methods/Frequency

A. Exams/Tests
Recommended minimum of 3 exams plus final.

B. Quizzes
Number of quizzes at the discretion of the instructor.

C. Research Projects
Number of research projects at the discretion of the instructor.

D. Class Work
Number of collaborative activities at the discretion of the instructor.

E. Home Work
Homework should be assigned for each section covered.

F. Lab Activities
Recommended minimum of eight laboratory assignments over the semester.

IX. TYPICAL TEXTS:

1. Johnson, David, and Thomas Mowry. *Mathematics A Practical Odyssey.* 8 ed., Cengage, 2016.
2. Miller, Charles, Vern Heeren, John Hornsby, and Christopher Heeren. *Mathematical Ideas.* 13 ed., Addison-Wesley, 2016.
3. Pirnot, Tom. *Mathematics All Around.* 6th ed., Pearson, 2018.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Scientific Calculator