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Course Outline for MATH 1

CALCULUS I

Effective: Fall 2016

I. CATALOG DESCRIPTION:
MATH 1 — CALCULUS I — 5.00 units

An introduction to single-variable differential and integral calculus including: functions, limits and continuity; techniques and applications of differentiation and integration; the Fundamental Theorem of Calculus; areas and volumes of solids of revolution.

5.00 Units Lecture

Prerequisite
MATH 20 - Pre-Calculus Mathematics
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	90.00
Total Hours:	90.00

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. MATH20
1. Find zeros of polynomials using the Rational Root Theorem and synthetic division;
2. Graph algebraic functions and relations;
3. Prepare detailed graphs of conic sections;
4. Create mathematical models using algebraic or transcendental functions;
5. Graph using translations, reflections and distortions;
6. Identify and use the trigonometric functions in problem solving;
7. Simplify trigonometric expressions and prove trigonometric identities;
8. Develop and use exponential, logarithmic and trigonometric formulas;
9. Graph exponential, logarithmic and trigonometric functions and their inverses;
10. Recognize the relationship between functions and their inverses graphically and algebraically
11. Solve and apply equations including rational, linear, polynomial, exponential, absolute value, radical, and logarithmic, and solve linear, nonlinear, and absolute value inequalities
12. Solve trigonometric equations, triangles, and applications
13. Graph the basic trigonometric functions and apply changes in period, phase and amplitude to generate new graphs
14. Solve systems of equations and inequalities
15. Identify special triangles and their related angle and side measures

IV. MEASURABLE OBJECTIVES:

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

A. Evaluate the limit of a function at a real number;
B. Determine whether a function is continuous at a point or an interval;
C. Find and interpret average and instantaneous rates of change;
D. State the definition of the derivative as the limit of a difference quotient and use the definition to find the derivative of a function;
E. Interpret the derivative as the slope of a tangent line and find the equation of a tangent line to a function;
F. Explain the definitions of velocity and acceleration and use the derivative to find the velocity and acceleration of an object in motion, given the position function for the object;
G. State and apply the rules for differentiating algebraic and trigonometric functions.
H. Utilize the chain rule when differentiating functions;
I. Work with differentials and their applications;
J. Use calculus-based methods to analyze functional behavior;
K. Sketch the graphs of functions using the methods of calculus;
L. Find all maxima, minima and points of inflection of a function;
M. Use implicit differentiation;

N. Evaluate the limit of a function at infinity;
O. Apply differentiation to solve related rate and optimization problems;
P. Apply the Mean Value Theorem;
Q. Utilize Newton's Method;
R. Evaluate a definite integral as the limit of a Riemann sum;
S. Apply the Fundamental Theorem of Integral Calculus;
T. Evaluate integrals by the method of substitution;
U. Find areas between curves and volumes of solids of revolution;
V. Use the precise definition of a limit to prove a limit exists.

V. CONTENT:

A. Limits
    1. Left-hand limits and right-hand limits
    2. Computing limits
        a. Numerically
        b. Graphically
        c. Algebraically
    3. Limits of trigonometric functions
    4. Limits at infinity
    5. Precise definition of a limit
B. Average and instantaneous rates of change
C. Continuity
    1. Definition of continuity
    2. Continuity at a real number
    3. Continuity on an interval
    4. Discontinuous functions
        a. Types of discontinuities
        b. Removable discontinuities
D. Intermediate Value Theorem
E. Secant and tangent lines
F. Average and instantaneous rates of change; velocity and acceleration
G. Definition of the derivative as the limit of a difference quotient
H. Interpretation of the derivative
    1. Slope of a tangent line
    2. Rate of change
    3. Derivative as a function
I. Differentiation formulas and techniques
    1. Differentiation of constant-valued function
    2. Power rule
    3. Product rule
    4. Quotient rule
    5. Trigonometric functions
    6. Chain rule
    7. Implicit derivative
    8. Higher-order derivatives
J. Applications of differentiation
    1. Rate of change
    2. Related rates
    3. Optimization
K. Functional analysis
    1. Mean Value Theorem
    2. Critical numbers
    3. Maximum and minimum values (absolute and local)
L. Curve sketching: algebraic, rational and trigonometric functions
    1. First Derivative Test
    2. Second Derivative Test
    3. Test for Concavity and Points of Inflection
    4. Extrema
    5. Asymptotic behavior
        a. Limits at infinity
        b. Horizontal and vertical asymptotes
M. Differentials and their applications
N. Newton's Method
O. Antiderivatives
P. Definite integral
    1. Interpretation as area under a curve
    2. Defined as limit of a Riemann Sum
    3. Evaluation of a definite integral as the limit of a Riemann Sum
Q. Indefinite integrals
R. Properties of definite and indefinite integrals
S. Fundamental Theorem of Calculus
T. Integration
    1. As antidifferentiation
    2. Method of substitution
U. Applications of integration
    1. Area under a curve
    2. Area between curves
    3. Volume of a solid of revolution
V. Inverse functions
    1. Differentiation of inverse functions

VI. METHODS OF INSTRUCTION:

A. **Discussion** -
B. **Lecture** -
C. Web- or CD-Rom-based tutorials
D. Student presentations
E. Collaborative learning

VII. TYPICAL ASSIGNMENTS:

A. Homework
   1. Homework should be assigned from the text and should include a sufficient number and variety of problems to develop both skill and conceptual understanding. A typical assignment should that an average student 1 to 2 hours for each hour in class.

B. Collaborative learning
   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 may be asked to present their results on the board.
   2. Example collaborative learning assignment: Have each group solve a curve-sketching problem and then present their work to the rest of the class, explaining the process they used and their results.

VIII. EVALUATION:

A. **Methods**

   1. Exams/Tests
   2. Quizzes
   3. Home Work
   4. Other:
      a. Collaborative Group Activities

B. **Frequency**

   1. Exams/Tests
      a. Recommend minimum of four exams
      b. Comprehensive final examination
   2. Quizzes
      a. Announced or unannounced, in-class or take home at the discretion of the instructor
   3. Homework
      a. Assigned for each section covered
   4. Collaborative Group Activities
      a. At the discretion of the instructor

IX. TYPICAL TEXTS:

1. Larson, R., & Edwards, B. (2014). *Calculus* (10th ed.). Boston, MA: Cengage Learning.
2. Briggs, W., Cochran, L., & Gillett, B. (2015). *Calculus* (2nd ed.). Boston, MA: Pearson.
3. Rogawski, J., & Adams, C. (2015). *Calculus* (3rd ed.). New York, NY: W.H Freeman.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Graphing calculator may be required