NORTHERN ARIZONA UNIVERSITY
College of Engineering, Forestry & Natural Sciences

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MAT 136 CALCULUS I
MASTER SYLLABUS

CATALOG DESCRIPTION

MAT 136 Calculus I (4). Calculus of one variable; basic concepts, interpretations, techniques, and applications of differentiation and integration. Letter grade only. Course fee required. *Prerequisite*: MAT 125 or MAT 125H with a grade greater than or equal to C or satisfactory mathematics placement.

COURSE INFORMATION

This course fulfills a requirement in the Science/Applied Science distribution block in the University Liberal Studies program. It supports the mission of the program to prepare students to live responsible, productive, and creative lives as citizens of a dramatically changing world through the study of Calculus and its applications. Essential skills in this course are critical thinking, quantitative reasoning, and scientific reasoning.

LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Demonstrate an understanding of the concepts of limit, derivative and integral in writing, and graphically.
2. Calculate, or approximate as appropriate, the limit of a function using appropriate techniques including l'Hospital's rule.
3. Find the derivative of elementary polynomial, exponential, logarithmic and trigonometric functions.
4. Use rules of differentiation including the power rule, product rule, quotient rule, chain rule, and implicit differentiation to compute the derivative of a function. Obtain expressions for higher order derivatives of a function.
5. Interpret the derivative as the instantaneous rate of change and as the slope of the tangent line.
6. Apply the derivative to find the line tangent to a function at a point and the linearization of a function at a point.
7. Apply the derivative to analyze graphical behavior of a function, motion problems, other rate problems, and optimization problems.
8. Construct a definite integral as the limit of a Riemann sum and use the sum to approximate a definite integral.
9. Find the anti-derivative of elementary polynomial, exponential, logarithmic and trigonometric functions.
10. Use substitution to find the anti-derivative of a composite function.

11. Evaluate a definite integral and interpret an indefinite integral as a definite integral with variable limit(s) in order to evaluate it.
12. Apply the definite integral to analyze the area under a curve and motion problems.
13. Apply the Fundamental Theorem of Calculus.
14. Apply differentiation and integration in setting up and critically evaluating hypotheses in the fields of science, engineering and technology.

COURSE CONTENT

1. Functions and Models - 4-6 days
   Review of functions including linear, exponential, power, logarithmic, trigonometric, polynomial and rational functions. Inverse functions, compositions and transformations, modeling.
2. Limits and Derivatives - 12-13 days
   Development of the notion of derivative via tangents and velocity. Limits of a function, limit laws, limits involving infinity, continuity, tangents, formal derivatives as functions, linear approximations, relationships between properties of a function and its derivative, rate of change and velocity, law of falling bodies in a constant gravitational field.
3. Differentiation Rules -10-11 days
   Derivatives of polynomial, exponential, trigonometric and logarithmic functions. Product rule, quotient rule, chain rule, implicit differentiation, linear approximations.
4. Applications of Differentiation - 11-12 days
   Related rates, Maxima/Minima, creation and analysis of graphs of functions, l'Hospital's Rule and indeterminate forms, applied optimization problems, anti-derivatives with applications to the analysis of motion.
5. The Integral - 13-14 days
   Computation of areas and distances, definite integrals, Fundamental Theorem of Calculus, integration by substitution.

STRUCTURE AND APPROACH

The course will use any or all of: lecture, discussion, student presentations, in-class work, or group work. In addition, students may use technology (e.g. Mathematica, or graphing calculators).

ASSESSMENT

The assessment procedures include: at least three, preferably four mid-term exams; a comprehensive final exam (minimum 20%); and some selection of (a) homework assignments (WebWork or other), (b) in-class work, and (c) quizzes.

CURRENT AND RECENT TEXTS

1. *MAT 136 Calculus I Lecture Notes* by J. Neuberger, N. Sieben and J. Swift: http://jan.ucc.nau.edu/ns46/CLN
2. Whitman Online Text: http://www.whitman.edu/mathematics/multivariable/
3. Paul's Online Math Notes: http://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx
4. Stewart: *Calculus – Concepts and Contexts*