HIBBING COMMUNITY COLLEGE
COURSE OUTLINE

COURSE NUMBER & TITLE: MATH 2101 - Calculus 1
CREDITS: 5 (5 Lec/ 0 Lab)
PREREQUISITES: Math 1040: College Algebra with a grade of "C" or better **and** MATH 1300: Trigonometry with a grade of "C" or better; or MATH 1501: Pre-Calculus with a grade of "C" or better, or Placement Test

CATALOG DESCRIPTION:
Calculus 1 covers rates of change, limits, vertical asymptotes, continuity, tangents, basic derivatives, differentiation rules, the derivative as a rate of change, derivatives of trigonometric functions, the chain rule, parametric equations, implicit differentiation, related rates, linearization and differentials, extreme values, the Mean Value Theorem, monotonic functions and the First Derivative Test, concavity and curve sketching, optimization problems, indeterminate forms, L'Hopital's Rule, Newton's method, antiderivatives, finite sums, sigma notation, limits of finite sums, the definite integral, the fundamental theorem of calculus, indefinite integrals, the substitution rule, area between curves, and applications of integrals. MNTC goal area: (4)Math & Logical Reasoning.

OUTLINE OF MAJOR CONTENT AREAS:

I. Preliminaries
   - A. Real numbers and the real line
   - B. Lines, circles and parabolas
   - C. Functions and their graphs
   - D. Identifying functions; mathematical models
   - E. Combining functions; shifting and scaling graphs
   - F. Trigonometric functions
   - G. Graphing with calculators and computers

II. Limits and continuity
   - A. Rates of change and limits
   - B. Using the limit laws
   - C. The limit definition
   - D. One-sided limits and limits at infinity
   - E. Infinite limits and vertical asymptotes
   - F. Continuity
   - G. Tangents and derivatives

III. Differentiation
   - A. The derivative as a function
   - B. Differentiation rules
   - C. The derivative as a rate of change

D. Derivatives of trigonometric functions
E. The chain rule and parametric equations
F. Implicit differentiation
G. Related rates
H. Linearization and differentials

IV. Applications of derivatives
A. Extreme values of functions
B. The mean value theorem
C. Monotonic functions and the first derivative test
D. Concavity and curve sketching
E. Optimization
F. Indeterminate forms and L'Hopital's Rule
G. Newton's Method
H. Antiderivatives

V. Integration
A. Estimating with finite sums
B. Sigma notation and limits of finite sums
C. Definite integrals
D. The Fundamental Theorem of Calculus
E. Indefinite integrals and the substitution rule
F. Substitution and area between curves

VI. Applications of definite integrals

COURSE GOALS/OBJECTIVES/OUTCOMES:

Students will

1. solve inequalities and show their solution sets on the real line.
2. calculate absolute values and know the basic properties of absolute value, including the triangle inequality.
3. solve equations involving absolute values.
4. solve inequalities involving absolute value and show the solution set on the real line.
5. find the net changes in a particle's coordinates as it moves from a point P to a point Q.
6. given the increments from the point P to the point Q and the coordinates of one of these points, determine the coordinates of the other point.
7. define the slope of a straight line and calculate the slope (if any) of the line determined by two given points.
8. find the slope (if any) of a line perpendicular to a line determined by two given points.
9. write an equation of any vertical line given a point on the line.
10. write an equation of any line with given slope and passing through a given point.
11. write an equation of any line given two points on the line.
12. recognize an equation as representing a line and determine the slope (if any), the x-intercept (if any), and the y-intercept (if any).

13. graph any equation representing a line.
14. find an equation of the line passing through a given point and parallel or perpendicular to a given line.
15. calculate the distance between two points.
16. find equations of circles.
17. given a circle's equation, determine its center and radius by completing the square.
18. recognize and graph equations of parabolas.
19. given an equation for a function y=f(x), calculate the value of f at a specified point, find the domain and range of f, and graph f by making a table of pairs.
20. make a table of values and graph a piecewise defined function.
21. write formulas for piecewise defined functions.
22. identify linear functions, power functions, polynomials, rational functions, algebraic functions, trigonometric functions, exponential functions, logarithmic functions, and transcendental functions.
23. identify increasing, decreasing, even, and odd functions.
24. combine functions algebraically.
25. compose and decompose functions.
26. given an equation representing a graph, write an equation for a shifted graph when the number of units and directions of the shift are specified.
27. given an equation representing a graph, write an equation for a reflected graph.
28. find trigonometric function values.
29. know from memory, the most important trigonometric formulas.
30. know from memory, the values of the trigonometric functions for all angles which are multiples of 30^o or 45^o.
31. graph a table of values and find the corresponding regression equation using a calculator.
32. calculate average rate of change.
33 calculate instantaneous rate of change.
34. determine the behavior of a function near a point.
35. find limits by calculating $f(x_o)$.
36. discuss behavior of functions which have no limit at a given point.
37. use the limit laws.
38. evaluate the limit of a rational function and the limit of a function that is both rational and radical.
39. apply the sandwich theorem.
40. state the delta-epsilon definition of the limit of a function.
41. prove limits using the delta-epsilon definition of the limit of a function.
42. evaluate one-sided limits and limits at infinity.
43. evaluate limits using the fact that the limit of y= (sinx)/x as x approaches 0 is 1.
44. calculate limits as x approaches infinity or minus infinity.
45. use limits at infinity to determine horizontal asymptotes.
46. find oblique asymptotes.

47. determine infinite limits and locations of vertical asymptotes.
48. use dominant terms to determine function behavior.
49. determine continuity or discontinuity at a point and over an interval of values.
50. for a given function, find a continuous extension to a point.
51. state and utilize the intermediate value theorem.
52. write equations of tangent lines.
53. calculate the derivative of a function at a point.
54. state the definition of the derivative of a function.
55. calculate derivatives from the definition.
56. determine the derivative of a function by applying rules of differentiation.
57. utilize derivative notation.
58. graph derivative functions.
59. calculate second- and higher-order derivatives.
60. recognize the derivative as a rate-of-change.
61. use the derivative to represent velocity, speed, acceleration, and jerk.
62. model free fall and vertical motion.
63. model economics using derivatives.
64. use the derivative as a measure of sensitivity to change.
65. derive the derivative functions for sine and cosine.
66. use the sine and cosine derivatives to find the derivatives for the tangent, cotangent, secant, and cosecant functions.
67. evaluate derivatives and higher-order derivatives for trigonometric functions.
68. use the Chain Rule to determine the derivative of a composite function.
69. parameterize curves.
70. graph parametric curves.
71. find slopes of parametric curves.
72. find second derivatives with parametric equations.
73. differentiate implicitly.
74. find second derivatives implicitly.
75. utilize the derivative to develop and analyze mathematical models which involve related rates of change.
76. find linearizations.
77. find differentials.
78. utilize the derivative to develop and analyze mathematical models which involve extreme values.
79. state and utilize Rolle's Theorem.
80. state and utilize the Mean Value Theorem.
81. state and utilize the corollaries of the Mean Value Theorem.
82. use the first derivative test to determine where a function is increasing or decreasing and to determine the locations of local extrema.
83. determine the concavity and points of inflection of a graph using the second derivative test.
84. use derivatives to solve optimization problems.
85. state L'Hopital's rule.

86. apply L'Hopital's rule to indeterminate forms.
87. apply Newton's method to approximate zeros of functions.
88. discuss examples for which Newton's method fails.
89. state the definition of an antiderivative.
90. find antiderivatives of functions.
91. solve initial value problems using antiderivatives.
92. find indefinite integrals.
93 estimate area using finite sums.
94. represent finite sums using sigma notation.
95. use the finite sum algebra rules and the formulas for the sum of the first n integers, the sum of the first n squares, and the sum of the first n cubes.
96. evaluate limits of finite sums.
97. use a Riemann sum to define and evaluate a definite integral.
98. use the rules for definite integrals.
99. evaluate area between curves using definite integrals.
100. calculate the average value of a continuous function using a definite integral.
101. prove and apply parts one and two of the Fundamental Theorem of Calculus.
102. use substitution to evaluate an integral.
103. evaluate the indefinite integrals of $(\sin x)^2$ and $(\cos x)^2$.
104. evaluate definite integrals of symmetric functions.
105. calculate areas by integrating with respect to x and with respect to y.
106. use geometric formulas to evaluate definite integrals.
107. use definite integrals in application problems.

MNTC GOALS AND COMPETENCIES MET:
Mathematical/Logical Reasoning a, b, c, and d

HCC COMPETENCIES MET:
Communicating Clearly & Effectively
Thinking Creatively & Critically

STUDENT CONTRIBUTIONS:
The student will attend class regularly, participate in class discussion, complete daily assignments, in class exercises, exams, and a comprehensive final examination. The student will spend a minimum of two hours completing assignments for every hour in class. These must be accomplished in such a way that they meet minimum standards set by the instructor.

STUDENT ASSESSMENT SHALL TAKE PLACE USING INSTRUMENTS SELECTED/DEVELOPED BY THE COURSE INSTRUCTOR.

SPECIAL INFORMATION: (SPECIAL FEES, DIRECTIVES ON HAZARDOUS MATERIALS):

The student may be required to provide a calculator for this course. If a specific calculator model is required, this model will be specified by the instructor on the course syllabus. Examples of calculators which may be required include but are not limited to the following: the TI89 and the TI Voyage 200.

AASC APPROVAL: January 18, 2012

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