ILLINOIS VALLEY COMMUNITY COLLEGE

Course Syllabus

DIVISION: English, Mathematics, Education

Course: MTH 2001 - Calculus and Analytical Geometry I

Date: April 18, 2013

Semester Hours: 5.0

Prerequisite(s): MTH 1005 or 1003 and 1004, or the equivalent with a grade of C or better and satisfactory score on placement test or consent of instructor.

Delivery Method:

☒	**Lecture**	**5 Credit Hours**
☐	**Seminar**	**0 Credit Hours**
☐	**Lab**	**0 Credit Hours**
☐	**Clinical**	**0 Credit Hours**

☐ **Online**

☐ **Blended**

Offered: ☒ **Fall** ☒ **Spring** ☐ **Summer**

IAI Equivalent –***Only for Transfer Courses***-go to *http://www.itransfer.org*:

CATALOG DESCRIPTION:

This course is the first in a three-semester sequence of analytic geometry and calculus. Topics include real numbers, lines, circles, conics, functions, limits, derivative and anti-derivative with applications, transcendental functions and the definite integral with applications.

GENERAL EDUCATION GOALS ADDRESSED

[See the last page of this form for more information.]

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

[Choose those goals that apply to this course.]

☒ To apply analytical and problem solving skills to personal, social and professional issues and situations.
☐ To communicate orally and in writing, socially and interpersonally.
☐ To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
☒ To understand and use contemporary technology effectively and to understand its impact on the individual and society.
☒ To work and study effectively both individually and in collaboration with others.
☐ To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
☐ To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
☒ To appreciate the ongoing values of learning, self-improvement, and career planning.

based on the Illinois Mathematics Standards (IMS) for Teachers

Upon completion of this course a student should be able to:

Knowledge Objectives

- Evaluate limits of functions. (IMS 3A, 5A)
- State and use the epsilon-delta definition of limit. (IMS 3A)
- Understand and apply the concept of continuity (including the Intermediate Value Theorem). (IMS 3A, 4B,5A)
- Understand and use the definition of derivative and interpret the derivative as an instantaneous rate of change and as the slope of the tangent line to a function at a point. (IMS 3A, 5A)
- Differentiate functions using the rules for differentiation: power, product, quotient, and chain rules. (IMS 3A)
- Differentiate functions implicitly. (IMS 3A)
- Understand and apply Rolle's Theorem and the Mean Value Theorem. (IMS 4B)
- Locate extreme values, points of inflection, and asymptotes of graphs of functions. (IMS 3A,5A)
- Solve applied maxima/minima problems. (IMS 2A, 3A, 4B, 5A)
- Solve related rate problems. (IMS 2A, 3A, 4B, 5A)
- Find and apply higher order derivatives and understand how they relate to the graph of a function. (IMS 3A, 5A)
- Understand and apply Newton's Method. (IMS 3A, 5A, 6B3)
- Know the development of and connections between exponential and logarithmic functions. (IMS 3A, 7A6)
- Apply calculus to transcendental functions. (IMS 3A)

- Find areas between curves. (IMS 3A, 5A)
- Use definite integrals to compute areas. (IMS 3A, 5A)
- Use definite integrals to solve problems involving work. (IMS 2A, 3A, 4B, 5A)

Performance Objectives

- Evaluate limits of functions. (IMS 3B, 6D1, 6D2, 7C8, 8C1, 8C2, 8C4, 8C5, 8C6)
- State and use the epsilon-delta definition of limit. (IMS 3B, 6D3, 8C4, 8C5, 8C6)
- Understand and apply the concept of continuity (including the Intermediate Value Theorem). (IMS 2C, 3B, 6D3, 8C5, 8C6)
- Understand and use the definition of derivative and interpret the derivative as an instantaneous rate of change and as the slope of the tangent line to a function at a point. (IMS 2C, 3B, 7C8, 8C5, 8C6)
- Differentiate functions using the rules for differentiation: power, product, quotient, and chain rules. (IMS 7C8, 8C5, 8C6)
- Differentiate functions implicitly. (IMS 8C5, 8C6)
- Understand and apply Rolle's Theorem and the Mean Value Theorem. (IMS 2C, 3B, 6D3, 7C8, 8C5, 8C6)
- Locate extreme values, points of inflection, and asymptotes of graphs of functions. (IMS 3B, 6C1, 6D1, 6D2, 7C8, 8C5, 8C6)
- Solve applied maxima/minima problems. (IMS 2C, 3B, 6C1, 6D1, 6D2, 7C8, 8C5, 8C6)
- Solve related rate problems. (IMS 2C, 3B, 6C1, 6C2, 6D1, 6D2, 7C8, 8C5, 8C6)
- Find and apply higher order derivatives and understand how they relate to the graph of a function. (IMS 2C, 3B, 6C1, 6D1, 6D2, 7C8, 8C5, 8C6)
- Understand and apply Newton's Method. (IMS 2C, 3B, 6C1, 6D3, 8C5, 8C6)
- Know the development of and connections between exponential and logarithmic functions. (IMS 3B, 7B6, 8C5, 8C6)
- Apply calculus to transcendental functions. (IMS 3B, 6D1, 6D2, 7B5, 7C8, 8C5, 8C6)
- Find areas between curves. (IMS 3B, 6D1, 6D2, 7C8, 8C5, 8C6)
- Use definite integrals to compute areas. (IMS 3B, 6D1, 6D2, 7C8, 8C5, 8C6)
- Use definite integrals to solve problems involving work. (IMS 2C, 3B, 6D1, 6D2, 7C8, 8C5, 8C6)

II. Course Assignments/Assessments/Artifacts *(by Standard and Indicator)*

<u>2A</u>

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Written analysis of videos modeling problem solving;
- Reflective writing on problem solving;

- Writing/analyzing multiple solution strategy problem solving;
- Peer tutoring on problem solving strategies.

2C

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams that demonstrate the ability to generalize mathematical properties from specific cases/problems and formulate theorems or discover more general situations where such properties apply.

3A

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on reasoning;
- Completion of proofs;
- Peer tutoring on reasoning.

3B

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on reasoning with technology;
- Completion of proofs;
- Peer tutoring on reasoning with technology.

4B

- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing on mathematics and how it relates to other disciplines.

5A

- Evaluations of appropriate use of technology on homework problems or class discussions or problem/project presentations or quizzes/exams requiring the use of technology: programming language or graphing calculator or mathematics software or internet resources or power point.

6B3

- Evaluations of ability to apply iteration to Newton's Method through homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing.

6C1 and 6C2

- Use number sense and proportional reasoning in the solving of calculus problems (finding extrema, points of inflections, asymptotes, max/min problems, related rates, Newton's Method) as evaluated by homework

problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Peer tutoring on number sense and proportional reasoning.

6D1 and 6D2
- Evaluations of appropriate use of algorithms with or without technology to solve problems as evidenced by homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Peer tutoring on use of algorithms with or without technology to solve problems.

6D3
- Evaluations of ability to apply and use numerical integration to approximate results and solve problems as evidenced by homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing.

7A6 and 7B6
- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams on logarithmic scale and finding derivatives and integrals of exponential/ logarithmic functions including in application problems.

7C8
- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams on modeling areas under curve as summation of rectangles and use of slices and shells to visualize volume.

8C1, 8C2, and 8C4
- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;
- Reflective writing;
- Completion of proofs involving limits and how they relate to rates of change, distance, area, and volume.

8C5 and 8C6
- Evaluations of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise;

- Reflective writing;
- Completion of proofs on ALL aspects of calculus: derivatives, integrals, continuity, limits, applications.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

[Outcomes related to course specific goals.]

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

1. Students will demonstrate knowledge of coordinates, graphs, and lines.
1.1. Students will be able to identify integers, rational numbers, and irrational numbers.
1.2. Students will be able to express sets in set builder notation.
1.3. Students will be able to solve inequalities and sketch solutions on coordinate line.
1.4. Students will be able to solve absolute values.
1.5. Students will be able to locate points on a Cartesian plane.
1.6. Students will be able to sketch the graphs of equations.
1.7. Students will be able to find slopes and equations of lines passing through points.
1.8. Students will be able to demonstrate if lines are parallel, perpendicular, or neither.
1.9. Students will be able to find the standard equation of a circle.

2. Students will demonstrate knowledge of functions and limits.
2.1. Students will be able to find the natural domain and range of functions.
2.2 Students will be able to express functions in piecewise form without using absolute values.
2.3. Students will be able to express functions as composition of two functions.
2.4 Students will be able to identify monomials, polynomials, rational functions, and explicit algebraic functions.
2.5. Students will be able to determine if a function is even, odd, or neither.
2.6. Students will be able to express x explicitly as a function of y.
2.7. Students will be able to express y explicitly as a function of x.
2.8. Students will be able to determine limits from graphs of functions.
2.9. Students will be able to determine limits from functions computationally.
2.10. Students will be able to determine one-sided limits.
2.11. Students will be able to demonstrate limits as x->00.
2.12. Students will be able to find points of discontinuity.
2.13. Students will be able to find limits of trigonometric functions.

3. Students will demonstrate knowledge of differentiation.
3.1. Students will be able to find the average rate of change.
3.2. Students will be able to find the instantaneous rate of change.
3.3. Students will be able to sketch secant and tangent lines of graphs.
3.4. Students will be able to find the slope and the equation of tangent lines.
3.5. Students will be able to find dy/dx and higher order derivatives.

3.6. Students will be able to find all points where the graph of the function has a horizontal tangent line.
3.7. Students will be able to find the derivatives of trigonometric functions.
3.8. Students will be able to find derivatives using the chain rule.
3.9. Students will be able to find derivatives using implicit differentiation.
3.10. Students will be able to find delta y x, dy, and dx and their differences.

4. Students will demonstrate knowledge of applications of differentiation.
4.1. Students will be able to find the rate at which some quantity is changing by relating it to other known quantities.
4.2. Students will be able to find where functions are increasing and decreasing.
4.3. Students will be able to find where functions are concave up and concave down.
4.4. Students will be able to find inflection points.
4.5. Students will be able to sketch a continuous curve with stated properties.
4.6. Students will be able to locate critical points and determine whether a relative maximum, relative minimum, or neither occurs there.
4.7.Students will be able to find symmetries, x-intercepts, y-intercepts, asymptotes, intervals of increase and decrease, stationary points, concavity, and inflection points of rational functions.
4.8. Students will be able to find the maximum and minimum values on the given closed interval and state where these values occur.
4.9. Students will be able to apply maximum and minimum problems to real life applications.
4.10. Students will be able to approximate values using Newton's Method.
4.11. Students will be able to verify that the hypothesis of Rolle's Theorem and Mean Value Theorem are satisfied on the given interval and find all values of c that satisfy the conclusion of the theorem.
4.12. Students will be able to discuss motion along a line by determining the velocity and acceleration based on position.

5. Students will demonstrate knowledge of integration.
5.1. Students will be able to evaluate integrals intuitively.
5.2. Students will be able to evaluate integrals by substitution.
5.3. Students will be able to evaluate summations.
5.4. Students will be able to express open form summations in sigma notation.
5.5. Students will be able to express sigma notations in closed form.
5.6. Students will be able to compute areas under a curve using summations and left endpoints, right endpoints, or midpoints.
5.7. Students will be able to express definite integrals as limit.
5.8. Students will be able to evaluate definite integrals by using area formulas from plane geometry.
5.9. Students will be able to demonstrate whether the value of the integral is positive or negative.
5.10. Students will be able to determine whether the function is integrable on the given interval.

5.11. Students will be able to evaluate the definite integrals using the First Fundamental Theorem of Calculus.
5.12. Students will be able to evaluate definite integrals by substitution.
5.13. Students will be able to use the Second Fundamental Theorem of Calculus to find the derivative.

6. Students will demonstrate knowledge of applications of the definite integral.
6.1. Students will be able to find areas of shaded regions of graphs.
6.2. Students will be able to sketch the region enclosed by the curves and find the area.
6.3. Students will be able to find the volume of the solid that results when a shaded region is revolved about the indicated axis.
6.4. Students will be able to use cylindrical shells to find the volume of the solid generated when the shaded region is revolved about the indicated axis.
6.5. Students will be able to find the arc length of the given curves.
6.6. Students will be able to find the area of the surface generated by revolving the given curve about the given axis.

7. Students will demonstrate knowledge of logarithmic and exponential functions.
7.1. Students will be able to simplify exponential and logarithmic expressions without calculators.
7.2. Students will be able to obtain an approximate value of the expressions using calculators.
7.3. Students will be able to expand logarithms in terms of sums, differences, and multiples of simpler logarithms
7.4. Students will be able to rewrite the expression as a single logarithm.
7.5. Students will be able to find solve for the variable without using a calculator.
7.6. Students will be able to find the derivatives of logarithmic functions
7.7. Students will be able to evaluate indefinite integrals with logarithmic functions.
7.8. Students will be able to perform logarithmic differentiation.
7.9. Students will be able to find the limits of exponential functions.
7.10. Students will be able to determine whether the function has an inverse.
7.11. Students will be able to express the given quantity as a power of e.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Preliminary concepts
   A. Sets
   B. Properties of real numbers
   C. Inequalities
   D. The coordinate line
   E. Absolute value
   F. Functions and their graphs

II. Basic analytic geometry
   A. The straight line

B. The circle

III. Limits and continuity
A. Definitions
B. Theorems on limits
C. One sided limits
D. limits as X -- ± 00

IV. Derivatives
A. Definitions and evaluation
B. Formulas for differentiation
C. Higher order differentiation
D. Implicit differentiation
E. Differentials

V. Applications of the derivative
A. Slope, tangent, normals
B. Rate of change problems
C. Problems in maximum and minimum
D. Curve sketching

VI. Integrals
A. Antiderivatives
B. Applications of the antiderivative
C. Definition and properties of definite integrals
D. Fundamental theorem of calculus
E. Evaluation of definite integrals
F. Application of definite integrals to areas, volumes, length of arc, and surface areas

VII. Transcendental functions
A. Logarithmic functions
B. Exponential functions
C. Trigonometric functions

INSTRUCTIONAL METHODS:

1. Lecture
2. Class participation
3. Audio-visual aids
4. Instructional quizzes and exams

INSTRUCTIONAL MATERIALS:

1. Text: *Calculus*, 8th edition, Houghton Mifflin, 2006.
2. Computer for demonstration
3. TI-89 graphing calculator for demonstrations

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

1. Homework from text
2. Class participation
3. Tests
4. Quizzes
5. Grading scale:

   100 - 90% A
   89 - 80% B
   79 - 70% C
   69 - 60% D
   Below 60%

OTHER REFERENCES

Calculus of a Single Variable, Larson, Edwards, 10th Edition, Brooks/Coles, 2014

Precalculus, Robert Blitzer, 5th Edition, Pearson, 2014

Thomas' Calculus, Weir, Hass, Giordano, 11th Edition, Addison Wesley, 2005

Calculus, Smith, Minton, 4th Edition, McGraw Hill, 2012

Form Revised: 4/18/13