ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Natural Sciences and Business

COURSE: MTH 2001 Calculus and Analytical Geometry I

Date: Spring 2022

Credit Hours: 5

Complete all that apply or mark "None" where appropriate:
Prerequisite(s): MTH1005 or MTH 1003 and MTH 1004 with a grade of C or better

Enrollment by assessment or other measure? ☒ Yes ☐ No
If yes, please describe: By appropriate assessment.

Corequisite(s): None

Pre- or Corequiste(s): None

Consent of Instructor: ☒ Yes ☐ No

Delivery Method: ☒ **Lecture** 5 **Contact Hours** (1 contact = 1 credit hour)
☐ **Seminar** 0 **Contact Hours** (1 contact = 1 credit hour)
☐ **Lab** 0 **Contact Hours** (2-3 contact = 1 credit hour)
☐ **Clinical** 0 **Contact Hours** (3 contact = 1 credit hour)
☒ **Online**
☒ **Blended**
☒ **Virtual Class Meeting (VCM)**

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

CATALOG DESCRIPTION and IAI NUMBER (if applicable):
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. IAI Equivalent: M1 900-1, MTH 901

ACCREDITATION STATEMENTS AND COURSE NOTES:
Successful completion requires a C or better in the course.

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 $X -- \pm 00$

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. Audio-visual aids

EVALUATION OF STUDENT ACHIEVEMENT:
1. Lecture
2. Class participation
3. Audio-visual aids
4. Instructional quizzes and exams

INSTRUCTIONAL MATERIALS:
Textbooks
Thomas' Calculus (Thomas 15th edition, Pearson, 2023)

Resources
None

LEARNING OUTCOMES AND GOALS:
Institutional Learning Outcomes
☐ 1) Communication – to communicate effectively;
☒ 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
☐ 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
☐ 4) Responsibility – to recognize how personal choices affect self and society.

Course Outcomes and Competencies
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.
4.3. Students will be able to find inflection points.
4.4. 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.
4.5. 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.
4.6. Students will be able to find the maximum and minimum values on the given closed interval and state where these values occur.
4.7. Students will be able to apply maximum and minimum problems to real life applications.
4.8. Students will be able to approximate values using Newton's Method.
4.9. 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.
4.10. 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.