ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Natural Sciences and Business

COURSE: MTH 2002 Calculus and Analytical Geometry II

Date: Spring 2022

Credit Hours: 4

Complete all that apply or mark "None" where appropriate:

Prerequisite(s): MTH 2001 with a "C" or better

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

Corequisite(s): None

Pre- or Corequiste(s): None

Consent of Instructor: ☒ Yes ☐ No

Delivery Method:
- ☒ **Lecture** **4 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):
Topics include: differential equations; the calculus of inverse trigonometric functions; applications of the integral; techniques of integration, including numerical methods, substitution, integration by parts, trigonometric substitution, and partial fractions; indeterminate forms and L'Hôpital's rule; improper integrals; sequences and series, convergence tests, Taylor series; conics; parametric equations; polar coordinates and equations. IAI Equivalent: M1900-2, MTH 902

ACCREDITATION STATEMENTS AND COURSE NOTES:
None

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Differential Equations, Inverse Trigonometric Functions
   B. Differential Equations; Growth and Decay
   C. Differential Equations; Separation of Variables
   D. Inverse Trigonometric Functions and Differentiation
   E. Inverse Trigonometric Functions and Integration

II. Applications of Integration
   A. Moments, Centers of Mass, and Centroids
   B. Fluid Pressure and Fluid Force

III. Integration Techniques, L'Hopital's Rule, and Improper Integrals
   A. Basic Integration Rules
   B. Integration by Parts
   C. Trigonometric Integrals
   D. Trigonometric Substitution
   E. Partial Fractions
   F. Integration by Tables and Other Integration Techniques
   G. Indeterminate Forms and L'Hopital's Rule
   H. Improper Integrals
   I. Numerical Integration

IV. Infinite Series
   A. Sequences
   B. Series and Convergence
   C. The Integral Test and p-Series
   D. Comparisons of Series
   E. Alternating Series
   F. The Ratio and Root Tests
   G. Taylor Polynomials and Approximations
   H. Power Series
   I. Representation of Functions by Power Series
   J. Taylor and Maclaurin Series

V. Conics, Parametric Equations, and Polar Coordinates
   A. Conics and Calculus
   B. Plane Curves and Parametric Equations
   C. Parametric Equations and Calculus
   D. Polar Coordinates and Polar Graphs
   E. Area and Arc Length in Polar Coordinates
   F. Polar Equations of Conics

INSTRUCTIONAL METHODS:
1. Lecture
2. Class discussion
3. Class participation and activities
4. Audio-visual aids - calculator, document camera, computers, etc.

EVALUATION OF STUDENT ACHIEVEMENT:
1. Homework, quizzes and exams
2. Activities (e.g. projects, case studies, etc.)

INSTRUCTIONAL MATERIALS:
Textbooks
Thomas' Calculus (Hass, et.al., Pearson)

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 be able to demonstrate knowledge of differential equations and the calculus of inverse trigonometric functions.**
1.1. Students will be able to solve differential equations for growth and decay applications.
1.2. Students will be able to solve first-order differential equations by the method of separation of variables.
1.3. Students will be able to differentiate and integrate inverse trigonometric functions.

2. **Students will be able to demonstrate knowledge of applications of definite integrals.**
2.1. Students will be able to find the moments, center of mass, and centroids of planar laminas and centroids.
2.2. Students will be able to calculate fluid pressure and fluid force.

3. **Students will be able to demonstrate proficiency in integration techniques.**
3.1. Students will be able to use the basic integration rules to solve integration problems.
3.2. Students will be able to use the method of integration by parts to solve certain integration problems.
3.3. Students will be able to use certain techniques for solving trigonometric integrals involving combinations of powers of the sine, cosine, tangent and secant functions.

3.4. Students will be able to solve certain integration problems by using an appropriate trigonometric substitution.
3.5. Students will be able to use the method of partial fractions to solve certain integration problems.
3.6. Students will be able to use the table of integrals to solve certain integration problems.
3.7. Students will be able to use L'Hopital's Rule to evaluate limits involving indeterminate forms.
3.8. Students will be able to evaluate improper integrals.
3.9. Students will be able to approximate definite integrals with numerical integration techniques such as the Trapezoidal Rule and Simpson's Rule.

4. **Students will be able to demonstrate knowledge of infinite sequences and series.**

4.1. Students will be able to find the limit of a sequence.
4.2. Students will be able to determine if a sequence converges or diverges.
4.3. Students will be able to determine the pattern of a sequence.
4.4. Students will be able to recognize and work with monotonic and bounded sequences.
4.5. Students will be able to determine the sequence of partial sums for an infinite series.
4.6. Students will be able to determine if a geometric series converges or diverges; and, if it converges, then to what number.
4.7. Students will be able to determine if an infinite series diverges using the divergence test
4.8. Students will be able to use the Integral Test to determine the convergence or divergence of a series.
4.9. Students will be able to use the p-series test to determine the convergence or divergence of a series.
4.10. Students will be able to use the direct Comparison Test to determine the convergence or divergence of a series.
4.11. Students will be able to use the Limit Comparison Test to determine the convergence or divergence of a series.
4.12. Students will be able to use the Ratio Test to determine the convergence or divergence of a series.
4.13. Students will be able to use the Root Test to determine the convergence or divergence of a series.
4.14. Students will be able to match the Taylor polynomial approximation of a function with its correct graph.
4.15. Students will be able to find the Maclaurin polynomial of degree n for a given function.
4.16. Students will be able to find the nth Taylor polynomial of a function centered at c.
4.17. Students will be able to approximate a function at a given value using either a Taylor polynomial or Maclaurin polynomial.
4.18. Students will be able to use Taylor's Theorem to determine the accuracy of an approximation.

4.19. Students will be able to determine the degree of a Taylor or Maclaurin polynomial that would be needed to achieve a desired accuracy.
4.20. Students will be able to find the radius of convergence and the interval of convergence for a power series.
4.21. Students will be able to find geometric series representations for certain functions.
4.22. Students will be able to find a power series representation of a function centered at c and also determine the interval of convergence.
4.23. Students will be able to use the definition to find the Taylor series (centered at c) for a given function.
4.24. Students will be able to use the binomial series to find the Maclaurin series for a given function.
4.25. Students will be able to find the Maclaurin series representation of a function by using existing Maclaurin series of related functions.
4.26. Students will be able to integrate or differentiate a power series to obtain another power series.
4.27. Students will be able to add, subtract or multiply two power series together to obtain another power series.

5. **Students will be able to demonstrate knowledge of conics, parametric equations, and polar coordinates.**

5.1. Students will be able to match the equation of a conic with its graph.
5.2. Students will be able to find the vertex, focus, and directrix of a parabola and then sketch its graph.
5.3. Students will be able to find the equation of a parabola if the vertex and focus are known.
5.4. Students will be able to find the equation of a parabola if the focus and directrix are known.
5.5. Students will be able to find the equation of a parabola if the vertex and dirctrix are known.
5.6. Students will be able to solve application problems that relate to the equation of a parabola.
5.7. Students will be able to find the center, foci, vertices, and eccentricity of an ellipse, and then sketch its graph.
5.8. Students will be able to find the equation of an ellipse if certain combinations of the center, foci, vertices, major axis, minor axis or a point on graph are given.
5.9. Students will be able to solve application problems that relate to the equation of an ellipse.
5.10. Students will be able to find the center, foci, and vertices of a hyperbola and then sketch its graph.
5.11. Students will be able to find the equation of a hyperbola if certain combinations of the vertices, asymptotes, foci or center are given.
5.12. Students will be able to solve application problems that relate to the equation of a hyperbola.
5.13. Students will be able to find all points of horizontal and vertical tangency for parabolas, ellipses, and hyperbolas.
5.14. Students will be able to classify the graph of an equation as a circle, parabola, ellipse, or a hyperbola.

5.15. Students will be able to sketch the curve represented by a set of parametric equations both by hand and with technology.
5.16. Students will be able to eliminate the parameter from a set of parametric equations to obtain the standard form in rectangular coordinates.
5.17. Students will be able to find two different sets of parametric equations for a given rectangular equation.
5.18. Students will be able to match a set of parametric equations with its correct graph.
5.19. Students will be able to compute first and second derivatives of parametric equations.
5.20. Students will be able to find an equation of the tangent line to a point on the curve of parametric equations.
5.21. Students will be able to find all points of horizontal and vertical tangency for a parametric curve.
5.22. Students will be able to compute the arc length for a parametric curve.
5.23. Students will be able to compute the area of a surface of revolution in parametric form.
5.24. Students will be able to convert the rectangular coordinates of a point to polar coordinates and vice-versa.
5.25. Students will be able to convert a rectangular equation to a polar equation and vice-versa.
5.26. Students will be able to use a graphing utility to graph a polar equation.
5.27. Students will be able to find the points of vertical and horizontal tangency to a polar curve.
5.28. Students will be able to find the area of a region bounded by the graph of a polar equation.
5.29. Students will be able to find the points of intersection between the graphs of two polar equations.
5.30. Students will be able to use a graphing utility to approximate the points of intersection between the graphs of two polar equations.
5.31. Students will be able to find the area of a common region of two polar curves.
5.32. Students will be able to compute the area of a surface of revolution in polar form.
5.33. Students will be able to sketch and identify the graph of conic in polar form.
5.34. Students will be able to find a polar equation of a conic given its eccentricity and directrix or given its vertices.
5.35. Students will be able to use a graphing utility to approximate the area of the region bounded by the graph of a polar equation.