ILLINOIS VALLEY COMMUNITY COLLEGE

Course Syllabus

DIVISION: English, Mathematics, Education

Course: MTH 2002 Calculus and Analytical Geometry II

Date: May 6, 2013

Semester Hours: 4

Prerequisite(s): MTH 2001 or the equiv. with a grade of C or better

Delivery Method:

☒	**Lecture**	**4 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:

Topics include: the definite integral and applications, techniques of integration, polar coordinates, indeterminate forms, improper integrals, conics, Taylor polynomials, sequences, series.

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

- Apply techniques of integration, including numerical methods, to integrate algebraic and transcendental functions. (IMS 2A, 3A, 4B, 8B3)
- Recognize need for and apply integration by parts, trigonometric substitution, partial fractions, and other integration techniques. (IMS 2A, 4B, 8B3)
- Solve the definite integral to find areas, volumes, lengths of curves, growth and decay, work, surface area, computation of moments, centers of mass, etc. (IMS 2A, 3A, 4B, 5A, 7A6)
- Solve differential equations, including separable equations and work with these equations in the context of exponential growth and decay. (IMS 2A, 3A, 4B, 5A, 7A6)
- Explain and represent a series as a sequence of partial sums. (IMS 3A)
- Use the integral and comparison tests for convergence on positive series. (IMS 2A)
- Test alternating series for both absolute and conditional convergence. (IMS 3A)
- Use Taylor series to represent functions. (IMS 2A, 5A)
- Use series in applications. (IMS 2A, 4B, 5A)

Performance Objectives

- Explain the connection between a function and its antiderivative/indefinite integral. (IMS 3B, 8C1, 8C2, 8C5, 8C6)
- Explain the connection between the indefinite integral & the definite integral [i.e. the Fundamental Theorem of Calculus]. (IMS 3B, 6D1, 7C8, 8C2, 8C5)
- Apply techniques of integration, including numerical methods, to integrate algebraic and transcendental functions. (IMS 2C, 3B, 6D1, 6D3, 7C8, 8C5, 8C6)
- Recognize need for and apply integration by parts, trigonometric substitution, partial fractions, and other integration techniques. (IMS 2C, 3B, 6D1, 8C5, 8C6)
- Use the definite integral to find areas, volumes, lengths of curves, growth and decay, work, surface area, computation of moments, centers of mass, etc. (IMS 2C, 3B, 6C1, 6C2, 6D1, 6D3, 7B6, 7C8, 8C5, 8C6)
- Solve differential equations, including separable equations and work with these equations in the context of exponential growth and decay. (IMS 2C, 3B, 6C1, 6C2, 6D1, 7B6, 7C8, 8C5, 8C6)
- Explain and evaluate improper integrals. (IMS 2C, 3B, 6C1, 6D1, 7C8, 8C2, 8C4, 8C5,8C6)
- Explain and represent a series as a sequence of partial sums. (IMS 3B, 6D3, 8C1, 8C4, 8C6)
- Use the integral and comparison tests for convergence on positive series. (IMS 2C, 3B, 6C1, 6C2, 6D1, 6D3, 8C4, 8C6)
- Test alternating series for both absolute and conditional convergence. (IMS 3B, 6C2, 6D1, 6D3, 7C8, 8C4, 8C6)
- Use Taylor series to represent functions. (IMS 2C, 3B, 6D1, 6D3, 7B6, 8C1, 8C4, 8C6)
- Use series in applications. (IMS 2C, 3B, 6C1, 6D1, 7C8, 8C2, 8C4, 8C6)

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.

<u>2C</u>

- 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.

8B3

- Evaluation of homework problems or class discussions or problem/project presentations or quizzes/exams;
- Computer/calculator programming exercise on finding integrals of relations such as logarithmic, parametric, absolute value and connections of the calculus to the graphs of these relations.

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 be able to demonstrate knowledge of applications of definite integrals.
1.1. Students will be able to solve work problems.
1.2. Students will be able to find the moments, center of mass, and centroids of planar laminas and centroids.
1.3. Students will be able to calculate fluid pressure and fluid force.
1.4. Students will be able to differentiate and integrate inverse trigonometric functions and hyperbolic functions.

2. Students will be able to demonstrate proficiency in the basic techniques of integration.
2.1. Students will be able to use the basic integration rules to solve integration problems.
2.2. Students will be able to use the method of integration by parts to solve certain integration problems.
2.3. Students will be able to use certain techniques for solving trigonometric integrals involving combinations of powers of the sine, cosine, tangent and secant functions.
2.4. Students will be able to solve certain integration problems by using an appropriate trigonometric substitution.
2.5. Students will be able to use the method of partial fractions to solve certain integration problems.
2.6. Students will be able to use the table of integrals to solve certain integration problems.
2.7. Students will be able to use a substitution for rational functions of sine and cosine that appear in the integrand.
2.8. Students will be able to use a graphing calculator to evaluate definite integrals.
2.9. Students will be able to use L'Hopital's Rule to evaluate limits involving indeterminate forms.
2.10. Students will be able to evaluate improper integrals both by hand and with a graphing calculator.

3. Students will be able to demonstrate knowledge of infinite sequences and series.
3.1. Students will be able to find the limit of a sequence.
3.2. Students will be able to determine if a sequence converges or diverges.
3.3. Students will be able to determine the pattern of a sequence.
3.4. Students will be able to recognize and work with monotonic and bounded sequences.
3.5. Students will be able to determine the sequence of partial sums for an infinite series.
3.6. Students will be able to determine if a geometric series converges or diverges; and, if it converges, then to what number.
3.7. Students will be able to determine if an infinite series diverges using the divergence test.
3.8. Students will be able to use the Integral Test to determine the convergence or divergence of a series.
3.9. Students will be able to use the p-series test to determine the convergence or divergence of a series.

3.10. Students will be able to use the direct Comparison Test to determine the convergence or divergence of a series.
3.11. Students will be able to use the Limit Comparison Test to determine the convergence or divergence of a series.
3.12. Students will be able to use the Ratio Test to determine the convergence or divergence of a series.
3.13. Students will be able to use the Root Test to determine the convergence or divergence of a series.
3.14. Students will be able to match the Taylor polynomial approximation of a function with its correct graph.
3.15. Students will be able to find the Maclaurin polynomial of degree n for a given function.
3.16. Students will be able to find the nth Taylor polynomial of a function centered at c.
3.17. Students will be able to use a symbolic differentiation utility to find the indicated Taylor polynomial for a given function and graph these along with the function on a graphing calculator.
3.18. Students will be able to approximate a function at a given value using either a Taylor polynomial or Maclaurin polynomial.
3.19. Students will be able to use Taylor's Theorem to determine the accuracy of an approximation.
3.20. Students will be able to determine the degree of a Taylor or Maclaurin polynomial that would be needed to achieve a desired accuracy.
3.21. Students will be able to find the radius of convergence and the interval of convergence for a power series.
3.22. Students will be able to find geometric series representations for certain functions.
3.23. Students will be able to find a power series representation of a function centered at c and also determine the interval of convergence.
3.24. Students will be able to use the definition to find the Taylor series (centered at c) for a given function.
3.25. Students will be able to use the binomial series to find the Maclaurin series for a given function.
3.26. Students will be able to find the Maclaurin series representation of a function by using existing Maclaurin series of other functions.
3.27. Students will be able to integrate or differentiate a power series to obtain another power series.
3.28. Students will be able to add, subtract or multiply two power series together to obtain another power series.

4. Students will be able to demonstrate knowledge of conics, parametric equations, and polar coordinates.
4.1. Students will be able to match the equation of a conic with its graph.
4.2. Students will be able to find the vertex, focus, and directrix of a parabola and then sketch its graph.
4.3. Students will be able to find the equation of a parabola if the vertex and focus are known.
4.4. Students will be able to find the equation of a parabola if the focus and directrix are known.

4.5. Students will be able to find the equation of a parabola if the vertex and dirctrix are known.
4.6. Students will be able to solve application problems that relate to the equation of a parabola.
4.7. Students will be able to find the center, foci, vertices, and eccentricity of an ellipse, and then sketch its graph.
4.8. 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.
4.9. Students will be able to solve application problems that relate to the equation of an ellipse.
4.10. Students will be able to find the center, foci, and vertices of a hyperbola and then sketch its graph.
4.11. Students will be able to find the equation of a hyperbola if certain combinations of the vertices, asymptotes, foci or center are given.
4.12. Students will be able to solve application problems that relate to the equation of a hyperbola.
4.13. Students will be able to classify the graph of an equation as a circle, parabola, ellipse, or a hyperbola.
4.14. Students will be able to sketch the curve represented by a set of parametric equations both by hand and with a graphing calculator.
4.15. Students will be able to eliminate the parameter from a set of parametric equations to obtain the standard form in rectangular coordinates.
4.16. Students will be able to find two different sets of parametric equations for a given rectangular equation.
4.17. Students will be able to match a set of parametric equations with its correct graph.
4.18. Students will be able to compute first and second derivatives of parametric equations.
4.19. Students will be able to find an equation of the tangent line to a point on the curve of parametric equations.
4.20. Students will be able to use a graphing utility to confirm the result of competency 4.19.
4.21. Students will be able to find all points of horizontal and vertical tangency for a parametric curve.
4.22. Students will be able to compute the arc length for a parametric curve.
4.23. Students will be able to compute the area of a surface of revolution in parametric form.
4.24. Students will be able to convert the rectangular coordinates of a point to polar coordinates and vice-versa.
4.25. Students will be able to convert a rectangular equation to a polar equation and vice-versa.
4.26. Students will be able to use a graphing utility to graph a polar equation.
4.27. Students will be able to find the points of vertical and horizontal tangency to a polar curve.
4.28. Students will be able to find the angle psi between the radial and tangent lines to a polar graph at a given value of theta.
4.29. Students will be able to find the area of a region bounded by the graph of a polar equation.
4.30. Students will be able to find the points of intersection between the graphs of two polar equations.

4.31. Students will be able to use a graphing utility to approximate the points of intersection between the graphs of two polar equations.
4.32. Students will be able to find the area of a common region of two polar curves.
4.33. Students will be able to compute the area of a surface of revolution in polar form.
4.34. Students will be able to sketch and identify the graph of conic in polar form.
4.35. Students will be able to find a polar equation of a conic given its eccentricity and directrix or given its vertices.
4.36. Students will be able to use the integration capability of a graphing calculator to approximate the area of the region bounded by the graph of a polar equation.
4.37. Students will be able to find the polar equation of the orbit of a planet, and the perihelion and aphelion distances.

COURSE TOPICS AND CONTENT REQUIREMENTS:

I. Differential Equations, Inverse Trigonometric Functions, Hyperbolic 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
   F. Hyperbolic Functions

II. Applications of Integration
   A. Work
   B. Moments, Centers of Mass, and Centroids
   C. 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

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 and Kepler's Laws

INSTRUCTIONAL METHODS:

1. Lecture
2. Classroom Discussion
3. Class Participation
4. Audio-visual Aids: calculator, overheads, videos, computer, etc.
5. Quizzes and Exams

INSTRUCTIONAL MATERIALS:

1. TEXT: *Calculus*, Larson, Hostetler, Edwards, 8th Edition, Houghton-Mifflin, 2010
2. Complete Solutions Guide, Volumes I, II and III
3. Instructor's Resource Guide
4. Computer Test Generator
5. Transparencies
6. Videos
7. TI-89 graphing calculator and overhead projector for demonstrations

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

1. Homework assignments
2. Class participation
3. Boardwork
4. Quizzes and exams
5. Regular attendance
6. Grading Scale: 100-90%=A, 89-80%=B, 79-70%=C, 69-60%=D, Below 60%=F

OTHER REFERENCES

Culculus, Larson, Hostetler, Edwards, 7th Edition, Houghton-Mifflin, 206

Precalculus, Robert Blitzer, 1st Edition, Prentice Hall, 2012

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

Calculus, James Stewart, 5th Edition, Thompson/Brooks/Cole, 2003

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