Course and Number: MATH 1172 Engineering Mathematics A

CREDITS: 5  CLASS HOURS PER WEEK: 5  PREREQUISITES: MATH 1151 with a C or higher

DESCRIPTION OF COURSE (AS IT APPEARS IN THE COLLEGE CATALOG):
Integration techniques, sequences & series, Taylor series, vectors and parametric curves, several variables, partial derivatives, chain rule, max-min. Not open to students with credit for any higher numbered math class, or for MATH1152.

COURSE GOALS AND/OR OBJECTIVES
Continue to introduce the student to the concepts, methods and applications of differential and integral calculus necessary for further study in calculus, science and engineering; to promote the further development of the student's algebraic, numerical, graphical and communication skills; to develop student's mathematical thinking and problem solving ability; and to facilitate student's progression from a procedural/computational understanding of mathematics to a broader understanding encompassing logical reasoning, generalization, abstraction, and formal proof.

LEARNING OUTCOMES:
After completing this course, students will be able to:

• Apply definite integrals to represent area of a planar region between two curves, volume of a solid by slicing, volume of a solid of revolution by the cylindrical shell method, length of a plane curve, area of a surface of revolution, work
• Employ a variety of integration techniques to evaluate special types of integrals, including substitution, integration by parts, trigonometric substitutions, and partial fraction decomposition.
• Solve linear, first order, separable differential equations using the method of separation of variables and apply the method to models for exponential growth and decay
• Analyze curves by parametric equations or in polar form and find the areas of regions defined by such curves.
• Determine the convergence or divergence of improper integrals, including integrals over infinite intervals, as well as integrals in which the integrand becomes infinite on the interval of integration.
• Determine the existence of and find the limits of sequences numerically, graphically, and analytically. Determine the convergence or divergence of
an infinite series by using geometric series, telescoping series, n-th term test
• Find the n-th degree Maclaurin or Taylor polynomial at a specified center for a function and estimate the error term.
• Perform and apply vector operations, including dot product and cross product of vectors in the plane and space.
• Compute the distance between two points in 3-space, find the midpoint of two points in 3-space, determine the center and radius of a sphere, and find an equation of a sphere.
• Perform and apply vector operations, including the dot and cross product of vectors, in the plane and space. Graph and find equations of lines, planes, cylinders and quadratic surfaces.
• Differentiate and integrate vector-valued functions. For a position vector function of time, interpret these as velocity and acceleration.
• Evaluate limits and determine the continuity and differentiability of functions of several variables.
• Describe graphs, level curves and level surfaces of functions of several variables.
• Find arc length and curvature of space curves, including the use of unit tangents and unit normals; identify and interpret tangential and normal components of acceleration.
• Find partial derivatives, directional derivatives, and gradients and use them to solve applied problems.
• Find differentials of functions of several variables and use them to solve applied problems.
• Find equations of tangent planes and normal lines to surfaces that are given implicitly or parametrically.
• Use the chain rule for functions of several variables (including implicit differentiation).

GENERAL EDUCATION GOALS:
Critical thinking and Quantitative Literacy

EQUIPMENT AND MATERIAL REQUIRED:
A Graphing Calculator is recommended. However, any symbolic manipulator, e.g. TI-89, TI-92 etc., is not permitted.

TEXTBOOK, MANUALS, REFERENCES, AND OTHER READINGS:
• MyMathLab (access code included with the purchase of a new text at the CSCC bookstore). To create your own MML course, copy the course shell having Course ID yang06049. Do not give your students Department Shell course ID, it disallows students’ enrollment.
GENERAL INSTRUCTIONAL METHODS:
Classroom lecture, discussion, recitation, and/or problem solving explorations supplemented by visual and/or computer aids.

ASSESSMENT: (required wording)
Columbus State Community College is committed to assessment (measurement) of student achievement of academic outcomes. This process addresses the issues of what you need to learn in your program of study and if you are learning what you need to learn. The assessment program at Columbus State has four specific and interrelated purposes: (1) to improve student academic achievements; (2) to improve teaching strategies; (3) to document successes and identify opportunities for program improvement; (4) to provide evidence for institutional effectiveness. In class you are assessed and graded on your achievement of the outcomes for this course. You may also be required to participate in broader assessment activities.

STANDARDS AND METHODS FOR EVALUATION:
The final examination must account for between 25% and 35% (inclusive) of the course grade. The remainder of the course grade is to be determined by the instructor, subject to the following departmental policies:
• NO credit is to be awarded for attendance and/or class participation.
• NO credit is to be awarded for assignments that are only checked for completion rather than graded for correctness.
• Routine homework (e.g. MyMathLab and textbook exercises) should account for no more than 15% of the course grade. Group work and special projects, if utilized, should account for no more than 10% of the course grade. However, the collective total of these scores and the routine homework scores should account for no more than 20% of the course grade. At least 80% of the course grade must be based on proctored, closed book quizzes, tests, and/or final exam. (There may be situations where exceptions to theses caps are appropriate. Please discuss such cases with the Lead Instructor(s) of the course prior to straying from these guidelines.)
• Eliminate extra credit assignments, or limit them to no more than 2% of the course grade.

GRADING SCALE:
Letter grades for the course will be awarded using a 90% - 80% - 70% - 60% scale.

SPECIAL COURSE REQUIREMENTS:
None

UNITS OF INSTRUCTION
Please provide a weekly course schedule indicating the Units of Instruction, learning objectives/goals, assigned readings, assignments, and exams.

Week 1
- **Unit of Instruction:** Applications of Integration  - **Student Learning Outcomes:**
  - Apply the definite integral to find the area between two curves
  - Find the volume of solids of revolution by applying the method of discs and cylindrical shells

- **Assigned Reading:** 7.1, 7.2, 7.3
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity

**Week 2**

- **Unit of Instruction:** Applications of Integration  - **Student Learning Outcomes:**
  - Find the lengths of curves in the plane
  - Find the areas of surfaces of revolution
  - Find the work done on an object

- **Assigned Reading:** 7.4, 7.5
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 3**

- **Unit of Instruction:** Integration  - **Student Learning Outcomes:**
  - Apply basic integration rules
  - Apply the method of integration by parts
  - Evaluate integrals involving trigonometric substitutions

- **Assigned Reading:** 8.1, 8.2, 8.4
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 4**

- **Unit of Instruction:** Integration Techniques  - **Student Learning Outcomes:**
  - Evaluate integrals involving partial fraction decomposition.
  - Determine the convergence or divergence of improper integrals, including integrals over infinite intervals, as well as integrals in which the integrand becomes infinite on the interval of integration

- **Assigned Reading:** 8.5, 8.8
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 5**

- **Unit of Instruction:** Differential Equations  - **Student Learning Outcomes:**
• Apply elementary modeling methods with differential equations
• Solve equations using separation of variables
• Apply various models for population growth

- **Assigned Reading:** 6.1, 6.2, 6.3, 6.4
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 6**
- **Unit of Instruction:** Parametric Equations and Polar Coordinates - **Student Learning Outcomes:**
  • Sketch the graph of a curve given by a set of parametric equations
  • Find a set of parametric equations to represent a curve
  • Find the first and second derivatives of a parametric curve
  • Find the slope and/or the equation of the tangent line to a parametric curve at a given point
  • Graph points in polar coordinates
  • Convert between Cartesian and Polar coordinates
  • Graph polar curves
  • Find the equation of a polar graph
  • Find the slope and/or the equation of the tangent line to a polar curve at a given point
  • Find points of intersection of polar curves
  • Find areas bounded by various polar graphs
  • Find the length of a curve in polar coordinates

- **Assigned Reading:** 10.2, 10.3, 10.4, 10.5,
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 7**
- **Unit of Instruction:** Infinite Series - **Student Learning Outcomes:**
  • Analyze the behavior of sequences
  • Find limits of sequences numerically, graphically, and analytically
  • Show that a given sequence is monotonic
  • Determine the convergence or divergence of a monotonic sequence
  • Explain the meaning of convergence and divergence of infinite series
  • Determine the convergence or divergence of a geometric series
  • Determine the sum of a convergent geometric and telescoping series

- **Assigned Reading:** 9.1, 9.2
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.
Week 8
- **Unit of Instruction:** Infinite Series - **Student Learning Outcomes:**
  - Find Taylor and MacLaurin polynomials
  - Compute the error when a function is approximated by a Taylor or Maclaurin polynomial.
  - Use Taylor and MacLaurin series to approximate function values.
  - Applications of Taylor Polynomials
  - Find Taylor and Maclaurin series.

- **Assigned Reading:** 9.7, 9.10
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

Week 9
- **Unit of Instruction:** Vectors and the Geometry of Space - **Student Learning Outcomes:**
  - Perform vector operations (addition, subtraction, scalar multiplication), and interpret geometrically
  - Determine the magnitude of a given vector
  - Find a unit vector in the same or opposite direction as a given vector
  - Apply vectors to solve resultant force problems
  - Compute the distance between two points in 3-space
  - Find the midpoint of two points in 3-space
  - Sketch the graph of a sphere by determining its center and radius
  - Find the equation of a sphere
  - Sketch surfaces in 3-space
  - Compute the dot product of two vectors
  - Determine the angle between two vectors
  - Determine if two vectors are orthogonal
  - Compute the projection of one vector onto another
  - Apply vectors to determine the work done by a constant force
  - Compute the cross product of two vectors in 3-space
  - Interpret geometric properties of the cross product
  - Compute the triple scalar product of three vectors

- **Assigned Reading:** 11.1, 11.2, 11.3
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

Week 10
- **Unit of Instruction:** Vectors and the Geometry of Space - **Student Learning Outcomes:**
  - Determine the parametric equations of a line
• Sketch the graph of a line in space
• Find the point of intersection of a line with the coordinate planes
• Find the point of intersection of two lines in space
• Determine the equation of a plane in 3-space
• Sketch planes in 3-space
  Determine whether a line and a plane intersect and find the point of intersection of a line with a plane

- **Assigned Reading:** 11.4, 11.5
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 11**

- **Unit of Instruction:** Vectors and the Geometry of Space; Vector Valued Functions and Motion in Space
- **Student Learning Outcomes:**
  • Identify quadric surfaces
  • Recognize the equations of quadric surfaces
  • Sketch quadric surfaces
  • Plot a point in cylindrical coordinates
  • Plot a point in spherical coordinates
  • Translate equations between Rectangular, Cylindrical, and Spherical coordinates
  • Find the domain of vector-valued functions
  • Evaluate vector-valued functions at an indicated value
  • Identify the curve represented by a vector-valued function
  • Identify the space curve represented by the intersection of surfaces
  • Evaluate limits of vector-valued functions
  • Discuss the continuity of vector-valued functions
  • Find the derivative of a vector-valued function, and interpret the derivative geometrically

- **Assigned Reading:** 11.6, 11.7, 12.1, 12.2
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 12**

- **Unit of Instruction:** Vector Valued Functions and Motion in Space - **Student Learning Outcomes:**
  • Evaluate the integral of a vector-valued function
  • Solve initial value problems involving vector-valued functions
  • Given a vector-valued function representing the position of an object in motion, sketch the position, velocity, and acceleration vectors at a point
• Given a vector-valued function representing the position of an object in motion, find the velocity, speed, and acceleration of the object
• Solve initial-value problems involving acceleration, velocity, and position of objects in motion
• Solve applications involving particle motion, including those involving Kepler's laws.
• Determine whether a vector-valued function is smooth
• Find the length of a curve in space
  Given a vector-valued function, find the unit tangent and unit normal vectors at a given point
• Find the tangential and normal components of acceleration
• Find the parametric equations of a tangent line
• Find the curvature of a curve in the plane
• Find the curvature of a curve in space

- **Assigned Reading:** 12.3, 12.4, 12.5
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 13**
- **Unit of Instruction:** Functions of Several Variables - **Student Learning Outcomes:**
  • Evaluate functions of several variables
  • Describe the domain of functions of several variables
  • Sketch the graph of simple surfaces given as a function of two variables
  • Sketch the level curves for a function of two variables
  • Sketch the level surfaces for simple functions of three variables
  • Solve applications involving functions of two or more variables
  • Find limits and discuss continuity of functions of several variables
  • Show that certain limits do not exist by evaluating the limit along different paths
  • Sketch the largest region on which a function is continuous.

- **Assigned Reading:** 13.1, 13.2
- **Assessment Methods:** Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

**Week 14**
- **Unit of Instruction:** Functions of Several Variables - **Student Learning Outcomes:**
  • Find first partial derivatives of functions of several variables
  • Evaluate a partial derivative at a point
  • Find the slopes of a surface in the x- and y-directions at a given point
• Find all mixed partial derivatives of a function of several variables
• Solve applications involving the partial derivatives of functions of several variables
• Find the local linear approximation of a function at a point
• Find the total differential of a function of several variables
• Use the total differential to approximate the change in the value of a function between two points
• Solve applications involving the total differential of a function of several variables
• Use the appropriate Chain Rule to find ordinary and partial derivatives
  Use proper notation in using the Chain Rules
• Use implicit differentiation to find ordinary and partial derivatives
• Solve applications involving the Chain Rules
• Find a unit normal vector to a surface at a given point
• Find an equation of the tangent plane to a surface at a given point
• Find the symmetric equations of the normal line to a surface at a given point

- Assigned Reading: 13.3, 13.4, 13.5
- Assessment Methods: Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

Week 15
- Unit of Instruction: Functions of Several Variables - Student Learning Outcomes:
  • Find the directional derivative of a function of several variables at a point in a given direction
  • Find the gradient of a function
  • Interpret directional derivatives and gradients geometrically
  • Find a normal vector to a level curve at a given point
  • Solve applications involving directional derivatives and the gradient
  • Find a unit normal vector to a surface at a given point
  • Find an equation of the tangent plane to a surface at a given point
  • Find the symmetric equations of the normal line to a surface at a given point

- Assigned Reading: 13.6, 13.7
- Assessment Methods: Daily questioning, graded homework assignments, quizzes and/or tests. Out of class assignments allowing for greater computational and conceptual complexity.

ATTENDANCE POLICY: Determined by instructor
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