COLLIN COLLEGE EXPANDED GENERIC COURSE SYLLABUS

COURSE INFORMATION

Course Number: MATH 2415
Course Title: Calculus III
Credit Hours: 4
Lecture Hours: 3
Lab Hours: 3

Prerequisite

MATH 2414 with a grade of C or better, or equivalent.

Course Description

Advanced topics in calculus, including vectors and vector-valued functions, partial differentiation, Lagrange multipliers, multiple integrals, and Jacobians; application of the line integral, including Green's Theorem, the Divergence Theorem, and Stokes' Theorem. Lab required.

Textbook/Supplies

Onsite Courses: *Calculus, Early Transcendentals*, 3rd Edition by Briggs-Cochran-Gillett-Schulz available only at Collin's Bookstores, Pearson Publishing.

Online/Alternate Text: *Calculus, Early Transcendentals*, 9th edition by James Stewart.

Supplies: Graphing calculator required.

STUDENT LEARNING OUTCOMES (SLO)

Upon completion of this course the students should be able to do the following:

1. Perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion.
2. Perform calculus operations on functions of several variables, including partial derivatives, directional derivatives, and multiple integrals. (Empirical/Quantitative)
3. Find extrema and tangent planes. (Critical Thinking)
4. Solve problems using the Fundamental Theorem of Line Integrals, Green's Theorem, the Divergence Theorem, and Stokes' Theorem.
5. Apply the computational and conceptual principles of calculus to the solutions of real-world problems. (Communication Skills)

REQUIRED CORE OBJECTIVES FOR MATHEMATICS

As per the Texas Higher Education Coordinating Board, mathematics students must develop and demonstrate the following three required core objectives:

- Critical Thinking Skills - creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.
- Communication Skills - effective development, interpretation and expression of ideas through written, oral and visual communication.
- Empirical and Quantitative Skills - manipulation and analysis of numerical data or observable facts resulting in informed conclusions.

METHOD OF EVALUATION

Course requirements

Attending class**,** completing homework assignments**,** completing labs, completing required tests, and a comprehensive final exam.

Course format

Lecture, lab, and guided practice.

A minimum of four written tests, a lab component of the grade, online/written homework, and a comprehensive final exam. Homework may be used in place of one test or in addition to tests, but may not replace the final exam. The weight of each of these components of evaluation will be specified in the individual instructor's Concourse Syllabus. All out-of-class course credit, including home assignments, service-learning, extra credit, etc. may not exceed 25% of the total course grade; thus, at least 75% of a student's grade must consist of tests and the final exam given in the class or testing center, and a student may not retake any of these tests nor the final exam.

COURSE POLICIES

College-wide policies are pre-loaded into the Concourse Syllabi and are not duplicated in the Expanded Generic Syllabi for each course.

Instructor specific policies should be added to the Concourse Syllabus.

COURSE CONTENT

Proofs and derivations will be assigned at the discretion of the instructor. The student will be responsible for knowing all definitions and statements of theorems for each section outlined in the following modules.

Module 1

The student will be able to:
1. Plot points in the 3-D rectangular Cartesian coordinate system.
2. Calculate distance in 3-D.
3. Write a vector in component form and basis form.
4. Find the magnitude of a vector.
5. Apply the properties of vector arithmetic operations.
6. Find the dot product of two vectors and apply the properties of dot product.
7. Calculate the angle between two vectors and apply to work problems.
8. Determine if two vectors are orthogonal.
9. Find the orthogonal projection of one vector onto another.
10. Calculate the cross product of two 3-D vectors and understand right-hand rule.
11. Calculate torque as the cross product of a moment arm vector and a force vector.
12. Use vectors to find the area of a parallelogram and the volume of a parallelepiped.
13. Represent a line as a vector equation and as a set of parametric or symmetric equations.
14. Represent a plane as a vector equation and as a linear equation in x, y, and z.
15. Determine if two lines in space are intersecting, parallel, or skew.
16. Determine if two planes are parallel, perpendicular, or neither.
17. Find a plane's equation passing thru three non-collinear points or two intersecting lines.
18. Find the angle between two intersecting planes or between two surfaces at a point.
19. Find the distance from a point to a plane.
20. Sketch or describe traces of functions of two variables.
21. Sketch graphs of functions of two variables, especially cylinders and quadric surfaces.

Module 2

The student will be able to:
1. Find the domain of a vector function.
2. Find the limit of a vector function
3. Determine where a vector function is continuous.
4. Sketch basic curves in two or three dimensions defined by vector equations.
5. Determine whether a space curve is smooth at a point.
6. Find the derivative of a vector function. SLO1
7. Find the antiderivative of a vector function, perhaps with initial conditions. SLO1
8. Given a position vector function, calculate the velocity and acceleration vector functions. SLO1
9. Find the arc length of a space curve defined by a vector equation. SLO1
10. Find the curvature of a smooth curve. SLO1
11. Solve projectile motion problems in 2-D. SLO5
12. Find the unit tangent, unit normal, and unit binormal vectors, i.e., the Frenet-Serret TNB-frame for a given curve. SLO1

Module 3

The student will be able to:

1. Evaluate multivariable functions.
2. Determine a multivariable function's domain and range.
3. Find level curves and level surfaces of multivariable functions.
4. Create a contour diagram given a basic function of two variables.
5. Evaluate limits and continuity of basic multivariable functions.
6. Calculate a partial derivative to evaluate rate of change of one specific variable. SLO2
7. Approximate a partial derivative using the difference quotient. SLO2
8. Find all first-order partial derivatives of functions of several variables. SLO2
9. Find necessary higher-order partial derivatives of functions of several variables. SLO2
10. Determine the equation of the tangent plane to a surface at a given point. SLO3
11. Find the local linearization model of a function of two variables. SLO3
12. Find the total differential for a function of several variables. SLO2
13. Estimate the maximum error of one of the variables of a function using differentials.
14. Find the derivative of a composition function using the Chain Rule. SLO2
15. Calculate the rate of change of one of the variables of a multivariable function using the Chain Rule. SLO2
16. Find directional derivatives and gradients for functions of two or three variables. SLO2
17. Find critical points for functions of two variables. SLO3
18. Categorize critical points of functions of two variables as a relative (local) maximum or minimum, saddle point, or neither using the second derivative test. SLO3
19. Find absolute (global) extrema for functions of two variables on a given domain. SLO3
20. Find critical points for multivariable functions with constraints using Lagrange multipliers. SLO3
21. Solve applied optimization problems. SLO5

Module 4

The student will be able to:

1. Define a double integral as the limit of a double Riemann sum.
2. Estimate a double integral of a function of two variables over a rectangular domain.
3. Find the volume under a surface by calculating a double integral. SLO2
4. Set up iterated double integrals over a defined domain.
5. Understand the conditions under which Fubini's Theorem applies.
6. Find areas of two-dimensional regions using a double integral. SLO2
7. Find the average value of a multivariable function. SLO2
8. Set up double integrals for general regions and reverse the order of integration.
9. Convert double integrals in rectangular coordinates to polar coordinates and evaluate. SLO2
10. Find volumes of solids using a double or a triple integral. SLO2
11. Find the mass and center of mass of a lamina with variable density using a double integral. SL05
12. Find the moments of inertia and radius of gyration for a lamina using a double integral. SLO5
13. Define a triple integral as the limit of a triple Riemann sum.

14. Set up and evaluate triple integrals in cylindrical and spherical coordinates. SLO2
15. Find mass and center of mass of a solid using a triple integral. SLO5
16. Find moments of inertia and radius of gyration of a solid using a triple integral. SLO5

Module 5

The student will be able to:

1. Find the mass of a curved wire using a line integral. SLO5
2. Calculate work along a curved path under the influence of a specified vector field using a line integral. SLO5
3. Determine if a vector field is a gradient field. SLO2
4. Find the potential function for a given conservative vector field. SLO2
5. Apply the fundamental theorem of line integrals. SLO4
6. Evaluate line integrals over a specified path directly or parametrically. SLO2
7. Define conditions under which a vector field is independent of path.
8. Evaluate line integrals of closed two-dimensional curves using Green's Theorem. SLO4
9. Calculate the curl and divergence of a vector field. SLO2
10. Calculate the circulation of a vector field around a simple closed curve using Curl. SLO2
11. Calculate the net rate of flow of energy across a surface or curve using Divergence. SLO2
12. Determine when a surface is positively or negatively oriented.
13. Find the area of a surface using a double integral. SLO2
14. Find the mass of a laminar surface using a surface double integral. SLO2
15. Calculate the flux of a vector field across a surface using a surface integral. SLO2
16. Evaluate surface integrals over parametrized surfaces. SLO2
17. Evaluate line integrals over simple-closed 3-D curves using Stokes' Theorem. SLO4
18. Evaluate flux integrals through Gaussian closed surfaces using the Divergence Theorem. SLO4