SYLLABUS

Code: MATH 273   **Title:** CALCULUS III

Institute: STEM   **Department:** MATHEMATICS

Course Description: This course, a continuation of MATH 172, Calculus II, completes the study of elementary calculus. Topics include polar equations, vectors and vector-valued functions, surfaces in space and functions of several variables, partial derivatives and multiple integrals, and topics from vector analysis. Applications will be considered throughout the course. Problems are approached from a variety of perspectives, including graphical, numerical, verbal, and algebraic. Computer software will be used extensively in class to gain a greater understanding of concepts as well as to consider non-routine problems.

Section Information: All tests will be proctored in person.

Prerequisites: A grade of C or higher in MATH 172.

Credits: 4   **Lecture Hours:** 4   **Lab:** 0

REQUIRED TEXTBOOK/MATERIALS:

See your instructor addendum for a complete list of required materials for your section.

Textbook:
Stewart, James, Multivariable Calculus: Concepts and Contexts, 4th Edition, Brooks/Cole Cengage Learning, 2010.

Or

Stewart, James, Math 171/172/273 Brookdale Community College with EWA, Brooks/Cole Cengage Learning, 2009. This is a customized edition that is available at the College Bookstore only.

Note: WebAssign (EWA) will be required for online homework in some sections. Check with your instructor. An EWA access code is included in the textbook bundle sold at the College bookstore. If you buy a used textbook or prefer the ebook, an access code can be purchased online at www.cengagebrain.com

RECOMMENDED MATERIALS:

1. Graphing Calculator – If you are purchasing a new calculator, the TI-83 (any version) or TI-84 (any version) will be sufficient. The TI-89 has more advanced capabilities. If you are considering buying either of these, talk to your instructor first.

2. Free graphing software – Winplot – is available for download at http://math.exeter.edu/rparris/winplot.html. It is highly recommended.

3. Clegg, Dan, Student Solutions Manual for Stewart's Multivariable Calculus: Concepts and Contexts, 4th Edition, Brooks/Cole Cengage Learning, 2010.

4. Burton, Robert and Garity, Dennis, Study Guide for Stewart's Multivariable Calculus: Concepts and Contexts, 4th Edition, Brooks/Cole Cengage Learning, 2010

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ADDITIONAL TIME REQUIREMENTS

Projects are a required component of this course. You may need to allow some on-campus time during each unit to meet with your group to work on the projects. Some discussions can be done via email, but you may need some group meeting time and your group may need to meet with your instructor to discuss parts of the project. For information on Brookdale's policy on credit hour requirements and outside class student work refer to Academic Credit Hour Policy.

OTHER TIME COMMITMENTS:

- In addition to the regular class hours, you will need to set aside time each week for homework. The weekly time will vary by topic and level of difficulty, but as an estimate, you should expect two homework hours for *each* class hour per week. For example, if your class meets for four hours per week, you should expect to spend about *eight* hours per week on homework.
- You will need to allow time (possibly on campus) to do homework and/or project problems that require the use of computer software.
- If you are having any difficulty with the course material, you may need to allow time to see your instructor during office hours or to get help in the Math Lab.

COURSE LEARNING OUTCOMES

Upon completion of this course, students will be able to:
- Demonstrate the mathematical skills related to polar coordinates, vectors, vector-valued functions, and functions of two variables. (M)
- Extend the skills of single-variable calculus to multi-dimensional functions. (M)
- Analyze and solve application problems related to vectors and to multi-dimensional calculus. (M)
- Explain the analysis and solution of application problems. (M)
- Use computer software to understand concepts and to explore and solve problems. (M)

    Learning Outcome(s) support the following General Education Knowledge Areas:

    ➢ (M) Mathematics

GRADING STANDARD

In this course, you will be evaluated by means of tests and projects, quizzes, homework or other assignments.

A. TESTS

There will be three tests, one after each unit, graded on the basis of 100 points. Each test is cumulative and covers material from the beginning of the course. Each test will consist of a computer and non- computer part. All supporting work must be shown on tests in order for your instructor to properly assess your understanding of the material. The tests will be given in class and it is expected that you will be in class to take the test on the day it is given. If you are very ill (verifiable with a doctor's note) or you have some other emergency, you *must* contact your instructor immediately.

Note: All tests will be proctored in person, see Instructor Addendum for more information.

B. PROJECTS/QUIZZES/HOMEWORK/OTHER ASSIGNMENTS

Projects for the course will be done in groups. In the projects, you will apply the concepts and skills learned in class to a problem situation, present the mathematics, write careful explanations, and interpret your results. Specific guidelines for the projects will be handed out in class. The final copy of each project will be kept by your instructor.

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There are periodic quizzes and your instructor may also choose to use homework or other assignments for evaluation.

GRADING

At the end of the semester, you will have three test grades and a project/quizzes/homework/other assignments grade. See your instructor addendum for how projects, quizzes, homework and other assignments will be averaged into your final grade. There are no grade curves applied in this course. Your final course average is determined by a weighted average as follows:

Test 1	27%
Test 2	26%
Test 3	27%
Project/quizzes/homework/other assignments	20%

FINAL GRADE

Your final grade is determined by your final course average, using only the above grades. There are no extra-credit options (e.g. research papers, special projects, essays, etc.) available for this course. Your final grade is determined as follows:

If your final course average is	Your final grade is
90 – 100	A
88 – 89	A-
86 – 87	B+
80 – 85	B
78 – 79	B-
76 – 77	C+
70 – 75	C
60 – 69	D**
Below 60	F

** To use this course as a prerequisite for another mathematics course, you must have a grade of C or better.

Incomplete

INC is only given at the discretion of your instructor. This may occur in documented cases of hardship or emergency. In this case, you must meet with the instructor to discuss the work that must be completed to earn a grade in the course. All work must be completed within 21 days after the end of the term, exclusive of official college closings.

Withdrawal

You may withdraw from the course, without penalty, up to a date set by the College. If you do not withdraw from the course but stop attending, your grade at the end of the semester will be F.

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COURSE CONTENT: (TEXT SECTION)

Unit 1: In this unit, you will learn about the polar coordinate system and how it provides simple descriptions and equations for certain types of regions and curves. You will learn how to use technology (graphing calculators, <u>Converge</u> and <u>Maple)</u> to graph polar equations and space curves. You will be introduced to the three-dimensional rectangular coordinate system, vectors, lines, planes, surfaces in space, and how to take limits of, differentiate and integrate space curves (vector-valued functions).

Unit 1 Outcomes: You will: (Text Section)
- Change points and equations from rectangular to polar coordinates and vice versa. (H1)
- Sketch polar equations using point plotting, the rectangular plotting method and technology. (H1)
- Express polar equations as parametric equations in order to find the slope of a polar equation. (H1)
- Find the minimum and maximum distance from the pole. (H1)
- Use integration to find the area and arc length of polar graphs. (H2)
- Use the right hand rule to draw three-dimensional axes. (9.1)
- Visualize the three coordinate planes and the eight octants. (9.1)
- Plot a point in three dimensions, using rectangular coordinates. (9.1)
- Use the distance formula and find the equation of a sphere in three dimensions. (9.1)
- Explain the difference between a vector and a scalar. (9.2)
- Perform vector addition and scalar multiplication. (9.2)
- Find a position vector. (9.2)
- Distinguish between component form and standard basis vector form. (9.2)
- Find the magnitude of a vector, parallel vectors, and a unit vector in a given direction. (9.2)
- Solve application problems based on the resultant force of two vectors. (9.2)
- Define the dot product. (9.3)
- Given two vectors in component form, compute the dot product. (9.3)
- Perform orthogonality tests on two nonzero vectors. (9.3)
- Know and apply properties of the dot product. (9.3)
- Calculate scalar and vector projections. (9.3)
- Define the cross product. (9.3)
- Define matrices, and 2×2 and 3×3 determinants. (9.3)
- Understand important properties of the cross product. (9.3)
- Find the volume of a parallelepiped using the Triple Scalar Product. (9.3)
- Find the vector, parametric and symmetric equations of a line in space. (9.4)
- Determine whether a pair of lines are parallel, skew or intersecting. (9.4)
- Find the vector equation of a plane and the scalar equation of a plane through a point and with a given normal vector. (9.5)
- Determine whether two planes are parallel, perpendicular or neither. (9.5)
- Define a function of two variables and define the domain and range of such functions. (9.6)
- Using traces, draw a three-dimensional surface. (9.6)
- Identify and sketch quadric surfaces. (9.6)
- Sketch plane and space curves. (10.1)
- Parameterize a space curve. (10.1)
- Find limits of vector functions. (10.1)
- Calculate derivatives and integrals of vector functions. (10.2)
- Find tangent vectors. (10.2)
- Find unit tangent vectors. (10.2)
- Find the angle between two space curves at their intersection. (10.2)

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Unit 2: In this unit, you continue learning about vector-valued functions. These functions are used to describe curves in space and also, to describe the motion of objects through space. Also, in this unit, functions of several variables (from section 9.6) are revisited in more detail. You will learn how to differentiate functions of several variables using a process called partial differentiation. Applications to tangent planes, linear approximations, directional derivatives and the gradient vector are considered. Analogous to Calculus I, you will learn to find extrema of functions of several variables, and do applied optimization problems using Lagrange Multipliers.

Unit 2 Outcomes: You will: (Text Section)

o   Find the length of a space curve. (10.3)
o   Find normal, unit normal, and binormal vectors. (10.3)
o   Use the three curvature formulas in the proper context. (10.3)
o   Find the equation of the normal plane. (10.3)
o   Use the position vector to calculate velocity and acceleration vectors. (10.4)
o   Sketch the position, velocity, and acceleration vectors onto a plane curve. (10.4)
o   Determine if an object is speeding up or slowing down based on the velocity and acceleration vectors. (10.4)
o   Recover the position and velocity vectors from the acceleration vector. (10.4)
o   Apply the vector form of Newton's Second Law. (10.4)
o   Define functions of several variables; consider the domain and range of such functions and define contour maps and level surfaces. (11.1)
o   Define the limit of a function of several variables and discuss the continuity of such functions. (11.2)
o   Define and interpret first and second partial derivatives for functions of two, three or more variables. (11.3)
o   Find the equation of a tangent plane to a point on a surface; relate the equation of the tangent plane to the linear approximation of the surface at a point. (11.4)
o   Extend the idea of a differential to functions of two or more variables. Compute the total differential for functions of two or more variables. (11.4)
o   Know the different versions of the Chain Rule for functions of several variables. (11.5)
o   Learn the Implicit Function Theorem for use in differentiating functions of several variables defined implicitly. (11.5)
o   Define a directional derivative in order to find the rate of change of a function of two or more variables in any direction. (11.6)
o   Define the gradient vector and learn about and understand its properties. (11.6)
o   Use partial derivatives to locate maxima and minima of functions of two variables. (11.7)
o   Solve applied max/min problems for function of two variables. (11.7)
o   Find absolute extrema on a closed, bounded set in $\Box^2$. (11.7)
o   Use the Method of Lagrange Multipliers to find the maximum and minimum values of $f(x, y, z)$ subject to one constraint. (11.8)

Unit 3: In this unit, you will extend the idea of a definite integral to double and triple integrals of functions of two or more variables. You will learn about two other three-dimensional coordinate systems: the cylindrical and spherical coordinate systems, which give convenient descriptions of some commonly occurring surfaces and solids. You will solve application problems involving volumes, masses, and centroids. You will also study the calculus of vector fields and define line integrals, ending with a study of Green's Theorem.

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Unit 3 Outcomes: You will: (Text Section)

o   For a function of several variables $f(x, y)$ where $f(x, y) \square\square 0$, define the volume of a solid lying above a rectangle as the double integral over the rectangle (12.1)
o   Define the average value of a function of two variables over a rectangle. (12.1)
o   Evaluate iterated integrals for functions of two variables. (12.2)
o   Evaluate double integrals over general regions (that is, not just over rectangles). (12.3)
o   Reverse the order of integration for double integrals over general regions and evaluate the resulting integral. (12.3)
o   Find volumes of solids over more general regions. (12.3)
o   Change to polar coordinates in a double integral. (12.4)
o   Use polar coordinates to find the volume of a given solid. (12.4)
o   Solve physical application problems such as computing mass, electric charge, center of mass, and moments of inertia. (12.5)
o   Define triple integrals for functions of three variables over a rectangular box and then over a more general bounded region. Learn how to evaluate these integrals. (12.7)
o   Solve application problems related to volume, center of mass (called a centroid if the density is constant) and moments of inertia using triple integrals. (12.7)
o   Express a triple integral over a solid as an iterated integral in six different orders (*dxdydz* , *dydxdz* , *dzdxdy*, *dzdydx* , etc.). (12.7)
o   Plot points in both the cylindrical and spherical coordinate systems and change points among the three coordinate systems: rectangular, cylindrical and spherical. (9.7)
o   Write equations given in rectangular coordinates in both cylindrical and spherical coordinates. (9.7)
o   Write equations given in either cylindrical or spherical coordinates in rectangular coordinates. (9.7)
o   Develop an understanding of which surfaces and solids are best described in cylindrical and spherical.
   coordinates in order to use in computing volumes and triple integrals in chapter 12. (9.7)
o   Set up and evaluate triple integrals in cylindrical and spherical coordinates. (12.8)
o   Sketch the solids given by triple integrals in spherical and cylindrical coordinates. (12.8)
o   Evaluate a triple integral given in rectangular coordinates by changing the integral to cylindrical coordinates. (12.8)
o   Evaluate a triple integral given in rectangular coordinates by changing the integral to spherical coordinates. (12.8)
o   Sketch a vector field. (13.1)
o   Find the gradient vector field of a multivariable function. (13.1)
o   Calculate line integrals with respect to arc length. (13.2)
o   Calculate line integrals with respect to x and y. (13.2)
o   Use line integrals to determine the work done in moving through a vector field. (13.2)
o   Determine if a vector field is a conservative vector field. (13.3)
o   Determine whether or not a given set is open, connected, and simply connected. (13.3)
o   Show that a line integral is independent of path. (13.3)
o   Determine if the proper conditions exist for the application of Green's Theorem. (13.4)
o   Use Green's Theorem to calculate certain double integrals. (13.4)

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DEPARTMENT POLICIES
The Math Department wants you to be successful in this course. Because of this, we have compiled a list of strategies and behaviors.

Attendance and class participation
- If you want to be successful in this course, attend every class.
- Come to class on time, and stay for the entire class period. If you are late or leave during class, you will miss important class material and you will also distract your classmates and your instructor. (See the Student Conduct Code)
- Turn off your cell phone during class. You and your classmates need to be free from distractions. (See the Student Conduct Code)
- Bring your book and Supplement and Homework Assignments to every class.
- Respect your classmates and your instructor. Listen carefully to questions asked and answers given. Treat all questions with respect.
- Participate fully in class. Volunteer answers, work problems, take careful notes, and engage in discussions about the material. Use computers only for designated work. Above all, stay on task.
- Contribute your share to the group work for the projects and do your best to make the group experience a positive one for all members.
- Do your own work on tests and quizzes. Cheating will not be tolerated. (See the Academic Integrity Code.)

Homework
- Homework is the way you practice the ideas and skills that are introduced in class. To be successful on the tests, you must do the homework. Homework may be collected and homework questions may be included on quizzes or tests. The homework assignments are listed in the homework assignment section of the Supplement.
- When you do the homework, write down all supporting work. Using the correct process is at least as important as getting the correct answer, so your work and steps are very important.
- Remember to check your answers. They will be in the back of he text or in the student's solutions manual.
- If there are questions you can't get or don't understand, ask about them at the beginning of the next class. If you have trouble with more than a few problems, try starting your homework in the Math Lab, where help is available.

Absence
- If you are sick and an absence is unavoidable, please call or email your instructor. You are still expected to read the course material and to try to do the homework.
- Make time to see your instructor when you return so that you can get any papers you missed.
- Remember that you are expected to be in class for the tests and quizzes. You will not be able to make up tests or quizzes.

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Getting Help

After you have tried the homework, there are ways to get help:

- Look in your text and your class notes for examples similar to the problems you are finding difficult.
- See your instructor during office hours or make an appointment. Bring the work you have done.
- Go to the Math Lab to get extra help on your homework or simply go and do your homework there. Someone will be there if you get stuck. You don't need an appointment to use the Math Lab.
- Form a study group with other class members. Working with other students can be a great way to learn. If you have a group to work with, consider meeting and working together in the Math Lab.
- Your textbook may have a complete solutions manual available in the Math Lab, which can be used in the Math Lab.
- You can use the computers in the computer lab within the Math Lab to do work related to your math course.
- In the Math Lab, you can get help on how to use your calculator.

Visit the **Math Lab website** to view hours and other useful information about the Math Lab.

COLLEGE POLICIES:

As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student's disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit www.brookdalecc.edu/support.

For information regarding:
- ♦ Brookdale's Academic Integrity Code
- ♦ Student Conduct Code
- ♦ Student Grade Appeal Process

Please refer to the **BCC STUDENT HANDBOOK** AND **BCC CATALOG**.

NOTIFICATION FOR STUDENTS WITH DISABILITIES:

Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Disabilities Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability, and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

MENTAL HEALTH:

- Mental Health Crisis Support: From a campus phone, dial 5555 or 732-224-2329 from an external line; off-hours calls will be forwarded to BCC police (2222 from a campus phone)
- Psychological Counseling Services: 732-224-2986 (to schedule an appointment during regular hours)

The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arises