



**VIRGINIA BEACH CITY PUBLIC SCHOOLS**  
CHARTING THE COURSE

*Department of Teaching & Learning*  
*Parent/Student Course Information*

***DUAL ENROLLMENT VECTOR CALCULUS***  
***(TC 3277)***  
***TIDEWATER COMMUNITY COLLEGE***  
***(MTH 277)***  
***One-half credit, One semester***

*Counselors are available to assist parents and students with course selections and career planning. Parents may arrange to meet with the counselor by calling the school's guidance department.*

**COURSE DESCRIPTION**

Vector Calculus is a dual enrollment, one-semester course providing the successful student with four college semester credits and one-half Virginia Beach City Public Schools (VBCPS) elective credit. This course provides an introduction to vector-valued functions, functions of several variables, partial differentiation, multiple integrals and vector analysis. Vectors play a role in nearly all areas of mathematics and its applications. More advanced physical applications of vectors include aerodynamics, electromagnetic theory, quantum theory and more recent fields such as computer graphics, image processing and robotics.

\*Tuition, fees and textbook fees are the responsibility of the student in accordance with the dual enrollment regulation (5-30.2).

**PREREQUISITE**

Students who have either successfully completed Advanced Placement (AP) Calculus BC with a minimum score of four on the corresponding AP exam or who have completed the dual enrollment course Calculus with Analytic Geometry II (MTH 174).

## **Objectives for MTH 277: Vector Calculus**

The student will be able to:

1. Review basic differentiation and integration techniques from Calculus BC.
2. Graph vectors in a plane.
3. Translate between coordinate and vector space notation.
4. Apply vector operations (addition, scalar multiplication, dot and cross products) to solve geometric and applied problems.
5. Convert points and equations between Cartesian, cylindrical and spherical coordinates in three space or between Cartesian and polar in two space and sketch polar curves.
6. Identify quadratic equations in two variables with corresponding conic curves or in three variables with quadric surfaces and sketch them.
7. Evaluate vector-valued functions as a set of parametric equations in either two space or three space.
8. Find concavity and slope for a vector-valued function.
9. Find velocity and acceleration given the position vector function of time.
10. Identify and interpret tangential and normal components of acceleration.
11. Differentiate and integrate vector-valued functions.
12. Find arc length and curvature of vector-valued functions.
13. Compute values for functions of several variables.
14. Determine limits and continuity for functions of several variables.
15. Calculate and interpret first and second partial derivatives and, for composite functions, apply the chain rule.
16. Find and classify critical points of a function of two or more variables as maxima, minima or saddle points and find absolute extrema over a closed-bounded domain.
17. Find tangent planes and normal lines to multivariate functions.
18. Find, interpret and apply the gradient of a function.
19. Optimize a function with given constraints using the method of Lagrange Multipliers.
20. Compute area in a plane using iterated integrals.
21. Compute volumes of solids using double integrals.
22. Use multiple integration techniques to compute surface areas of solids.
23. Solve multiple integration problems involving polar, spherical and cylindrical coordinates.
24. Compute the Jacobian Matrix involved in changing variables.
25. Compute vector fields and study their applications.
26. Set up and compute line integrals.
27. Study conservative vector fields and independence of path.
28. Study Green's Theorem and Stokes Theorem.
29. Study the Divergence Theorem for vector-valued integrals.

Aaron C. Spence, Ed.D., Superintendent  
Virginia Beach City Public Schools  
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Produced by the Department of Teaching and Learning.  
For further information, please call (757) 263-1070.

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Title IX Notice: Complaints or concerns regarding discrimination on the basis of sex or sexual harassment should be addressed to the Title IX Coordinator, at the VBCPS Office of Student Leadership, 641 Carriage Hill Road, Suite 200, Virginia Beach, 23452, (757) 263-2020, [Mary.Dees@vbschools.com](mailto:Mary.Dees@vbschools.com) (student complaints) or the VBCPS Department of School Leadership, 2512 George Mason Drive, Municipal Center, Building 6, Virginia Beach, Virginia, 23456 (757) 263-1088, [Elizabeth.Bryant@vbschools.com](mailto:Elizabeth.Bryant@vbschools.com) (employee complaints). Additional information regarding Virginia Beach City Public Schools' policies regarding discrimination on the basis of sex and sexual harassment, as well as the procedures for filing a formal complaint and related grievance processes, can be found in School Board Policy 5-44 and School Board Regulations 5-44.1 (students), School Board Policy 4-4 and School Board Regulation 4-4.3 (employees), and on the School Division's website at [Diversity, Equity and Inclusion/Title IX](#). Concerns about the application of Section 504 of the Rehabilitation Act should be addressed to the Section 504 Coordinator/Executive Director of Student Support Services at (757) 263-1980, 2512 George Mason Drive, Virginia Beach, Virginia, 23456 or the Section 504 Coordinator at the student's school. For students who are eligible or suspected of being eligible for special education or related services under IDEA, please contact the Office of Programs for Exceptional Children at (757) 263-2400, Plaza Annex/Family and Community Engagement Center, 641 Carriage Hill Road, Suite 200, Virginia Beach, VA 23452.

The School Division is committed to providing educational environments that are free of discrimination, harassment, and bullying. Students, staff, parents/guardians who have concerns about discrimination, harassment, or bullying should contact the school administration at their school. Promptly reporting concerns will allow the school to take appropriate actions to investigate and resolve issues. School Board Policy 5-7 addresses non-discrimination and anti-harassment, Policy 5-44 addresses sexual harassment and discrimination based on sex or gender. Policy 5-36 and its supporting regulations address other forms of harassment.

Alternative formats of this publication which may include taped, Braille, or large print materials are available upon request for individuals with disabilities. Call or write the Department of Teaching and Learning, Virginia Beach City Public Schools, 2512 George Mason Drive, P.O. Box 6038, Virginia Beach, VA 23456-0038. Telephone 263-1070 (voice); fax 263-1424; 263-1240 (TDD) or email him at [George.Coker@vbschools.com](mailto:George.Coker@vbschools.com).

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