UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
**Department of Mathematics and Statistics**

# Mathematics 377 Vector Calculus for Engineers and Scientists

**Calendar Description: H(3-1.5T)**

Review of calculus of functions of several variables. Vector fields, line integrals, independence of path, Green's theorem; Surface integrals, divergence theorem, Stokes's theorem; applications; curvilinear coordinates; Laplace, diffusion and wave equations in three-dimensional space.

**Prerequisite(s):** Math 375

**Antirequisite(s):** Credit for more than one of Mathematics 377, 331, 353, 367, 381 or Applied Mathematics 309 will not be allowed.

## *Syllabus*

| **Topics** | **Number of Hours** |
|---|---|
| Review of vector functions and multiple integration | 7 |
| Line integrals and surface integrals | 7 |
| Gradient, curl, divergence, Green's theorem, divergence theorem, Stokes's Theorem | 9 |
| Partial differential equations of mathematical physics | 9 |
| Orthogonal curvilinear coordinate systems | 5 |
| **TOTAL HOURS** | **37** |

See accompanying page for a detailed breakdown of instructional hours.

16:11:03 Effective: Winter 2020 JM

**MATH 377 Vector Calculus for Engineers and Scientists:**

Review of Vector Functions :

| | |
|---|---|
| Vector Functions of One variable. | 1 Hour |
| Curves and Parametrization | 2 Hours |

**Review of Multiple Integration :**

| | |
|---|---|
| Double Integrals , Triple Integrals | 4 Hours |

**Vector Fields :**

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|---|---|
| Vector and Scalar Fields. | 1 Hour |
| Conservative Fields | 1.5 Hour |
| Line Integrals. | 1 Hour |
| Line Integrals of Vector Fields. | 1 Hour |
| Surfaces and Surface Integrals. | 1.5 Hour |
| Oriented Surfaces and Flux Integrals. | 1 Hour |

**Vector Calculus : (16.1 - 16.6)**

| | |
|---|---|
| Gradient , Divergence , and Curl. | 2 Hours |
| Some Identities Involving Grad , Divergence , and Curl. | 1 Hour |
| Green's Theorem in the Plane. | 1 Hour |
| The Divergence Theorem in 3-Space. | 1 Hour |
| Stokes's Theorem. | 2 Hours |
| Some Physical Applications of Vector Calculus. | 2 Hours |

**Partial Differential Equations of Mathematical Physics:**

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|---|---|
| Double Fourier Series | 1.5 Hours |
| The three-dimensional Laplace equation. | 1.5 Hours |
| The two-dimensional wave equation | 1.5 Hours |
| The two-dimensional Heat equation | 1.5 Hours |
| Fourier integrals with applications to boundary value problems | 3 Hours |

value problems

**Orthogonal Curvilinear coordinate systems:**

| | |
|---|---|
| Coordinate surface and coordinate curves | 1 Hour |
| Scale factors and differential elements | 1.5 Hours |
| Gradient , Divergence , Curl and Laplacian in orthogonal curvilinear coordinates | 1.5 Hours |
| Application to velocity and acceleration | 1 Hour |

**Total: 37 Hours**

# MATH 377: Vector Calculus for Engineers and Scientists

## COURSE OUTCOMES

Upon Successful Completion of the Course, Students will be able to:

1. Adapt to the terminology, vocabulary of vector calculus and recognize wide range of symbols it employs;

2. Develop proficiency on the key concepts of vector calculus and use them to

   compute Line, Surface, and Flux Integrals of Scalar and/or vector fields of several variables;

3. Use available tools such as the Divergence Theorem , Stokes's Theorem and Orthogonal Curvilinear Coordinates to significantly reduce the complexity of calculations of multiple integrals;

4. Apply vector calculus techniques to solve and analyze wide variety of Physical applications in interdisciplinary fields including but not limited to Fluid Dynamics, Electromagnetism, Electrostatics, Maxwell's Equations of modern electrical and communications technologies. etc.

5. Explore the relationship between key vector calculus concepts, and their geometric implications for an enhanced interpretation of certain physical or natural phenomena.

6. Use Double Fourier Series to obtain solutions to the most frequent equations of Mathematical Physics (Heat, Wave and Laplace Equations) in two or more Space variable.