**Bronx Community College**
**of the City University of New York**
**Department of Mathematics and Computer Science**

**SYLLABUS: MTH 35: Vector Calculus** (4 credits-4 hours)
**Prerequisite: MTH 33: Calculus III**
**Main Text:** *Calculus, 6th Ed.,* by J. Stewart
**Supplementary Text on reserve at the library:** *Vector Calculus, 5th Edition,* by J.E.Marsden, A.J. Tromba

**Learning Objectives:** On successful completion of this course, students will be able to

- Compute the derivative matrix of multivariable and multivalued functions; state and apply the Chain rule to compute partial derivatives.
- State and aplly the Implicit and Inverse Function theorems to determine if equations can be solved locally; find a derivative by implicit methods.
- Find maxima and minima of functions subject to constraints using the Lagrange multipiers method.
- Compute double and triple integrals over general elementary regions in the plane and space respectively.
  Compute the Jacobian of a transformation and use it to change variables in double and triple integrals; choose the appropriate coordinate system (rectangular, polar, cylindrical, spherical) to compute double and triple integrals.
- Apply double and triple integrals to compute areas of surfaces, volumes of solids, averages, centers of mass, moments of inertia and gravitational potentials.
- Compute line and surface integrals of functions and vector fields; use these integrals to compute work, flux, and mass integrals on curves, surfaces and solids respectively.
- State and use the three vector forms of the Fundamental Theorem of Calculus in the multivariable setting: Green's, Stokes' and Gauss' (divergence) theorems.
- Determine whether a vector field is conservative; find and use potential functions to compute work integrals along curves.
- Use differential forms to state Green's, Stokes' and Gauss' theorems under a single theorem.
- Apply Vector Analysis to study physical and geometrical problems described in the language of Partial Differential Equations.

This course addresses the following **General Education Proficiencies:** *reasoning and analysis* by a) understanding and applying mathematical concepts, definitions and theorems in the formulation and solution of problems and b) by proving fundamental theorems; *mathematical and scientific methods* to model, analyze and solve real-life problems in order to understand the physical, natural and social worlds; *communication skills* by a) constructing, interpreting and applying symbolic and graphical representations of data and b) by constructing and presenting (generally in writing, but, occasionally, orally) a rigorous mathematical argument; *information literacy* by using technology appropriately to analyze and solve mathematical problems, for instance, by graphing vector fields, surfaces and, in general, having students use technology to practice their skills at three-dimensional visualization, which is very important in this course.

**Derivative of maps from $\mathbb{R}^n$ to $\mathbb{R}^m$**(mostly from the Supplementary Text)

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|---|---|---|
| 1.5 | n-Dimensional Euclidean Space | p.86 1,2,4,7,8,10,11-15,17 |
| 2.3 | Definition of Differentiability for maps from $\mathbb{R}^n$ to $\mathbb{R}^m$ | p.139 1-4,7,8,13,17 |
| 3.4 & 15.8(from the Main Text) | Lagrange Multipliers | p.976 1-19 odd, 21-39 odd, 45 |
| 3.5 | The Implicit Function Theorem | p.253 1-3,5,7,9,10,12 |
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| **16** | **Multiple Integrals** | |
| 16.1 | Double Integrals over Rectangles | p.994 1-17 odd |
| 16.2 | Iterated Integrals:Fubini's Theorem | p.1000 1-29 odd,35 |
| 16.3 | Double Integrals over General Regions | p.1008 1-27 odd, 37-53 odd, 57 |
| 16.4 | Double Integrals in Polar Coordinates | p.1014 1-31 odd, 36,37 |
| 16.5 | Applications of Double integrals | p.1024 1-19 odd |
| 16.6 | Triple Integrals | p.1034 3-19 odd, 31 |
| 16.7 | Triple Integrals in Cylinrdical Coordinates | p.1040 1-25 odd, 27 |
| 16.8 | Triple Integrals in Spherical Coordinates | p.1046 1-31 odd, 35 |
| 16.9 | Change of Variables in Multiple Integrals | p.1056 1-19 odd,20,24 |
| | Review | p.1057-p.1059 |
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| **17** | **Vector Integral Calculus** | |
| 17.1 | Vector Fields | p.1068 1-31 odd,35-36 |
| 17.2 | Line Integrals | p.1079 1-21 odd,37,39,41,48 |
| 17.3 | The Fundamental Theorem for Line Integrals | p.1089 1-23 odd,27,33,34 |
| 17.4 | Green's Theorem | p.1096 1-21 odd |
| 17.5 | Curl and Divergence | p.1104 1-21 odd, 12, 25-31, 33–38 |
| 17.6 | Parametrized Surfaces and Their Areas | p.1114 1,3,11-23 odd,33-45 odd |
| 17.7 | Surface Integrals of Scalar Functions and Vector Fields | p.1127 1,5-27 odd,36,37-43 odd |
| 17.8 | Stokes' Theorem | p.1133 1-11a) odd,13,15,19 |
| 17.9 | The Divergence Theorem | p.1139 1-13 odd,23,25-30 |
| 8.5(from the Suplementary Text) | Applications to Some Partial Differential Equations | p.585 1,3,7-10 |
| 8.6(from the Supplementary Text) | Differential Forms | p.603 1,3,4,5,6,8,9,11,12 |
| | Review | p.1142-p.1144 |

MP (Spring 2010)