Multivariable Analysis – MAA 5105

Catalog description: Derivative of a function of several variables, Implicit and Inverse Function Theorems, submanifolds of Euclidean space, rank theorem, tangent spaces, the derivative as a linear transformation, differential forms, integration on manifolds, Stoke's Theorem.

Prerequisites: MAA 4200, Modern Analysis, and MAS 4107, Linear Algebra, or permission of the instructor.

Corequisites: None.

Required Text: *Analysis on Manifolds* by J. R. Munkres

Supplementary Text: None.

Course description: This course is a one-semester introduction to the foundations of the mathematical analysis of functions of several real variables and differentiable manifolds at the introductory graduate level.

Instructional objectives:

- Master the calculus of functions of several variables
- Develop proof-writing skills and communication of mathematical ideas
- Apply the major theorems of vector analysis

Method of instruction: Lecture.

Schedule of topics covered:

Topic	**Approx. Number of weeks**
The Derivative	1 week
Implicit and Inverse Function Theorems	1 week
Euclidean submanifolds	2 weeks
Integration on manifolds and change of variables theorem	2 weeks
Exterior algebra	1 week
Differential forms	2 weeks
Orientation and Stokes' Theorem	2 weeks
Closed and exact forms – De Rham theory	1 week

Assessment procedures: Homework 30%, midterm exams 30%, and a final exam 40%.

Grading criteria: 90-100%=A, 80-89%=B, 70-79%=C, 60-69%=D, 0-59%=F

References

[1] David Bachman. *A geometric approach to differential forms.* Birkhäuser Boston Inc., Boston, MA, 2006.

[2] William M. Boothby. *An introduction to differentiable manifolds and Riemannian geometry.* Academic Press [A subsidiary of Harcourt Brace Jovanovich, Publishers], New York-London, 1975. Pure and Applied Mathematics, No. 63.

[3] Seán Dineen. *Multivariate calculus and geometry.* Springer Undergraduate Mathematics Series. Springer-Verlag London Ltd., London, second edition, 2001.

[4] Manfredo P. do Carmo. *Differential geometry of curves and surfaces.* Prentice-Hall Inc., Englewood Cliffs, N.J., 1976. Translated from the Portuguese.

[5] C. H. Edwards, Jr. *Advanced calculus of several variables.* Dover Publications Inc., New York, 1994. Corrected reprint of the 1973 original.

[6] Harold M. Edwards. *Advanced calculus.* Birkhäuser Boston Inc., Boston, MA, 1994. A differential forms approach, Corrected reprint of the 1969 original, With an introduction by R. Creighton Buck.

[7] John Hamal Hubbard and Barbara Burke Hubbard. *Vector calculus, linear algebra, and differential forms.* Prentice Hall Inc., Upper Saddle River, NJ, 1999. A unified approach.

[8] Klaus Jänich. *Vector analysis.* Undergraduate Texts in Mathematics. Springer-Verlag, New York, 2001. Translated from the second German (1993) edition by Leslie Kay.

[9] Michael Spivak. *Calculus on manifolds. A modern approach to classical theorems of advanced calculus.* W. A. Benjamin, Inc., New York-Amsterdam, 1965.

[10] Steven H. Weintraub. *Differential forms.* Academic Press Inc., San Diego, CA, 1997. A complement to vector calculus.