SYLLABUS
MULTIVARIABLE CALCULUS (MAC 2313, U04, Course Number ?)

(a 4-credit course)

University Core Curriculum Category: Mathematics

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Office Hours: Mo-We 5:45-5:45 pm, DM 413A

Textbook: Calculus: Early Transcendentals

By Bernard Gillett, Lyle Cochran, and William Briggs.

Pearson; 3rd edition (January 2, 2018)

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Course Goals

The goal of this course is to extend many of the basic concepts of calculus one and two to (scalar and vector-valued) functions of more than one variable.

Scalar functions: We'll study limits, continuity, partial derivatives and differentiation of functions of two or three variables. One application of partial derivatives will be optimization (maximum or minimum) of functions of two variables by a standard method or using Lagrange Multipliers. We will extend the concept of Riemann sums to functions of two or three variables. Double and triple integration will be used to calculate areas, surface areas, volumes, center of gravity or centroids of solids.

Vector-valued functions: We'll study vectors, vector-valued functions, apply these abstract concepts to develop basic principles of gravitational attraction and derive Kepler's laws of planetary motion. We'll introduce the concept of vector field, which is the mathematical description of flow. This will be used to study fluid flow and other applied problems. By the end of the course student will have a good understanding of conservative vector fields, gradient operators, curl, divergence

and flux. We will extend the Fundamental Theorem of (single-variable) Calculus to the Fundamental Theorem of Lines Integrals, Green's Theorem, Divergence Theorem and Stokes' Theorem. Applications to Fluid Mechanics will be discussed.

Learning objectives: Upon completion, students should demonstrate:

(1) Understanding vectors, their algebraic structure, and the geometry they represent. Graphing lines, planes, and simple surfaces in 3-space.

(2) The ability to do calculus with vector-valued functions and how to use them to represent an object's motion in 3-space.

(3) Understanding the differential calculus of multivariable functions, including linearization and optimization problems.

(4) The ability to compute multiple integrals in Euclidean and other coordinates and under-stand applications of these integral.

(5) Understanding vector fields, their differential operators, and the integral-based theorems relating them. Applications of these theorems to Mathematics and to Physics will be discussed.

Course description: The course deals with the differential and integral calculus of real multivariable functions. The student should have passed MAC 2311-2312 with at least a C, including most topics in Chapters 1-12, but excluding Ch. 9. This syllabus assumes a semester with 15 instructional weeks. The course covers most of chapters 13--17 from the textbook. Specifically

Chapter 13 (2 weeks) **Vectors and Geometry of Space**
13.1 Vectors in the Plane. 13.2 Vectors in three dimensions. 13.3 Dot Products. 13.4 Cross Products .13.5 Lines and Planes in Space. 13.6 Cylinders and Quadric Surfaces

Chapter 14 (2 weeks) **Vector-Valued Functions**
14.1 Vector-Valued functions. 14.2 Calculus of Vector-Valued Functions. 14.3 Motion in Space. 14.4 Length of Curves. 14.5 Curvature and Normal Vectors

Notes: *Torsion is optional and usually omitted (in 14.5).*

Chapter 15 (3 weeks) **Functions of several variables**
15.1 Graphs and Level Curves 15.2 Limits and Continuity 15.3 Partial Derivatives.

15.4 The Chain Rule. 15.5 Directional Derivatives and the Gradient. 15.6 Tangent Planes and Linear Approximation. 15.7 Maximum/ Minimum Problems. 15.8 Lagrange Multipliers (optional)

Chapter 16 (2.5 or 3 weeks) **Multiple Integration**

16.1 Double Integrals over Rectangular Regions. 16.2 Double Integrals over General Regions. 16.3 Double Integrals in Polar Coordinates. 16.4 Triple Integrals. 16.5 Triple Integrals in Cylindrical and Spherical Coordinates. 16.6 Integrals for Mass Calculations (just the basics, and more if time allows). 16.7 Change of Variables in Multiple Integrals. (just the basics, and more if time allows)

Chapter 17 (2.5 or 3 weeks) **Vector fields**
17.1 Vector Fields. 17.2 Line Integrals. 17.3 Conservative Vector Fields. 17.4 Green's Theorem. 17.5 Divergence and Curl. 17.6 Surface Integrals. 17.7 Stokes Theorem. 17.8 Divergence Theorem.

Evaluations and Exams:

- **Exams**: There will be a 30-minute Test 0, three 100-minute Midterms and a 120-minute Final Exam. Test 0 is scheduled for January 10th. The Midterm dates are Friday, **January 31st** (on Ch. 13-14); Wednesday, **March 26th** (on Ch. 15-16); and Wednesday, **April 18th** (on Ch. 17). The Final Exam is comprehensive; its schedule will be announced later.
- There are no make-up exams. A missed exam can be waived upon presentation of valid and verifiable proof of an emergency at the time of scheduled examination. The final exam is mandatory and cannot be waived.

Testing Protocol:

- Please keep back-packs, electronic devices away from your desk during exam.
- Prepare before coming to your exam; No bathroom breaks allowed.
- No admission to testing will be allowed after 15 minutes past the beginning of testing.

- Please, bring your ID!

Grading: Grades will be assigned on a 100-point basis.

The worth of exams and quizzes:

Quizzes = 15% Tes1 = Test2 = Test3 = 20% Final Exam = 25%

(i.e., 85% of the final grade come from Tests and Final, 15% come from Quizzes)

Remark:

- Quizzes. A 10-min Quiz will be given on every lecture with the exception of Jan 8th, Jan 10th, and the days of Tests.
- Test 0 will count for Quiz.
- The lowest marked Quiz will be dropped from deciding the overall grade.
- Extra credit, up to 15% may come from class participation, oral presentations or Guided Projects (MyLab Math).

Grading Scheme

A: 95 or above B : 83 - 86 C: 70 - 76 D: 60 - 69 F 59 or less

A-: 90 - 94 B-: 80 - 82

B+: 87 - 89 C+: 77 - 79

Academic misconduct

FIU defines academic misconduct in the Student Conduct and Honor Code as *any act or omission which violates the concept of academic integrity and undermines the academic mission of the University. Academic misconducts include, but are not limited to dishonesty, bribery, cheating, complicity, falsification, and plagiarism.*

Misconduct, academic or otherwise, will not be tolerated, and will be dealt with in accordance with the University Rules.