Comprehensive Course Syllabus

Multivariable Calculus

Course Description:
Students will apply and extend their knowledge of calculus to problems involving several variables. They will examine the similarities and differences between one- and several-variable situations from computational, geometrical, and theoretical points of view. The course covers the material from a traditional semester-long university course: geometry and algebra of vectors, coordinate systems, functions of several variables and their graphs and behaviors, differentiation (partial derivatives, gradients, divergence, curl, etc.), and integration (multiple integrals, path, line, and surface integrals). Other topics may include applications (min/max problems, work, flux, etc.), Change-of-Variables Theorem, Green's Theorem, Gauss' Theorem, and Stokes' Theorem.

I N S T R U C T O R (S) :

- Name(s): **Patrick Davis**

- Office Number(s) (When and where you are available for help.): **A157,**

Hours: By appointment

- Telephone number(s): **x-5492**

- Email address(es): **pdavis@imsa.edu**

Meeting Days, Time and Room(s)
Section 1: A152, ABCD days, Mod 6
Section 2: A152, ABCD days, Mod 8

Text(s) / Materials:
Colley, Susan J. (2003). *Vector Calculus*, 4th ed. Pearson.

Essential Content:
Content is that which is typically covered in a one semester college multivariable calculus course. (Not including linear algebra or differential equations material.)

SSLs and Outcomes:
FA = Formally assessed, IA = Informally assessed

IA. Students expected to demonstrate automaticity in skills, concepts, and processes that enable complex thought by
- ❖ completing daily homework assignments **FA, IA**
- ❖ completing regular problem sets **FA**
- ❖ engaging in daily collaboration to complete or check work **IA**
- ❖ completing quizzes and tests **FA**

IB. Students expected to construct questions, forge connections and deepen meaning by
- completing daily homework assignments **FA, IA**
- completing regular problem sets **FA**
- engaging in daily collaboration to complete or check work **IA**
- completing quizzes and tests **FA**

IC. Students expected to precisely observe phenomena and accurately record findings by
- regularly justifying conclusions and claims in all written work **FA,IA**
- carefully supporting answers verbally with appropriate mathematical justification during in-class discussions **IA**
- engaging in daily collaboration to complete or check work **IA**

ID. Students expected to evaluate the soundness and relevance of information and reasoning findings by
- regularly justifying conclusions and claims in all written work **FA**
- carefully supporting answers verbally with appropriate mathematical justification during in-class discussions **IA**
- engaging in daily collaboration to complete or check work **IA**

IIA. Students identify unexamined cultural, historical and personal assumptions and misconceptions that impede and skew inquiry by
- identifying weaknesses or misconceptions in related prior mathematical concepts **IA**
- discussing problems from multiple perspectives and opposing views to determine validity to various approaches **IA**
- engaging in daily collaboration to complete or check work **IA**

IIIA. Students use appropriate technologies as extensions of the mind by
- exploring mathematical ideas and problem solving using tools such as graphing calculators, Winplot, Mathematica, Excel, etc. **IA**
- making mathematical conjectures based on reasoned exploration **IA**

IIIB. Students recognize, pursue, and explain substantive connections within and among areas of knowledge by
- applying calculus methods to familiar contexts, e.g., applying green's Theorem in physics **FA**
- solving problems that require similar means which involve new or less familiar application contexts and justifying conclusions **FA**

IVA. Students construct and support judgments based on evidence through
- experimenting with 3d graphs then generalizing structure **FA,IA**
- Hypothesizing and proving vector properties **FA**
- exploring and justifying solutions to problems in class on a daily basis **FA**

IVB. Students will be challenged to write and speak with economy, power, and elegance by
- supporting answers with written justification using precise mathematical notation and language **FA,IA**
- making sound mathematical verbal arguments using precise language **FA,IA**

IVC. Students will identify and characterize the composing elements of dynamic and organic wholes, structures and systems.
- Actively developing the theory of vector calculus **FA,IA**

IVD. Students will be challenged to develop an aesthetic awareness and capability.
- Looking at the historical development of vector calculus **IA**
- Comparing student solutions and discussing relative merits, including elegance **IA**

VA. Students will identify, understand and accept the rights and responsibilities of belonging to a diverse community by
- actively participating in class discussions **IA**
- respecting each others' questions and responses, both in and out of class **IA**
- collaborating outside of class on Take Home and other assignments without infringing on each others' intellectual capital **IA**

VB. In order for students to make reasoned decisions which reflect ethical standards, and act in accordance with those decisions, students
- collaborate outside of class on assignments without infringing on each others' intellectual capital **IA**
- produce their own work on formal assessments **FA**

Instructional Design and Approach:
Students should be involved in exploration of the concepts and topics through reading of the text and outside material, giving presentations to classmates, through computer work, and solving problems in individual and group settings. Students will be asked to engage in the dialogue of problem solving, and to help their classmates understand the content of the course. Learning to leverage both an algebraic and geometric understanding of the material is a major goal for the course.

Student Expectations:
Students are expected to come to each class prepared to contribute to the classroom learning experience. This involves reading all assigned text and attempting all assigned problems before coming to class. Students are expected to work together and independently in deepening their understanding of course concepts. Students will have to take careful and complete notes in class, as the text does not cover all required material.

Assessment Practices, Procedures, and Processes:
Students are assessed through a variety of means including, but not limited to: written in-class and out-of-class exams, quizzes, classroom presentations, and homework. The relative weights of these factors depend on the amount of data available from each type of assessment. Typically, the breakdown is 2/3 tests and quizzes, with 1/3 homework and other assignments. Semester grades are based on 80% of the term work grade and 20% from the final exam.

Sequence of Topics and Activities (approximate)

Weeks 1-3	Vectors
Weeks 4-6	Functions, graphs, limits, differentiability, partial and directional derivatives
Weeks 7-8	Differential geometry, vector fields
Weeks 9-10	Taylor series, differentials, optimization
Weeks 11-12	Iterated integrals
Weeks 13-15	Line integrals, Green's Theorem, independence of path
Weeks 16-18	Surface integrals, Stokes theorem, Gauss' Theorem