Estd 1864

Forman Christian College, Lahore

(A Chartered University)

Spring 2022

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Office Hours: Mo, Wed & Fri: 01:00 pm– 02:30 pm

Tuesday & Thursday: 11:30 am – 01:00 pm

Course Information:

Multivariable Calculus, MATH 301 (A), 3 credits, Class Room: S-412

Lectures Time: Monday, Wednesday & Friday (11:00 - 11:50)

Prerequisite: MATH 201

Text Book:

"CALCULUS" by Howard Anton, Irl Bivens and Stephen Davis, 10th edition

https://www.academia.edu/34762815/Calculus_10th_edition_H._Anton

Reference Book:

Essential Calculus: Early Transcendentalsby James Stewart.

Course Contents:

Course contents include, but not limited to the following:

Vectors, Analytic geometry in 3-space, Quadratic surfaces, Limit and continuity, Partial and directional derivatives, Chain rule, Maxima and minima of function of more than one variable, Lagrange's multipliers, Double and triple integrals with applications, Line integral and Green's theorem.

Course Objectives:

In calculus of single variable functions (Calculus I, Calculus II) we study functions of a single variable. Multivariable Calculus (MATH 301) is a core course for mathematics and as appears from its name, is the extension of calculus of one variable function to two or more variables. So in this course, the concept of differentiability and integration, which have been used in calculus of singe variable functions, will be extended to functions of two and three variables. Calculus deals with rates of change, and therefore it is used to describe surfaces and is the framework for many theoretical concepts in the physical sciences. Mathematical techniques bases on calculus are used in many applications. Calculus of multivariable functions have very important role for describing the physical world as many things depend on more than one independent variable, for example, in geometry area and volume of regions depends on more than one variable, in thermodynamics pressure depends on volume and temperature, in electricity and magnetism, the magnetic and electric fields are functions of three space variables and one time variable t, in economics, functions can depend on a large number of independent variables, in modeling fluid or heat flow the velocity field depends on position and time. Through examples the course will indicate some of the width of applications.

Learning Outcomes: Upon successful completion of this course, students will be able to:

- Know the basic concepts of vector analysis and analytic geometry in 3-space.
- Know cylindrical and quadratic surfaces and their rough sketching.
- Compute limits and derivative of functions of two and three variables.
- Understand directional derivatives.
- Compute derivatives using chain rule.
- Understand gradient and its relationship to surfaces.
- Solve optimization problems involving several variables, also use Lagrange's Multipliers method.
- Set up and compute multiple integrals in rectangular, polar, cylindrical and spherical coordinates.
- Change variables in multiple integrals.
- Understand line integral and the concept of conservative vector field.
- Understand Green's theorem and use it in problems to compute line integral.

Course Requirements:

- **Teaching Mode:** The mode of teaching will be either fully in-person (for all students), or online, or basic blended model (in two groups), subject to the condition and the university instructions.
- **Attendance:** Students are expected to attend every class (both in person and in online classes). Student whose attendance is less than 70% will not be allowed to take the final exam. Students must arrive at class on time, should remain in class for the entire class period and mobile phone should be switched off or on silence. Note that there is 5 marks for attendance and behavior, if a student arrives more than 10 minutes late or leaves class during lecture or uses mobile in class, he/she will be marked absent for that day.
- **Assessment:** Course assessment will be through **quizzes, attendance and behavior, assignments, midterm, and final exam**. Quizzes, mid term exam and final exam will be conducted on campus for all students (unless it's totally online). Assignments will be conducted on Moodle along with its viva on Zoom or in person. There is no make up of any quizzes, but **best 3 out of 4** will be counted. Make up for midterm and final exam is possible only under extremes cases if student provides strong documentary evidence within 3 days, but in that case, there will be a 0-20% deduction in marks depending upon case to case basis.
- **Academic dishonesty or cheating:** Academic dishonesty or cheating will result in zero points and will be referred to AIC (Academic Integrity Committee) at FCC for necessary action.

Grades	Quality Points	Numerical Value
A	4.00	93-100
A-	3.70	90-92
B+	3.30	87-89
B	3.00	83-86
B-	2.70	80-82
C+	2.30	77-79
C	2.00	73-76
C-	1.70	70-72
D+	1.30	67-69
D	1.00	60-66
F	0.00	59 or below

Course Evaluation: Grading will be based on the following criteria:

Quizzes (4)	20 %
Attendance and behavior	05 %
Assignments (2)	05 %
Mid Term	30 %
Final Exam	40 %

Week	Topics (page numbers from the lecture notes)	Assessments
1 March 7, 9, 11	❖ Introduction to course policies, requirements, grading criteria ❖ Vectors **(page: 2-9)**	
2 March 14, 16, 18	❖ Line and Plane in 3-space **(pages: 9-11)** ❖ Spheres **(page: 12)** ❖ Cylindrical Surfaces **(page: 13)**	
3 March 21, 25	❖ Quadric Surfaces **(page: 14-23)**	**Quiz 1** March 25 (Fri)
4 March 28, 30 April 01	❖ Cylindrical and Spherical Coordinates **(pages: 23-26)**	
5 April 04, 06, 08	❖ Functions of Two or More Variables **(pages: 27-32)** ❖ Limits and Continuity **(pages: 33-36)**	
6 April 11, 13	❖ Partial Derivatives and Directional Derivatives **(pages: 37-42)**	**Quiz 2** April 13 (Wed)
7 April 20, 22	❖ The Chain Rule and Implicit Differentiation **(pages: 42-45)** ❖ Tangent Plane, Gradient and Normal Line **(pages: 46-48)**	**Assignment 1**
8 April 25, 27, 29	❖ Maxima and Minima of Functions of Two Variables **(pages:49-52)**	**Mid Term** April 29 (Fri)
9 May 09, 11, 13	❖ Lagrange Multipliers **(pages: 53-54)** ❖ Double Integrals **(pages: 55-65)**	
10 May 16, 18, 20	❖ (. . . continued) Double Integrals **(pages: 55-65)** ❖ Double Integrals in Polar Coordinates **(pages: 66-70)**	
11 May 23, 25, 27	❖ Triple Integrals **(pages: 71-76)**	
12 May 30 June 01, 03	❖ Triple Integrals in Cylindrical and Spherical Coordinates **(pages: 77-80)**	**Quiz 3** June 01 (Wed)
13 June 06, 08, 10	❖ Change of variables in multiple integrals; Jacobians **(pages:81-90)**	
14 June 13, 15, 17	❖ Line Integrals **(pages: 91-95)** ❖ Conservative Vector Fields; Path Independence **(pages: 96-98)**	**Assignment 2**
15 June 20, 22, 24	❖ Green's Theorem **(pages: 99-102)**	**Quiz 4** June 24 (Fri)