Syllabus / Course Outline Spring 2023

Course Name: **Multivariable Calculus**		
Course Code: MATH 301	**Course Type:** Core	**Course Credits:** 3
Class Timings: Mon, Wed, Fri: 11:00 - 11:50	**Section:** A	**Student Meeting Hours/ Office Hours:** Mon, Wed, Fri: 01:00 – 02:30 Tuesday: 12:00 – 02:30
Instructor Name: Dr. Shabnam Malik		

A Note from the Instructor:

- Students are expected to attend every class. Student whose attendance is less than 70% won't 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 behaviour, 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.
- 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. 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 extreme 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 will result in zero points and will be referred to AIC (Academic Integrity Committee) at FCC for necessary action.

Instructor Contact Details
Email: shabnammaik@fccollege.edu.pk
Office: S-351, Armacost Science Building
Office Hours: Mon, Wed, Fri: 01:00 – 02:30 and Tuesday: 12:00 – 02:30
Guidelines for contacting instructor: Students may visit during office hours for queries/discussion, and may also send email.

Course Description:
Pre-requisites : MATH 201
Mode of Instruction: In class (face to face) teaching and discussions

Main Mode of Instruction: Moodle and face to face
Technology Requirements: Students need to access their Moodle accounts for course materials**.**

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 based 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.

Student Learning Outcomes (SLOs): 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 Content and Activities Schedule: 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.

Week	Topics (page numbers from the lecture notes)	Assessments
1 Feb 13, 15, 17	❖ Introduction to course policies, requirements, grading criteria ❖ Vectors **(p: 2-9)**	
2 Feb 20, 22, 24	❖ Line and Plane in 3-space **(p: 9-11)** ❖ Spheres **(p: 12)** ❖ Cylindrical Surfaces **(p: 13)**	
3 Feb 27 March 01, 03	❖ Quadric Surfaces (**p: 14-23)**	**Quiz 1** March 01 (Wed)
4 March 06, 08, 10	❖ Cylindrical and Spherical Coordinates **(p: 23-26)**	
5 March 13, 15, 17	❖ Functions of Two or More Variables **(p: 27-32)** ❖ Limits and Continuity **(p: 33-36)**	

6 March 20, 22, 24	❖ Partial Derivatives and Directional Derivatives **(p: 37-42)**	
7 March 27, 29, 31	❖ The Chain Rule and Implicit Differentiation **(p: 42-45)** ❖ Tangent Plane, Gradient and Normal Line **(p: 46-48)**	**Quiz 2** March 29 (Wed)
8 April 03, 05	❖ Maxima and Minima of Functions of Two Variables **(p:49-52)**	**Assignment 1**
9 April 12, 14	❖ Lagrange Multipliers **(p: 53-54)**	**Mid Term** April 14 (Fri)
10 April 17, 19	❖ (. . . continued) Lagrange Multipliers **(p: 55-65)** ❖ Double Integrals **(p: 55-65)**	
11 April 28	❖ (. . . continued) Double Integrals **(p: 55-65)**	
12 May 03, 05	❖ Double Integrals in Polar Coordinates **(p: 66-70)**	**Assignment 2**
13 May 08, 10, 12	❖ Triple Integrals **(p: 71-76)**	
14 May 15, 17, 19	❖ Triple Integrals in Cylindrical and Spherical Coordinates **(p:77-80)**	**Quiz 3** May 15 (Mon)
15 May 22, 24, 26	❖ Change of variables in multiple integrals; Jacobians **(p: 81-90)**	
16 May 29, 31 June 02	❖ Line Integrals **(p: 91-95)** ❖ Conservative Vector Fields; Path Independence **(p: 96-98)**	
17 June 05, 07, 09	❖ Green's Theorem **(p: 99-102)** ❖ Quiz 4	**Quiz 4** June 09 (Fri)

Reading References:

- ❖ "CALCULUS" by Howard Anton, Irl Bivens and Stephen Davis, 10th edition
- ❖ Essential Calculus: Early Transcendentalsby James Stewart.

Course Requirements:

- ➢ **Class Participation**
  Students are expected to participate in the class discussion and problem-solving sessions
- ➢ **Assignment**
  There will be 2 assignments.
- ➢ **Quizzes**
  There will be 4 quizzes and best 3 will be counted.
- ➢ **Mid Term and Final Exam**

The breakup is as follows:

Assignments:	05 %
Attendance and Behaviour:	05 %
Quizzes:	20 %
Midterm exam:	30 %
Final term exam:	40 %
TOTAL	**100%**

Missed Assignments/Quiz/Make-Ups

- There will be no make-up of missed assignment and Quiz.

Attendance Policy:

- At least 70 %

Classroom Participation:

- Students are expected to participate in the class discussion and problem-solving sessions

Grade Determination & Course Assessment as per FCC Policy:

- There will be absolute grading in the course as per department Policy.

Grading Legend:

Below is the grading legend of FCCU (published in all catalogs and available on the FCCU website)

Grade	Point Value	Numerical Value	Meaning
A	4.00	93-100	Superior
A-	3.70	90-92	
B+	3.30	87-89	Good
B	3.00	83-86	
B-	2.70	80-82	
C+	2.30	77-79	Satisfactory
C	2.00	73-76	
C-	1.70	70-72	
D+	1.30	67-69	Passing
D	1.00	60-66	
F	0.00	59 or below	Failing