National University
Of Computer & Emerging Sciences
Karachi

Course Outlines of BS (CS) Degree Program

Course Instructor	Dr. S.M. Fahad Riaz/Ms. Urooj/Ms. Alishba/Mr. Moheez/Mr. Maraj/Mr. Abdul Basit/Ms. Uzma Saleh	**Semester**	Spring
Batch/Section(s)	Batch 2024 sections	**Year**	2025
Course Title	MT2008 Multivariate Calculus	**Credit Hours**	3
Prerequisite(s)	MT119- Calculus and Analytical Geometry	**Course TA**	

Text Book(s)

1.Title of book	Calculus Early Transcendentals, Tenth Edition		
Author(s)	*Howard Anton, Irl C. Bivens, Stephen Davis*	Publisher	John Wiley & Sons.

Reference Book(s)

Multivariable Calculus, 7th Edition		
James Stewarts	Publisher	BROOKS COLE;
Calculus		
Thomas Finney	Publisher	Pearson
Calculus		
Gilbert Strang	Publisher	S.Chand and Company ltd

Course Description:

In this course, the goal will be to master the techniques of calculus in two and three variables, such as finding and analyzing critical points and evaluating multiple integrals. More broadly, we will attempt to develop an underlying geometric intuition that will allow us to understand the problems on a qualitative (as well as quantitative) level. Throughout the course we will emphasize mathematical writing and proof: we want to ensure that our solutions are presented in a manner that is clear, concise, and complete.

Course Objective:

Upon successful completion of this course, students should be able to:
- Handle vectors fluently in solving problems involving the geometry of lines, curves, planes, and surfaces in space.
- Visualize and draw graphs of surfaces in space.
- Differentiate scalar functions of vectors and integrate vectors.
- Calculate extreme values using Lagrange multipliers.
- Solve double and triple integrals.

No.	Assigned Program Learning Outcome (PLO)	Level	Tools
02	Identify, formulate, research literature, and analyze complex computing problems, reaching substantiated conclusions using the first principles of mathematics, natural sciences, and computing sciences.	R	

I = Introduction, R=Reinforcement, E = Evaluation. A = Assignment, Q = Quiz, Pr=Presentation,

No.	Course Learning Outcome (CLO) Statements	Tools

1	Understand the basic concepts and know the basic techniques of differential and integral calculus of functions of several variables.	Q,1, Q2 A1, A2, A3, M1, F
2	Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids.	A1, M1, F
3	Solve problems involving maxima and minima, line integral and surface integral, and vector calculus.	Q3, A2, A3, M2, F
4	Apply gradient and derivative for solving various problems arising in sciences.	M1, M2, F

P=Project, M = Midterm, F=Final.

Tentative Lecture Schedule:

Week	Contents/Topics	Exercises	CLO	Practice Questions
1	**Partial Derivatives:** Introduction, Functions of Two or More Variables, Domain and its sketching, Level Curves and Level Surfaces	13.1	2	1-8,17-20,23-28, 43-44,51-64
2	Limits and Continuity Limit Along Curves, open and closed sets, continuity, Limits at discontinuities, Limits by converting into polar coordinates, introduction of partial derivatives	13.2 13.3	2	1-26,34, 35, 38-40 1-14,17,18, 25-50
3	Partial derivatives of functions of two or more variables, partial derivative function and notations, PD as rate of changes/slopes, PD from tabular data (applied problems), implicit PDs, PDs and continuity, Higher order PDs, Equality of second order mixed derivatives,	13.3	2	57-65 ,69-100
4	Differentiability, Differentials, and Local Linear Approximation The Chain Rule for PDs with a tree diagram.	13.4 13.5	2	9-26 ,33-40 1-14,17-36,41-48
5	Directional Derivatives and Gradients Directional Derivatives, Gradients, Properties of gradients, Gradients are normal to level curves. Tangent Planes and Normal Vectors	13.6 13.7	1 4	1-45,53-66 3-12
6	**MIDTERM 1**			
7	Extreme value of the function of two variables. Absolute & Relative Extrema, Extreme Value theorem, The second order Partials test	13.8	3	1,2,9-18 5-12

	Lagrange Multipliers Method **Least Square and Convex Optimization problems** **(Material will be provided)**	13.9	4	
8	**Gradient Descent Algorithm (Material will be provided)** <u>**Multiple Integral:**</u> Double Integrals, Fubini's theorem	14.1	2	1-16
9	Double Integral over non-rectangular region Double Integral in polar coordinates	14.2 14.3	2	1-12,15-25,47-56 1-10
10	Double Integral in polar coordinates, Surface Area and Parametric Surfaces*	14.3 14.4*	3	23-34 1-10,13-16
11	**MIDTERM 2**			
12	Triple Integrals, Change of Variable in Multiple Integrals Jacobians*	14.5 14.7*	1	1-8 1-12,35-38,44-46
13	**Topics in Vector Calculus:** Vector Fields, gradient, divergence, and curl Line Integrals	15.1 15.2	2	17-28 7-14,19-30,37-40
14	Green's Theorem Surface integrals	15.4 15.5	3	1-14 1-8
15	Gauss-Divergence Theorem	15.7	3	1-4
16	Stokes' Theorem	15.8	3	1-12

Grading Criteria:

Marks Distribution:

Particulars	% Marks
1. Quizzes (atleast 3)	10
2. Assignments (atleast 3)	10
3. First Mid Exam	15
4. Second Mid Exam	15
5. Final Exam	50
Total:-	**100**

Important Instructions to be followed for this Course

- Be in the classroom on time. Any student who arrives more than 5 min late in the class will be marked LATE. Anybody coming to class more than 15 minutes late will be marked ABSENT.
- Turn off your cell phones or any other electronic devices before entering the class.
- Maintain the decorum of the classroom all the time.
- Avoid a conversation with your classmates while the lecture is in progress.
- Use parliamentary language in the classroom as well as in assignments. Refrain from using impolite, vulgar, or abusive language in the classroom as well as in class presentations and assignments.

- Submit your assignments on time, no assignment will be accepted after the deadline.
- There would be no re-take of any quiz.

Instructions / Suggestions for satisfactory progress in this course:

- On average, most students find at least three hours outside of class for each class hour necessary for satisfactory learning.
- Chapters should be read and homework should be attempted before class.
- Do not get behind. You are encouraged to work with other students. Plus, I am always available during office hours to help you.
- The homework assigned is a minimum. You may always work extra hours on your own.
- Use the few minutes you usually have before the start of each class to review the prior meetings' notes and homework. This will save us valuable in-class time to work on new material.
- Develop a learning habit rather than memorizing.
- Work in groups, whenever appropriate.
- Apply the learned principles and gained knowledge.
- Be creative in thinking, but stick to the topic assigned for discussions, assignments and presentations.
- Always bring your textbooks with you in the class.

Note: Students are welcome all the time to get help from the Teacher.

Signature: _____   Date:12-01-2025