Course	MAT281 Multivariable Calculus	Semester	Monsoon Semester 2024
Faculty Name(s)	Pravakar Paul	Contact	pravakar.paul@ahduni.edu.in
School	SEAS	Credits	3
GER Category:	Mathematical and Physical Sciences	Teaching Pedagogy Enable:NO	P/NP Course: Can not be taken as P/NP

Schedule

Section 1	09:30 am to 11:00 am	Wed	01-08-24 to 26-11-24
	09:30 am to 11:00 am	Mon	01-08-24 to 26-11-24

Prerequisite	Not Applicable OR Class 12th with mathematics or MAT142 is necessary.
Antirequisite	Not Applicable
Corequisite	Not Applicable
Course Description	This is the first course in mathematics taken by all engineering students, BS (Physics) students and anyone else who is interested in basic techniques of differential calculus of one and many variables. The course is highly applications oriented. Graphical visualization will be encouraged. Python code will be shared with interested students. The emphasis is on engineering and physics applications. The major topics covered are vectors, dot products, determinants, matrices, review of single variable calculus, continuity, differentiability, limits, Taylor and McLaurin series, convergence, partial derivatives, chain rules, extremum values, gradient, directional derivatives, Lagrange's multipliers Integral Calculus: Double integrals, polar coordinates, change of variables, Line integrals in plane, conservative fields, Gradient fields and potential, Integral theorem for Gradients, Spherical and Cylindrical Polar coordinates, Divergence and Curl, Gauss's theorem and Stokes' theorem, Examples of triple integrals in polar coordinates

Course Objectives	To prepare students with essential mathematical techniques useful in later courses and in their professional lives. At the end of the course, students will be able to work with vector analysis, calculate function approximations and errors, understand conservative and nonconservative fi elds, work with double integrals and change of variables, Connect the use of integration to physical quantities, Understand the connection between gradient, divergence and curl in terms of fluid dynamics and extend the understanding to general vector fields like the Electric and Magnetic fields, Apply Gauss's and Stokes' law in polar coordinates
Learning Outcomes	Essential mathematical skills in calculus, technical reading and writing
Pedagogy	Regular classroom lectures and tutorials One group project will be assigned in the second half of the course The emphasis is on active participation from students and supporting their learning, especially in applying mathematical methods correctly and in developing problem solving skills
Expectation From Students	Active participation

Assessment/Evaluation	• Mid-Semester Examination:
	  ◦ midsemester exam - 25%
	  ◦ Quiz - 20%
	• End Semester Examination:
	  ◦ End semester exam - 25%
	  ◦ Project - 10%
	  ◦ Quiz - 20%

Attendance Policy	As per Ahmedabad University Policy.
Project / Assignment Details	Projects: One team project will be assigned Quizzes: Total four quizzes of 10 marks each Assignments: Problem sets will be assigned regularly
Course Material	Reference Book • Thomas' Calculus, Weir, Hass and Giordano, 11 Edition, ISBN: 987-81-317-1867-4, Year: 2008,

Additional Information	There is no text book for the course. Lecture notes will be shared. Practice problems, online lectures and supporting material can be found at 1 Multivariable calculus, Prof. Denise Aurox, MIT OCW 2 Paul's online notes, Calculus III 3 Advanced Engineering Mathematics, Jain and Iyengar Problems assigned by the instructors will be enough preparation for the course. Students attempting problems other than shared in the course need to be cautioned that some of the problems in the references may be daunting. While we encourage students to attempt any problem they wish, it will be a good strategy to seek help if they can not solve the problem in a day or two.

Session Plan

NO.	TOPIC TITLE	TOPIC & SUBTOPIC DETAILS	READINGS,CASES,ETC.	ACTIVITIES	IMPORTANT DATES
1	Vectors and dot products	Applications in force and work		Discussion, Physical examples	
2	Cross product	Examples of cross products in Engineering and Physics			
3	Matrices and determinents	Matrix multiplication, geometric interpretation, Multiplication by a constant, Applications			
4	Tutorial			Problem set	
5	Graphing	Drawing of basic curves			
6	Approximations	Linear Approximations			
7	Approximations	Taylor and MacLaurin serieses			
8	Approximations	Some useful examples			
9	Review of single variable calculus	Change of variables, Chain rules			
10	Tutorial				
11	Project Discussion	Discussion and Teams	Our World in Data	Team Formation	
12	Limits, Continuity and differentiability	comparison of the concepts in one and many dimensions			
13	Limits, Continuity and differentiability	Some useful examples			

14	convergence	Tests for convergence			
15	Convergence	Tests for convergence			
16	partial derivatives	Definition, geometry, practical examples			
17	Tutorial			Problem set	
18	Chain rules	Variety of chain rules, dependent and independent variables			
19	Chain rules	Some useful examples			
20	extremum values	Critical points, local and absolute extrema			
21	Tutorial				
22	gradient, directional derivatives	Applications in real life			
23	Lagrange's multipliers	Theory of Lagrange's Multipliers			
24	Tutorial				
25	Double integrals	Basic rules for multiple integration			
26	Polar coordinates	Integration using polar coordinates			
27	change of variables	Jacobian,Problem solving			
28	Tutorial				
29	Line integrals in plane	Vector integrals, conservative fields			
30	Gradient fields	Potential, Integral theorem for Gradients			

31	Gradient fields	Examples of gradient fields			
32	Tutorial				
33	Curvilinear coordinates	Spherical Polar coordinates, change of variables			
34	Curviliniar coordinates	Cylindrical Polar coordinates, change of variables			
35	Divergence and Curl	Definition, calculation in Cartezian coordinates			
36	Project Discussion				
37	Tutorial				
38	Tutorial				
39	Revision				
40	Project Submission				