National University of Sciences & Technology (NUST)
School of Electrical Engineering and Computer Science (SEECS)
Department of Electrical Engineering

Multivariable and Vector Calculus			
Course Code:	MATH-106	**Semester:**	2nd
Credit Hours:	3+0	**Prerequisite Codes:**	MATH-101
Instructor:		**Discipline:**	EE
Office:		**Telephone:**	
Lecture Days:		**E-mail:**	
Class Room:		**Consulting Hours:**	
Knowledge Group:	Applied Mathematics	**Updates on LMS:**	Friday

Course Description:

The course introduces functions of several variables, partial differentiation with applications. Important quadric surfaces are included while students also become familiar with 3-dimensional cylindrical and spherical coordinate systems. Double and triple integration are included with applications to find areas and volumes. In the second part advanced topics in vector analysis like calculus of del operator, gradient, curl and divergence along with their physical interpretations are covered.

Course Objectives:

The course objective is that its successful completion should develop understanding of multivariable functions, partial differentiation and multiple integrals. The applications will be covered from several engineering problems. The other objective is to learn basic vector differential operators, gradient, divergence and curl along with their applications to calculate surface integrals, flows and flux across surfaces.

Course Learning Outcomes (CLOs):

After successful completion of this course, a student should be able to:	PLO	BT Level*
1. comprehend partial derivatives, extremas and saddle points of multivariable functions	2	C1,C2
2. evaluate area and volume using double and triple integrals in Cartesian, polar and spherical coordinates	1	C4
3. work out gradient, divergence and curl of vector fields and apply Green's, Gauss and Stokes theorems	2	C6

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain,
A= Affective domain

Mapping of CLOs to Program Learning Outcomes

PLOs/CLOs	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
PLO 1 (Engineering Knowledge)		√		√	√	√
PLO 2 (Problem Analysis)	√		√			
PLO 3 (Design/Development of Solutions)						
PLO 4 (Investigation)						
PLO 5 (Modern tool usage)						
PLO 6 (The Engineer and Society)						
PLO 7 (Environment and Sustainability)						
PLO 8 (Ethics)						
PLO 9 (Individual and Team Work)						
PLO 10 (Communication)						
PLO 11 (Project Management)						
PLO 12 (Lifelong Learning)						

Books:

Text Books:

- Calculus and Analytic Geometry (9th Edition) George B. Thomas, Jr. and Ross L. Finney.
- Thomas's Calculus (11th Edition) George B. Thomas, Jr.
- Advanced Engineering Mathematics (9th Edition) Ervin Kreyszig
- Calculus (6th Edition) Swokowski, Olinick and Pence

Topics to be covered:

These mainly fall into two main categories:

1. Calculus of Several Variables

Multivariable functions, limits, continuity and partial differentiation

Local and absolute extremas and saddle points

Multiple integrals, areas of regions and volume of surfaces

2. Vector Calculus

Vector fields in two and three dimensions

Gradient, divergence and curl

Flow and flux across curves and regions

Work integrals, surface integrals

Green's, Gauss's and Stoke's Theorems

Applications of three fundamental theorems

Topics	Lectures	Week
Surfaces in three basic coordinate systems: Cartesian, cylindrical and spherical	3	1 - 5
Multivariable functions, limits, continuity and partial differentiation.	3	
Relative changes, differentials, local and absolute extremas and saddle points	4	
Double integrals and areas of irregular regions	3	
OHT – 1		**6**
Triple integrals, change of order of integration	3	7 – 11
Volumes of surfaces and multiple integrals in different coordinate systems	2	
Vector fields, gradient and its geometrical understanding	3	
Concepts of divergence and curl, vector differential identities	2	
Work integrals	3	
OHT – 2		**12**
Flow and flux across curves and regions, Green's theorem (both tangent and normal forms)	4	13 – 17
Surface integrals	2	
Stoke's theorem	2	
Gauss's divergence theorem	2	
Applications of Gauss's and Stoke's divergence theorems in engineering problems to calculate impact of the vector fields	3	
ESE		**18**
Total	**39**	

Weightages:	
Quizzes:	10%
Assignments:	10%
OHT-1:	15%
OHT-2:	15%
Final Exam:	50%

Grading Policy:	
Quiz Policy:	The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor's discretion. Grading for quizzes will be on a fixed scale of 0 to 10. A score of 10 indicates an exceptional attempt towards the answer and a score of 1 indicates your answer is entirely wrong but you made a reasonable effort towards the solution. Scores in between indicate very good (8-9), good (6-7), satisfactory (4-5), and poor (2-3) attempt. Failure to make a reasonable effort to answer a question scores a 0.
Assignment Policy:	In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.
Plagiarism:	SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.