



National University of Engineering (UNI)

School of Civil Engineering
Syllabus 2026-II

1. COURSE

MA210. Calculus III (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: MA210. Calculus III
2.2 Semester	: 3 rd Semester.
2.3 Credits	: 4
2.4 Hours	: 3 HT; 2 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Mandatory
2.7 Learning modality	: Face to face
2.8 Prerequisites	: MA112. Calculus II. (2 nd Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course continues the study of calculus with functions of several variables, integrating concepts of vector calculus, partial derivatives, multiple integrals, and geometric and physical applications, including line and surface integrals. It develops skills for modeling and solving problems in three dimensions and introduces first-order ordinary differential equations, providing the foundations for advanced areas such as mathematical analysis, physics, and engineering.

5. GOALS

- Understand functions of several variables and their partial derivatives.
- Apply differential and integral calculus in three dimensions.
- Solve optimization problems with multiple variables.
- Master multiple, line, and surface integrals and their applications.
- Solve first-order ordinary differential equations and model simple physical systems with them.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Familiarity)

7. TOPICS

Unit 1: Multivariable and Vector Calculus (22 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Partial derivatives and the gradient vector • Multiple integrals in Cartesian, cylindrical, and spherical coordinate systems • Vector fields and line and surface integrals • Integral theorems: Green, Stokes, and the Divergence Theorem • Applications to flux, circulation, and conservative fields in engineering contexts	• Compute gradients and directional derivatives for scalar fields describing physical quantities [Usage] • Evaluate double and triple integrals for volumes, masses, and centroids of engineering objects [Usage] • Apply Stokes' and Gauss's Divergence Theorems to relate field integrals in electromagnetism and fluid mechanics [Assessment] • Determine whether a vector force field is conservative and compute the potential function [Assessment]
Readings : [Ste16], [TWH14]	

Unit 2: Multiple Integrals (12 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Double integrals over rectangles and general regions; iterated integrals (Fubini's theorem) • Double integrals in polar coordinates and change-of-variables formula • Triple integrals in Cartesian coordinates and applications to volume and mass • Triple integrals in cylindrical and spherical coordinates • Applications: area, volume, centers of mass, and moments of inertia	• Evaluate double and triple integrals over general regions using iterated integrals [Usage] • Apply coordinate changes in polar, cylindrical, and spherical systems to simplify multiple integrals [Usage] • Compute areas, volumes, and centers of mass using multiple integrals [Assessment]
Readings : [Ste16], [LE18]	

Unit 3: Line Integrals and Vector Fields (18 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Vector fields: definition, visualization, divergence, and curl • Line integrals of scalar functions: arc length and mass • Line integrals of vector fields: work and circulation • Conservative fields, potential functions, and path independence • Green's Theorem and its applications in the plane	• Compute scalar and vector line integrals over oriented curves [Usage] • Determine whether a vector field is conservative and construct its potential function [Usage] • Apply Green's Theorem to evaluate line integrals via double integrals [Assessment]
Readings : [MT03], [Ste16]	

Unit 4: Surface Integrals and Fundamental Theorems (16 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• Parametric surfaces, tangent plane, and surface area • Surface integrals of scalar functions • Flux integrals: surface integrals of vector fields • Stokes' Theorem: relation between line integrals and surface integrals • Divergence Theorem (Gauss): relation between flux and volume integral	• Parametrize surfaces and evaluate scalar and flux surface integrals [Usage] • Apply Stokes' and Divergence Theorems to reduce complex integrals [Assessment] • Relate local differential properties (curl, divergence) to global behavior via integral theorems [Assessment]
Readings : [MT03], [Apo69]	

Unit 5: First-Order Ordinary Differential Equations (ODEs) (16 hours)	
Competences Expected: ABET-1	
Topics	Learning Outcomes
• First-order equations: separable, linear, and exact forms	• Solve linear first-order ODEs using integrating factors [Usage]
Readings : [BDM17], [Ste16]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

- [Apo69] Tom M. Apostol. *Calculus, Volume II: Multi-Variable Calculus and Linear Algebra*. 2nd. Wiley, 1969.
- [MT03] Jerrold E. Marsden and Anthony J. Tromba. *Cálculo Vectorial*. 5th. Pearson, 2003.
- [TWH14] George B. Thomas, Maurice D. Weir, and Joel Hass. *Cálculo de varias variables*. 13th. Pearson, 2014.
- [Ste16] James Stewart. *Cálculo de varias variables: Trascendentes tempranas*. 8th. Cengage Learning, 2016.
- [BDM17] William E. Boyce, Richard C. DiPrima, and Douglas B. Meade. *Ecuaciones Diferenciales y Problemas con Valores en la Frontera*. 11th. Limusa Wiley, 2017.
- [LE18] Ron Larson and Bruce H. Edwards. *Cálculo Volumen 2*. 10th. Cengage Learning, 2018.