



National University of Engineering (UNI)
School of Computer Science
Syllabus 2027-I

1. COURSE

BMA102. Differential Calculus (Mandatory)

2. GENERAL INFORMATION

2.1 Course	: BMA102. Differential Calculus
2.2 Semester	: 1 st Semester.
2.3 Credits	: 5
2.4 Hours	: 4 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	: None

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Differential calculus is a fundamental mathematical tool shared by computer science and engineering disciplines, providing the foundations for the rigorous study of change, the analysis of rates of change, the optimization of systems and functions, and the modeling of continuous phenomena. This course provides a solid foundation in the concepts and techniques of differential calculus of one variable, with emphasis on its application in scientific and engineering contexts.

5. GOALS

- Rigorously understand the concepts of limit, continuity, and derivative of functions of one variable.
- Apply differentiation rules to compute derivatives of algebraic, composite, and implicit functions arising from scientific and engineering contexts.
- Use differential calculus to solve optimization problems, related rates problems, and function behavior analysis.

6. COMPETENCES

AG-C07) Computing Knowledge: Applies knowledge of mathematics, science, and computing. (Familiarity)

7. TOPICS

Unit 1: Limits and Continuity (12 hours)	
Competences Expected: AG-C07	
Topics	Learning Outcomes
• Epsilon-delta definition of a limit and formal proof techniques • Limit laws, one-sided limits, and limits at infinity • Continuity: types, properties, and the Intermediate Value Theorem • L'Hôpital's rule and indeterminate forms • Limits of sequences: convergence, Squeeze Theorem, and Bolzano-Weierstrass	• State the epsilon-delta definition of a limit and explain its geometric meaning [Familiarity] • Evaluate limits using limit laws, L'Hôpital's rule, and asymptotic analysis [Usage] • Prove continuity or discontinuity of a function and apply the Intermediate Value Theorem [Assessment]
Readings : [Stewart2015], [LarsonEdwards2014]	

Unit 2: Differential Calculus (36 hours)	
Competences Expected: AG-C07	
Topics	Learning Outcomes
• Derivative as a limit; geometric and physical interpretations; differentiability • Product, quotient, and chain rules; implicit differentiation; related rates • Rolle's theorem, Mean Value Theorem, and monotonicity criteria • Higher-order derivatives, Taylor polynomials, and remainder estimation • Extrema: first and second derivative tests, curve sketching, and applied optimization	• Interpret the derivative as a rate of change and as the slope of the tangent line [Familiarity] • Apply differentiation rules and implicit differentiation to compute derivatives of composite and implicit functions [Usage] • Solve optimization problems and sketch curves using the Mean Value Theorem and derivative tests [Assessment]
Readings : [Stewart2015], [LarsonEdwards2014]	

Unit 3: Parametric Equations and Polar Coordinates (6 hours)	
Competences Expected: AG-C07	
Topics	Learning Outcomes
• Parametric curves and their calculus, applied to trajectories in kinematics • Polar coordinates and their conversion to Cartesian coordinates	• Calculate the velocity and acceleration of a trajectory described parametrically [Usage] • Convert between polar and Cartesian coordinates when modeling engineering geometries [Usage]
Readings : [Stewart2016], [Thomas2014]	

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

Theory Sessions:

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

Lab Sessions:

In order to verify their competences, several activities including active learning and roleplay will be developed during lab sessions.

Oral Presentations:

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

Reading:

Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is considered as the mark of a qualified practice. The use of our virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.

The final grade NF depends on the following grades:

- PE : Partial Exam.
- FE : Final Exam.
- P : Permanent Evaluation (Average of practical work and graded assignments).

The final grade NF is calculated as follows:

$$NF = \frac{PE + FE + P}{3}$$

10. BASIC BIBLIOGRAPHY