

**COURSE CODE:** MATH-101  
**COURSE NAME:** CALCULUS AND ANALYTICAL GEOMETRY  
**CREDIT HOURS:** Theory = 03  
 Practical = 00  
 Total = 03  
**CONTACT HOURS:** Theory = 48  
 Practical = 00  
 Total = 48  
**PREREQUISITE:** Nil

**MODE OF TEACHING:**

Instruction: Three hours of lecture per week 100%

**COURSE DESCRIPTION:**

The course reviews the concepts of basic calculus, including limits, continuity, differentiation, and integration. A brief account of three-dimensional geometry and complex numbers is also included as pre-calculus review. Stress is laid on applications of differentiation and integration to practical/engineering problems. Convergence/divergence of the sequence and series are included towards the end of the syllabus

**COURSE OBJECTIVES:**

The course provides students a deeper understanding of the basic concepts of functions, limits and the derivatives and familiarizes students with the proper use of the differentiation formulas and integration of algebraic and transcendental functions. This course gives students abundant knowledge and skills in solving relevant problems in engineering and architecture. Also strengthen and broaden students' knowledge in partial differentiation and indeterminate forms of functions which they may encounter in solving different types of differentiation problems.

**RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the PLO/s:

- |   |                                  |                                     |    |   |                          |
|---|----------------------------------|-------------------------------------|----|---|--------------------------|
| 1 | Engineering Knowledge:           | <input checked="" type="checkbox"/> | 7  | Ethics:                                 | <input type="checkbox"/> |
| 2 | Problem Analysis:                | <input type="checkbox"/>            | 8  | Individual and Collaborative Team Work: | <input type="checkbox"/> |
| 3 | Design/Development of Solutions: | <input type="checkbox"/>            | 9  | Communication:                          | <input type="checkbox"/> |
| 4 | Investigation:                   | <input type="checkbox"/>            | 10 | Project Management:                     | <input type="checkbox"/> |
| 5 | Tool Usage:                      | <input type="checkbox"/>            | 11 | Lifelong Learning:                      | <input type="checkbox"/> |
| 6 | The Engineer and Society:        | <input type="checkbox"/>            |    |   |                          |

## COURSE LEARNING OUTCOMES (CLOs):

Upon successful completion of the course, students will be able to:

No.	CLO	Domain	Taxonomy Level	PLO
1	Apply basic laws of calculus and analytical geometry to solve mathematical problems	Cognitive	3	1

## PRACTICAL APPLICATIONS:

- Beam analysis in mechanics (piecewise linear, quadratic, and cubic functions, and differentiability of a function)
- Electrical circuit analysis (exponential functions and derivatives)
- Fitting a pipeline with minimal cost (optimization of a function on a closed interval)

## TOPICS COVERED:

### Theory:

Week	Topic
1	Review of vectors, scalars, and vector products. Three-Dimensional Coordinate System and equation of planes and straight lines with vector treatment.
2	Complex numbers, Argand Diagrams, Polar Form of Complex Numbers. Applications of De Moivre's Theorem. Hyperbolic Functions.
3	Concept of Limits. Rules and techniques of finding limits. Left Hand and Right-Hand Limits and existence/non-existence of Limits.
4	Continuity. Continuity at a point and continuity in an interval. Definition of Derivative and its calculation by definition. Geometric Interpretation of derivative.
5-6	Techniques of Differentiation: Basic Rules, Algebraic Functions, Trigonometric Functions, hyperbolic functions, Implicit Functions, Exponential and Logarithmic Functions. The Chain Rule.
7	Rates of change. Related Rates of Change
8	Local and Absolute Maxima and Minima. Rolle's Mean Value Theorem. First and second derivative tests for local maxima/minima. Concavity and convexity
9	Optimization Problems using differentiation. L' Hopital Rule. Indeterminate Forms
10	Indefinite Integration, Method of Substitution, Method of Parts, and other techniques of integration.
11	Integration of Rational and Irrational Functions. Introduction to Improper Integrals. Definite Integration. Finding areas between Curves in Cartesian Coordinates.
12-13	Polar Coordinates, Polar Curves and finding their areas using integration.
14	Arc Lengths of plane curves. Volumes of solids of revolution using integration. Disc Method and Cylindrical Shell Method.
15	Sequences and Series. Convergence/divergence of positive term series by Integral Test, p-test, Ratio Test, Root Test and Comparison Test.
16	Alternating Series. Absolute and Conditional Convergence. Power Series. Taylor's and McLaurin series
17-18	<b>ESE</b>

**TEXT AND MATERIAL:****Textbook (s):**

- a. Calculus and Analytic Geometry (9th Edition) by George B. Thomas, Jr. and Ross L. Finney.

**References Material:**

- a. Calculus (6th Edition) by Swokowski, Olinick and Pence
- b. Calculus (3rd Edition) by Robert T. Smith & Roland B. Minton

**ASSESSMENT SYSTEM:****1. CLOs Assessment**

<b>Cognitive</b>	<b>Psychomotor</b>	<b>Affective</b>
Spreadsheet	-	-

**2. Relative Grading**

<b>Theoretical/Instruction</b>			100%
	<i>Assignments 10%</i>		
	<i>Quizzes 10%</i>		
	<i>Mid Semester Exam 30%</i>		
	<i>End Semester Exam 50%</i>		
<b>Total</b>			<b>100%</b>