Course Title	Integral Calculus	**ISCED Code**	0541-122
		Course Code	MTH 122
Course Type	Core	**Course Status**	Theory
Course Hour	3.0 Hr./Week	**Credit Value**	3.0
Prerequisite	Algebra, Geometry and Trigonometry	**Total Marks**	100

Course Description

Integral Calculus is a major course for the undergraduate students of the B. Sc. (Honors) program, which carries **3.0 credits** and **42 hours** of effective teaching in **14 weeks**. The course grades will be assessed through participation, class presentations, assignments, two midterms and comprehensive examinations. This is an introductory course for the theory and applications of integration. It requires successful completion of **Algebra, Geometry and Trigonometry**.

Rationale

Integral calculus is a branch of calculus concerned with the theory and applications of integration. In Mathematics, integration is a method of adding or summing up the parts to find the whole. It is a reverse process of differentiation, where we reduce the functions into parts. Integral calculus is used for calculations involving arc length, pressure, area, the centre of mass, volume, and work. Calculus can also help more precisely comprehend the nature of space, time, and motion.

Course Objectives

The **Integral Calculus** course aims to provide a firm foundation in the concepts and techniques of integrations. It is primarily concerned with developing the student's understanding of anti-derivative concepts and providing experience with its methods and applications. It emphasizes a multi-representational approach to integral calculus, with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally. In addition, to acquire the knowledge of applying these representations in finding the length of a plane curve, an area under a curve, an area between two curves, volumes, area of the surface of revolution. Finally, the overall goal is to grow interest and provide the kind of problem-solving experience that the students might find in a research or industrial setting.

Course Learning Outcomes (CLOs

On satisfying the requirements and successful completion of this course, students will have the knowledge and skills to-

CLO1	Illustrate the concepts of anti-derivatives and indefinite integrals learn different techniques of evaluating integration.
CLO2	Learn to understand differentiation and anti-differentiation as inverse operation and Realize the meaning of the definite integral both as a limit of Riemann sums and as the area under a curve.
CLO3	Demonstrate basic properties of integration, evaluation of integration by successive reduction and Develop and apply definite integrals to evaluate area between two curves, volumes of solids of revolution, surface area, arc lengths utilizing different methods.
CLO4	Draw diagrams in polar coordinates, find tangent curves, evaluate areas enclosed by polar curves and arc lengths of the curves and Test convergence and divergence of different series, understand the different types of improper integrals and solve them.
CLO5	Evaluate some special integrals applying gamma and beta functions and Apply the method of integration to real-life problems.

Course Contents

	Course Contents	Hours	CLOs
1.	**Indefinite Integrals**: Introduction to indefinite integrals as anti-derivatives, Changes of variables in indefinite integrals, Standard formulae, Techniques of integration, Integration by parts and integration of trigonometric functions and rational functions.	7 Hrs.	CLO1, CLO2
2.	**Definite Integrals**: Concept of definite integration, Definite integration as the limit of a sum (with equally spaced as well as unequal intervals), Properties of definite integrals and their applications.	6 Hrs.	CLO2, CLO3

3.	**Theorems:** Fundamental theorems of integral calculus.	4 Hrs.	CLO1, CLO2 CLO3
4.	**Reduction formulae:** Reduction formulae for both indefinite and definite integrals.	5 Hrs.	CLO1, CLO2, CLO3, CLO4
5.	**Applications of Definite Integrals**: Curve tracing, Arc length, Plane areas, Volumes of solids of revolutions, Volumes by cylindrical shells, Volumes by cross-sections and area of a surface of revolution (for both Cartesian and polar curves).	6 Hrs.	CLO3, CLO5
6.	**Graphing in Polar Coordinates and Applications**: Curve tracing, Tangents to polar curves, Areas enclosed by curves in polar coordinates and arc length in polar coordinates.	5 Hrs.	CLO1, CLO3, CLO4
7.	**Improper Integrals**: Definition and evaluation of improper integrals, Tests for convergence and their applications.	5 Hrs.	CLO1, CLO3 CLO5
8.	**Gamma and Beta:** Gamma and Beta functions with applications.	4 Hrs.	CLO4 , CLO5

Alignment of CLOs VS PLOs

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs)

PLOs/ CLOs	PLO 1	PL02	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	PLO11	PLO12
CLO1	♦	-	♦	-	-	-	-	♦	-	-	-	-
CLO2	♦	♦	♦	-	-	-	-	-	-	-	-	-
CLO3	♦	-	♦	-	-	-	-	-	-	-	-	-
CLO4	♦	♦	♦	-	♦	♦	-	♦	-	-	-	-
CLO5	♦	-	-	-	♦	♦	-	♦	-	-	-	-

♦: Aligned -: Not-aligned

Learning Materials

Recommended Readings

i.	**Anton, H., Bivens, I.C. and Davis, S.,** *Calculus.* Tenth Edition, John Wiley & Sons, 2021.
ii.	**Thomas J., George B., Maurice D. Weir, Joel H., Christopher H.,***Thomas' calculus.* Fourteenth Edition, Boston, Pearson, 2018.

Supplementary Readings

i.	**Swokcoski E. W.,** *Calculus with Analytic Geometry*, Prindle, Weber & Schmidt, 1983.
ii.	**Stewart J.,** *Calculus*, Cengage Learning, 2015.

Teaching-Learning and Assessment Strategy

Mapping of Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecturing and Student Activity	Quiz/ Homework (Formative)
CLO2	Lecturing and Discussion	Midterm (Summative)
CLO3	Lecturing and Discussion	Assignment (Formative) and Midterm (Summative)
CLO4	Lecturing and Visual Presentation	Midterm and Final Exam (Summative)
CLO5	Lecturing and Discussion	Midterm and Final Exam (Summative)