OBE Curriculum
2022–2023 and Onwards

ISCED Code	0541-122	**Course Title**	Integral Calculus
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 integration. 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, students acquire knowledge of applying these representations in finding the length of a plane curve, an area under a curve, an area between two curves, volumes, and area of the surface of revolution. Finally, the overall goal is to grow interest and provide the kind of problem-solving experience that students might find in a research or industrial setting.	
CLOs	**CLO1**	Illustrate the concepts of anti-derivatives, indefinite and definite integrals, understand differentiation and anti-differentiation as inverse operations, and interpret definite integrals as limits of Riemann sums and as areas under curves.
	CLO2	Demonstrate and apply different techniques and properties of integration, including substitution, integration by parts, trigonometric and rational function integration, reduction formulae, improper integrals, convergence tests, and Gamma and Beta functions.
	CLO3	Apply definite integrals to determine areas, volumes of solids of revolution, surface areas, arc lengths, and related geometric quantities, including applications involving polar coordinates.
	CLO4	Apply integration concepts and techniques to solve mathematical, real-life, research, and industrial problems and demonstrate appropriate problem-solving skills.

No.	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.	CLO1
3	**Theorems:** Fundamental theorems of integral calculus.	4 Hrs.	CLO1
4	**Reduction Formulae:** Reduction formulae for both indefinite and definite integrals.	5 Hrs.	CLO2
5	**Applications of Definite Integrals:** Curve tracing, arc length, plane areas, volumes of solids of revolution, volumes by cylindrical shells, volumes by cross sections and area of a surface of revolution for both Cartesian and polar curves.	6 Hrs.	CLO3 & CLO4
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.	CLO3
7	**Improper Integrals:** Definition and evaluation of improper integrals, tests for convergence and their applications.	5 Hrs.	CLO2 & CLO4
8	**Gamma and Beta:** Gamma and Beta functions with applications.	4 Hrs.	CLO2

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

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	–	✓	–	–	–	–	✓	–	–	–	–
CLO2	✓	–	✓	–	✓	✓	–	✓	–	–	–	–
CLO3	✓	–	–	–	✓	✓	–	✓	–	–	–	–
CLO4	✓	✓	✓	✓	✓	✓	–	✓	✓	–	–	–

✓ : Aligned – : Not-aligned

Learning Materials	**Recommended Readings:** 1. Stewart J., Clegg D. and Watson S., *Calculus Early Transcendentals.* 9th Edition, Cengage Learning, 2019. 2. Anton, H., Bivens, I.C. and Davis, S., *Calculus.* Tenth Edition, John Wiley & Sons, 2021. **Supplementary Readings:** 1. Thomas J., George B., Maurice D. Weir, Joel H., Christopher H., *Thomas' Calculus.* Fourteenth Edition, Boston, Pearson, 2018. 2. Swokowski E. W., *Calculus with Analytic Geometry*, Prindle, Weber & Schmidt, 1983.

Mapping of CLOs with Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecturing, student activity and discussion	Quiz/Homework (Formative) and Midterm (Summative)
CLO2	Lecturing, discussion and group activity	Assignment (Formative), Midterm and Final Examination (Summative)
CLO3	Lecturing, discussion and visual presentation	Assignment (Formative) and Final Examination (Summative)
CLO4	Lecturing, discussion and group discussion	Presentation, Midterm and Final Examination (Summative)