Programme	B. Sc. Mathematics Honours			
Course Code	MAT1MN101			
Course Title	**CALCULUS**			
Type of Course	**Minor**			
Semester	I			
Academic Level	100 –199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic Idea of Functions, Limits and Continuity			
Course Summary	This course covers fundamental concepts in calculus: It begins with introducing the idea of tangent lines, rates of change, and the derivative, illustrating their application in describing motion and finding instantaneous rates of change. Basic rules of differentiation, including the product, quotient, and power rules, as well as techniques for finding higher-order derivatives are discussed. It also covers related rates, differentials, extrema of functions, the mean value theorem, concavity, inflection points, curve sketching, indefinite and definite integrals, integration by substitution, and the geometric interpretation of the definite integral. These sections explore various calculus techniques for analysing functions, determining areas under curves, and solving real-world problems.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate proficiency in finding derivatives using various differentiation techniques and apply them to describe motion, rates of change, and related rates problems.	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Analyse functions to determine extrema, concavity, and inflection points using the Mean Value Theorem, First and Second Derivative Tests, leading to effective curve sketching.	An	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Apply integration techniques to compute areas between curves, volumes of solids of revolution, arc lengths, and surface areas, culminating in understanding the Fundamental Theorem of Calculus and its applications.	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Text Book		Calculus, Soo T. Tan, Brooks/Cole Cengage Learning (2010) ISBN-13: 978-0-534-46579-7.		
Module	**Unit**	**Content**	**Hrs (48 +12)**	**Ext. Marks (70)**
I		**Introduction to Differentiation**	**14**	**Min 15**
	1	A Quick Review of Functions, Limits, and Continuity (This unit is optional)		
	2	Section 1.5: Tangent Lines and Rates of Change - An intuitive Look, Defining a Tangent Line, Tangent lines, Secant lines and Rates of Change.		
	3	Section 2.1**:** The Derivative - The Derivative, Using the Derivative to Describe the Motion of the Maglev, Differentiation, Finding the Derivative of a Function, Differentiability, Differentiability and Continuity		
	4	Section 2.2**:** Basic Rules of Differentiation - Some Basic Rules		
	5	Section 2.3**:** The Product and Quotient Rules - The Product and Quotient Rules(Example 6 is optional), Extending the Power Rule, Higher- Order Derivatives		
	6	Section 2.6: The Chain Rule – Composite Functions, The Chain Rule, Applying The Chain Rule		
	7	Section 2.7 : Implicit Differentiation – Implicit Functions, Implicit Differentiation		
	8	Section 2.8**:** Related Rates - Related Rates Problems, Solving Related Rates Problems.		
II		**Applications of Differentiation**	**12**	**Min 15**
	9	Section 2.9**:** Differentials and Linear Approximations - Increments, Differentials, Linear Approximations		
	10	Section 3.1: Extrema of Functions - Absolute Extrema of Functions, Relative Extrema of Functions, Finding the Extreme Values of a Continuous Function on a Closed Interval		
	11	Section 3.2: The Mean Value Theorem - Rolle's Theorem, Some Consequences of the Mean Value Theorem, Determining the Number of Zeros of a Function.		
	12	Section 3.3: Increasing and Decreasing Functions and the First Derivative Test - Increasing and Decreasing Functions, Finding the Relative Extrema of a Function		
	13	Section 3.4: Concavity and Inflection Points - Concavity, Inflection Points(Example 6 is optional), The Second Derivative Test, The roles of $f'$and f'' in Determining the Shape of a Graph.		
III		**Introduction to Integration**		
	14	Section 3.6: Curve Sketching -		

		The Graph of a Function, Guide to Curve Sketching(Up to and including Example 2)	**10**	**Min 15**
	15	Section 4.1: Indefinite Integrals - Antiderivatives, The indefinite Integral, Basic Rules of Integration.		
	16	Section 4.2: Integration by Substitution - How the method of Substitution Works, The Technique of Integration by Substitution (Example 8 is optional)		
	17	Section 4.3: Area - An Intuitive Look, Sigma Notation, Summation Formulas, Defining the Area of The Region Under the Graph of a Function (Example 9 is optional)		
	18	Section 4.4: The Definite Integral - Definition of the Definite Integral (Examples 2,3, and 4 are optional), Geometric Interpretation of the Definite Integral, The Definite Integral and Displacement, Properties of the Definite Integral.		
IV	**The Main Theorem and Applications of Integration**		**12**	**Min 15**
	19	Section 4.5: The Fundamental Theorem of Calculus - The Mean Value Theorem for Definite Integrals, The Fundamental Theorem of Calculus - Part 1, Fundamental Theorem of Calculus - Part 2, Evaluating Definite Integrals using Substitution, Definite Integrals of Odd and Even Functions		
	20	Section 5.1**:** Areas Between Curves - A Real- Life Interpretation, The Area Between Two Curves, Integrating with Respect to y		
	21	Section 5.2: Volumes: Disks, Washers, and Cross Sections - Solids of Revolution, The Disk Method, The Method of Cross Sections.		
	22	Section 5.4: Arc Length and Areas of Surfaces of Revolution - Definition of Arc Length, Length of a Smooth Curve, Surfaces of Revolution		
V	**Open Ended**		**12**	
	1	Limits Involving Infinity; Asymptotes		
	2	Derivatives of Trigonometric Functions		
	3	The General Power Rule and using the Chain Rule		
	4	Volumes Using Cylindrical Shells		
	5	Work , Moments and Centre of Mass		
	6	Taylor & Maclaurin's Series		
	7	Approximation by Taylor Series		
	8	Transcendental Functions		
	9	Improper Integrals		
	10	Numerical Integration		

References:

1. Calculus & Analytic Geometry, 9th Edition, George B. Thomas & Ross L. Finney, Pearson Publications.
2. Thomas' Calculus, 14th Edition, Maurice D. Weir, Christopher Heil, & Joel Hass, Pearson Publications.

3. Calculus, 7th Edition, Howard Anton, Biven, & Stephen Davis, Wiley India.
4. Advanced Engineering Mathematics, 10th Ed, Erwin Kreyszig, John Wiley & Sons.
5. Calculus, 4th Edition, Robert T Smith and Roland B Minton, McGraw-Hill Companies
6. Calculus, 9th Edition, Soo T Tan, Brooks/Cole Pub Co.
7. Calculus, Vol 1, Tom M. Apostol, John Wiley & Sons.
8. Michael Van Biezen Calculus Lectures: https://youtu.be/YZYxPclo2rg?si=qKCt6ty8m5dBR4DG

Note: 1) Optional topics are exempted for end semester examination.

2) Proofs of all the results are also exempted for the end semester exam.

Mapping of COs with PSOs and POs :

	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	1	3	1	2	1	3	1	1
CO 2	2	1	3	1	3	1	3	1	2
CO 3	3	2	3	1	3	1	3	1	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Assignment/ Seminar
- Internal Exam
- Viva
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓