Programme	B. Sc. Mathematics Honours			
Course Code	MAT1CJ101 / MAT1MN100			
Course Title	**DIFFERENTIAL CALCULUS**			
Type of Course	**Major**			
Semester	I			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic knowledge of Sets, Relations and Functions, School Level Algebra and Real Numbers (0-99 level).			
Course Summary	The course covers fundamental concepts in calculus, including functions, shifting of graphs, limits, continuity, differentiation, extreme values, the Mean Value Theorem, graphing with derivatives, and limits at infinity with asymptotes. Students learn techniques for evaluating limits, finding extrema, and graphing functions using derivatives, preparing them for further studies in calculus and related fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Compute domain, range of various functions and limits of functions also draw shifted graphs.	Ap	P	Internal Exam/ Assignment/ Seminar/Viva/End SemExam
CO2	Apply the concepts of continuity and differentiability of a function to solve mathematical problems	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End SemExam

CO3	Compute derivatives of different functions,Linearization and differentials.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End SemExam
CO4	Apply first and second derivatives and related theorems to find extrema of functions.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End SemExam
CO5	Sketch the graph of functions by computing critical points and asymptotes.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End SemExam

* - 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:

Textbook	**Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168**.			
Module	**Unit**	**Content**	**Hrs (48+12)**	**Marks**
				Ext: 70
I	**Module I**		**12**	**Min.15**
	1	Preliminaries: Section 3 - Functions		
	2	Preliminaries: Section 4 - Shifting Graphs.		
	3	Section 1.1-Rates of Change and Limits - Limits of Function Values onwards.		
	4	Section 1.2 - Rules for Finding Limits. Topics up to and including Example 3.		
	5	Section 1.2 - Rules for Finding Limits. Rest of the section.		

	6	Section 1.4- Extensions of the Limit Concept. Topics up to and including Example 6.		
II	**Module II**		**15**	**Min.15**
	7	Section 1.5 - Continuity.		
	8	Section 2.1 - The Derivative of a Function (The topic Graphing f' from estimated values is optional).		
	9	Section 2.2 - Differentiation Rules.		
	10	Section 2.3 - Rates of Change. Topics up to and including Example 5.		
	11	Section 2.5 - The Chain Rule. Topics up to and including Example 6.		
	12	Section 2.6- Implicit Differentiation and Rational Exponents. Topics up to and including Example 5.		
III	**Module III**		**11**	**Min.15**
	13	Section 3.1 - Extreme Values of Functions. Topics up to Finding Extrema.		
	14	Section 3.1 - Extreme Values of Functions- Topics from Finding Extrema onwards.		
	15	Section 3.2 - The Mean Value Theorem -Topics up to and including Example 4. (Proof of Theorem 3 is optional).		
	16	Section 3.2 - The Mean Value Theorem- Increasing Functions and Decreasing Functions		
	17	Section 3.3 - The First Derivative Test for Local Extreme Values.		

IV	**Module IV**		**10**	**Min.15**
	18	Section 3.4 - Graphing with y' and y'' - Topics up to and including Example 5.		
	19	Section 3.4 - Graphing with y' and y''- Topics from the Second Derivative Test for Local Extreme Values onwards.		
	20	Section 3.5 – Limits as $x \to \pm\infty$, Asymptotes and Dominant Terms. – Topics up to and including Summary for Rational Functions.		
	21	Section 3.5 – Limits as $x \to \pm\infty$, Asymptotes and Dominant Terms– Topics from Horizontal and Vertical Asymptotes up to and including Example 12.		
	22	Section 3.5 – Limits as $x \to \pm\infty$, Asymptotes and Dominant Terms–Topics from Graphing with Asymptotes and Dominant Terms onwards.		
V	**Module V (Open Ended)**		**12**	
	Trigonometric Functions, Tangent Values and Formal Definitions of Limits (From Precise Definition of limits onwards up to Example 6), Derivatives of Trigonometric Functions (Proofs are optional), Linearization and Differentials.			

References

1. Howard Anton, Biven, & Stephen Davis, Calculus, 7th Ed., Wiley India 2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed, John Wiley & Sons. 3. Robert T Smith and Roland B Minton, Calculus, 4th Ed. McGraw-Hill Companies 4. Soo T Tan, Calculus, 9th Ed.Brooks/Cole Pub Co.
5. Tom M. Apostol, Calculus, Vol 1: One Variable Calculus with an Introduction to Linear Algebra, 2nd Ed, John Wiley & Sons.
6. Michael Van Biezen Calculus Lectures: https://youtu.be/YZYxPclo2rg?si=qKCt6ty8m5dBR4DG

***Optional topics are exempted for end semester examination**

****70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module.**

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	3	2	0	2	1	3	0	2	1	3	1	3
CO 2	3	3	2	0	2	1	3	0	2	1	3	0	3
CO 3	3	3	2	2	2	1	3	0	2	1	3	1	3
CO 4	3	3	2	0	3	2	3	0	2	1	3	0	3
CO 5	3	3	2	2	3	2	3	0	2	2	3	0	3

Programme	B. Sc. Mathematics Honours			
Course Title	**MATRIX THEORY**			
Course Code	MAT1MN105			
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	Higher Secondary Algebra			
Course Summary	This course provides a comprehensive introduction to linear algebra, focusing on systems of linear equations, matrix algebra, determinants, and Euclidean vector spaces. Through a blend of theoretical concepts and practical applications, students will develop a strong foundation in linear algebra techniques and their uses in various fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the fundamental operations and concepts of systems of linear equations, including Gaussian elimination and elementary row operations, leading to an understanding of matrix algebra	U	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Apply the properties of determinants to evaluate them using cofactor expansions and row reduction techniques, and comprehend the relationships between matrices and determinants.	Ap	P	Internal Exam/ Assignment/ Seminar/ Viva/ End Sem Exam
CO3	Explore the geometry and properties of Euclidean vector spaces, including norms, dot products, distances, orthogonality, and the cross product.	An	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: Howard Anton and Chriss Rorres, Elementary Linear Algebra (11/e), Applications version, Wiley				
Module	**Unit**	**Content**	**Hrs (48 +12)**	**Ext. Marks (70)**
I	**System Of Linear Equations**		**12**	
	1	Section 1.1: -Introduction to systems of linear equations – up to and including Example 5		
	2	Section 1.1: - Rest of the section.		
	3	1.2 :- Gaussian Elimination – up to Example 5		
	4	Section 1.2; - From Example 5 onwards.		
	5	Section 1.3: - Matrices and Matrix Operations – up to and including Example 7.		
	6	Section 1.3; - Rest of the section.		
II	**Matrix Algebra**		**12**	
	7	Section 1.4: - Inverses; Algebraic Properties of Matrices - up to and including Example 6.		
	8	Section 1.4; - Properties of inverses onwards – up to and including Example 12.		
	9	Section 1.4: - Rest of the section.		
	10	Section 1.5; - Elementary matrices and a method for finding inverse (Proof of Theorem 1.5.3 is optional)		
	11	Section 1.6: - More on Linear systems and Invertible Matrices (Proofs of all the theorems are optional)		
	12	Section 1.7; - Diagonal, Triangular and Symmetric Matrices (Proof of theorem 1.7.1 is optional)		
III	**Determinants**		**12**	
	13	Section 2.1 :- Determinants by Cofactor expansions		
	14	Section 2.2; - Evaluating determinants by row reduction		
	15	Section 2.3: - Properties of determinants; Cramer's Rule – up to and including Theorem 3.2.5 (proofs of all the results are optional).		
	16	Section 2.3;- up to and including Example 7.		
	17	Section 2.3;- rest of the section.(proofs of all the results are optional)		
IV	**Euclidean Vector Spaces**		**12**	
	18	Section 3.1:- Vectors in 2-space, 3-space and n-space		
	19	Section 3.2:- Norm , dot product and distance in R^n (proofs of all the results are optional).		
	20	Section 3.3: - Orthogonality (proofs of all the results are optional).		
	21	Section 3.4:-The geometry of linear systems.		
	22	Section 3.5:-Cross product (Proof of Theorem 3.5.4 is optional)		
V	**Open Ended Module**		**12**	
	Matrix Transformations, Combinatorial approach to determinants, Rank of Matrix (From reference 1) Orthogonal Matrices (from reference 1)			

References:

1. Advanced Engineering Mathematics, 6th Edition, Dennis G. Zill, Jones & Bartlett Learning LLC (2018) ISBN: 978-1-284-10590-2.
2. Advanced Engineering Mathematics, Erwin Kreyzsig, 10th Edition, Wiley India.
3. Linear Algebra and its Applications: 3rd Edition, David C. Lay, Pearson Publications

Note: 1) Optional topics are exempted for end semester examination. (2) Proofs of all the results are exempted for external exam. (3) 70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module.

Mapping of COs with PSOs and POs :

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

Programme	B. Sc. Mathematics Honours			
Course Code	MAT1MN102			
Course Title	**CALCULUS OF A SINGLE VARIABLE**			
Type of Course	**MINOR**			
Semester	I			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practicum per week	Total Hours
	4	4	-	60
Pre-requisites	Set theory along with an understanding of the real number system.			
Course Summary	This course provides a foundational understanding of calculus concepts: From the beginning sections students learn about limits (including one-sided limits and limits at infinity), continuity (definitions and properties), and the intermediate value theorem. Modules II and III cover differentiation techniques, including tangent lines, the definition of derivatives, rules of differentiation (product, quotient, chain), implicit differentiation, and advanced topics like L'Hopital's Rule for indeterminate forms. Module IV focuses on the analysis of functions, discussing concepts such as increasing/decreasing functions, concavity, inflection points, and techniques for identifying relative extrema and graphing polynomials.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Analyse limit, continuity and differentiability of a function	An	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Apply rules and techniques of differentiation to solve problems, also find limit in indeterminate forms involving transcendental functions	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Draw a polynomial function by analysing monotonicity, concavity and point of inflection using derivatives test	An	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		**Anton, Howard, Irl C. Bivens, and Stephen Davis. *Calculus: early transcendentals*. 10th Edition, John Wiley & Sons, 2021.**		
Module	**Unit**	**Content**	**Hrs 60**	**External Marks (70)**
I		**Fundamentals of Limits and Continuity**	**14**	**Min.15**
	1	Section 1.1: Limits (An Intuitive Approach) - Limits, One-Sided Limits, The Relationship Between One-Sided and Two Sided Limits		
	2	Section 1.2: Computing Limits - Some Basic Limits, Limits of Polynomials and Rational Functions as $x \to a$		
	3	Section 1.2: Computing Limits - Limits involving Radicals, Limits of Piecewise-Defined Functions		
	4	Section 1.3: Limits at Infinity; End Behaviour of a Function Limits of Rational Functions as $x \to \pm\infty$ - A Quick Method for Finding Limits of Rational Functions as $x \to +\infty$ or $x \to -\infty$		
	5	Section 1.5: Continuity - Definition of Continuity, Continuity on an interval, Some Properties of Continuous Functions,		
	6	Section 1.5: Continuity - Continuity of Polynomials and Rational Functions, Continuity of Compositions, The Intermediate- Value Theorem.		
II		**Differentiation**	**14**	**Min.15**
	7	Section 2.1: Tangent Lines and Rates of Change - Tangent lines, Slopes and Rate of Change		
	8	Section 2.2: The Derivative Function - Definition of the Derivative Function-Topics up to and including Example 2.		
	9	Section 2.3: Introduction to Techniques of Differentiation - Derivative of a Constant, Derivative of Power Functions, Derivative of a Constant Times a Function, Derivatives of Sums and Differences, Higher Derivatives		
	10	Section 2.4: The Product and Quotient Rules - Derivative of a Product, Derivative of a Quotient, Summary of Differentiation Rules.		
	11	Section 2.5: Derivatives of Trigonometric Functions - Example 4 and Example 5 are optional		
	12	Section 2.6: The Chain Rule Derivatives of Compositions, An Alternate Version of the Chain Rule, Generalized Derivative Formulas		
		Differentiation contd :	**10**	
	13	Section 3.1: Implicit Differentiation - Implicit Differentiation (sub section)		
	14	Section 3.2: Derivatives of Logarithmic Functions -		

III		Derivative of Logarithmic Functions (sub section) Logarithmic Differentiation, Derivatives of Real Powers of x		**Min.15**
	15	Section 3.3: Derivatives of Exponential and Inverse Trigonometric Functions - Derivatives of Exponential Functions		
	16	Section 3.3: Derivatives of Exponential and Inverse Trigonometric Functions - Derivatives of the Inverse Trigonometric Functions		
	17	Section 3.6: L'Hopital's Rule; Indeterminate Forms - Inderminate Forms of Type 0/0, Indeterminate Forms of Type ∞/∞		
	18	Section 3.6: L'Hopital's Rule; Indeterminate Forms - Inderminate Forms of Type $0 \cdot \infty$, Indeterminate Forms of Type $\infty - \infty$		
IV		**Applications of Differentiation**	**10**	**Min 15**
	19	Section 4.1: Analysis of Functions I: Increase, Decrease, and Concavity - Increasing and Decreasing Functions		
	20	Section 4.1: Analysis of Functions I: Increase, Decrease, and Concavity - Concavity, Inflection Points		
	21	Section 4.2: Analysis of Functions II: Relative Extrema; Graphing Polynomials - Relative Maxima and Minima, First Derivative Test, Second Derivative Test		
	22	Section 4.2: Analysis of Functions II: Relative Extrema; Graphing Polynomials Geometric Implications of Multiplicity, Analysis of Polynomials		
V		**Module V (Open Ended)**	**12**	
		Infinite Limits		
		Differentiability, Relation between Derivative and Continuity		
		Parametric Equations, Parametric Curves		
		Inverse Trigonometric Functions and their derivatives		
		Taylor series expansion of functions		
		Maclaurin series of sin x, cos x, tan x, log(1+x), log(1-x) etc		
		Binomial expansion of $\frac{1}{(1+x)}$, $\frac{1}{(1-x)}$, $\frac{1}{\sqrt{1+x}}$, $\frac{1}{\sqrt{1-x}}$ etc		
		Different coordinate systems: - Cartesian, Spherical, and Cylindrical coordinates		
		Conic sections with vertex other than the origin		
		Indeterminate Forms of Type $0^0, \infty^0, 1^\infty$		
		Graphing Rational Functions		
References				
	1	Calculus and Analytic Geometry, 9 th Edition, George B. Thomas Jr and Ross L. Finney, Pearson Publications.		
	2	Calculus, Soo T. Tan, Brooks/Cole Cengage Learning (2010) ISBN-13: 978-0-534-46579-7.		

	3	Marsden, Jerrold, and Alan Weinstein. *Calculus I*. Springer Science & Business Media, 1985.
	4	Stein, Sherman K. *Calculus in the first three dimensions*. Courier Dover Publications, 2016.

Note: 1) Optional topics are exempted for end semester examination. 2) Proofs of all the results are also exempted for the end semester exam. (3) 70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module

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	2
CO 2	3	1	3	1	2	1	3	1	2
CO 3	2	1	3	2	3	2	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	✓	✓	✓	✓	✓

Programme	B. Sc. Mathematics Honours			
Course Code	MAT1FM105(2)			
Course Title	**MATHEMATICS FOR COMPETITIVE EXAMINATIONS - PART I**			
Type of Course	**MDC**			
Semester	I			
Academic Level	100 - 199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	3	3	-	45
Pre-requisites	Basic Arithmetic and Computational Skill			
Course Summary	The course is designed to equip students with essential arithmetic and problem-solving skills required for competitive exams. It covers topics ranging from fundamental arithmetic operations such as number systems, fractions, and roots to more advanced concepts like financial mathematics, time-speed-distance calculations, and problem-solving techniques..			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply concepts of the Number System, Number Series and Fractions to solve problems in competitive examinations by improving time management and problem- solving skills.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Use fast track techniques in HCF and LCM, Square root and Cube root and simplification, to solve problems in competitive examinations.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Identify and apply arithmetic operations like average, ratio and proportion and percentage to solve problems with focus on time management skills.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO4	Solve problems of financial Mathematics by managing time effectively	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

CO5	Use shortcut techniques to solve problems involving work, time, speed, distance etc. with enhanced accuracy and speed	Ap	P	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:

Module	Unit	Content	Hrs (36+ 9)	Ext. Marks (50)
I		**Fundamentals of Arithmetic**	9	Min 10
	1	Number System		
	2	Number Series		
	3	Simple and Decimal Fractions		
	4	HCF and LCM		
	5	Square root and Cube root		
II		**Basic Arithmetic Operations**	9	Min 10
	6	Simplification		
	7	Average		
	8	Ratio and Proportion		
	9	Problems based on ages		
	10	Percentage		
III		**Financial Mathematics**	9	Min 10
	11	Profit and Loss		
	12	Discount		
	13	Simple Interest		
	14	Compound Interest		
	15	Work and Time		

IV	**Time, Speed, and Distance**		**9**	**Min 10**
	16	Speed, Time and Distance		
	17	Problems based on trains		
	18	Boats and Streams		
	19	Clock and Calendar		
V	**Open Ended**		**9**	
	Mixture or Allegation, Partnership, Pipes and Cisterns			

References: 1. Fast Track Objective Arithmetic, Rajesh Verma, Arihant Publications India limited, 2018 (Primary Reference).
2. Objective Arithmetic for Competitive Examinations, Dinesh Khattar, Pearson Education, 2020.
3. Quicker Objective Arithmetic, Dr Lal, Jain, Upkar's publication, 2010.

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	0	3	0	3	0	0
CO 2	3	0	3	0	3	0	0
CO 3	3	0	3	0	3	0	0
CO 4	3	0	3	0	3	0	0
CO 5	1	0	2	0	2	0	0