Programme	B. Sc. Mathematics Honours			
Course Code	MAT1MN103			
Course Title	**BASIC CALCULUS**			
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	Basic Set Theory including functions and their algebraic operations .			
Course Summary	This course provides a comprehensive exploration of calculus and its applications: It begins with fundamental concepts of graphs, linear models, inverse functions, laying the groundwork for calculus. Modules II and III delve into differentiation techniques, including product and quotient rules, implicit differentiation, derivatives of inverse functions, and applications like extrema, theorems (such as Rolle's and Mean Value Theorems), and curve sketching. Module IV explores integral calculus, covering the fundamental theorem of calculus, numerical integration techniques (like the Trapezoidal Rule and Simpson's Rule), and introduces hyperbolic functions and their derivatives and integrals.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply graphical analysis skills to mathematical models**:**	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Evaluate and solve calculus problems involving limits and continuity	E	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Apply differentiation and integration techniques to analyse functions**:**	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:

Text Book		Calculus: Early Transcendental Functions (6edn), Ron Larson and Bruce Edwards Cengage Learning ISBN-13: 978-1-285-77477-0.		
Module	**Unit**	**Content**	**Hrs (48 +12)**	**Ext. Marks (70)**
I		**Foundations of Calculus: Graphs, Functions, and Limits**		
	1	A quick review of sections 1.1 and 1.2 (not for external exam) Section 1.3 – Functions and their Graphs	**13**	**Min 15**
	2	Section 1.5: Inverse Functions - Inverse Functions, Existence of an Inverse Function		
	3	Section 1.6: Exponential and Logarithmic Functions - Exponential Functions, The Number e, The Natural Logarithmic Function		
	4	Section 2.2: Finding Limits Graphically and Numerically - An Introduction to Limits, Limits That Fail to Exist, A Formal Definition of Limit (examples are optional topics)		
	5	Section 2.3: Evaluating Limits Analytically - Properties of Limits, A Strategy for Finding Limits,		
	6	Section 2.3: Evaluating Limits Analytically - Dividing Out Technique, Rationalizing Technique, The Squeeze Theorem		
II		**Continuity, Derivatives, and Differentiation Rules**		
	7	Section 2.4: Continuity and One-Sided Limits - Continuity at a Point and on an Open Interval, Properties of Continuity, The Intermediate Value Theorem.	**12**	**Mn 15**
	8	Section 3.1: The Derivative and the Tangent Line Problem - The Derivative of a Function, Differentiability and Continuity		
	9	Section 3.2: Basic Differentiation Rules and Rates of Change – The Constant Rule, The Power Rule, The Constant Multiple Rule, The Sum and Difference Rules		
	10	Section 3.2 : Basic Differentiation Rules – rest of the section.		
	11	Section 3.3: Product and Quotient Rules and Higher Order Derivatives - The Product Rule, The Quotient rule, Higher- Order Derivatives		
	12	Section 3.4 The Chain Rule.		
	13	Section 3.5: Implicit Differentiation Implicit and Explicit Functions, Implicit Differentiation, Logarithmic Differentiation		
III		**Applications of Derivatives: Extrema, Concavity, and Curve Sketching**		
	14	Section 4.1: Extrema on an Interval - Extrema of a Function, Relative Extrema and Critical Numbers, Finding Extrema on a Closed Interval	**12**	**Min 15**
	15	Section 4.2: Rolle's Theorem and The Mean Value Theorem - Rolle's Theorem, The Mean Value Theorem		
	16	Section 4.3: Increasing and Decreasing Functions and The First Derivative Test - Increasing and Decreasing Functions, The First Derivative Test		
	17	Section 4.4: Concavity and the Second Derivative Test -		

		Concavity, Points of Inflection, The Second Derivative Test		
	18	Section 4.6: A summary of Curve Sketching - Analyzing the Graph of a Function		
IV	**Integral Calculus: Fundamental Theorems and Applications"**			
	19	Section 5.1: Antiderivatives and Indefinite Integration – Antiderivatives, Basic Integration Rules, Initial Conditions and Particular Solutions.	11	**Min 15**
	20	Section 5.3: Reimann Sums and Definite Integrals – Reimann Sums, Definite Integrals, Properties of Definite Integrals.		
	21	Section 5.4: The Fundamental Theorem of Calculus - The Fundamental Theorem of Calculus, The Mean Value Theorem for Integrals.		
	22	Section 5.4: The Fundamental Theorem of Calculus - Average Value of a Function, The Second Fundamental Theorem of Calculus, Net Change Theorem		
V	**Open Ended**			
	One Sided Limits and Discontinuity, Derivatives of Inverse Functions, Derivatives of Trigonometric functions, Limits at Infinity and Horizontal Asymptotes, Numerical Integration, Area problems using Riemann Sums, Hyperbolic Functions.		**12**	

References:

1. Calculus, Soo T. Tan, First Edition, Brooks/Cole, Cengage Learning, 2011.
2. Calculus & Analytic Geometry, (9/e), George B. Thomas & Ross L. Finney, Pearson Publications
3. Calculus, (7/e), Howard Anton, Biven, & Stephen Davis, Wiley India
4. Calculus, (7/e)., Howard Anton, Biven, & Stephen Davis, Wiley India.
5. Calculus: Early Transcendentals, (4/e), Dennis G. Zill and Warren S. Wright

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	2	3	2	3	1	2
CO 2	3	1	3	1	3	1	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	MAT2MN103			
Course Title	**ANALYSIS AND SOME COUNTING PRINCIPLES**			
Type of Course	**Minor**			
Semester	II			
Academic Level	100 – 219			
Course Details	Credit	Lecture/Tutorial per week	Practicum per week	Total Hours
	4	4	-	60
Pre-requisites	Basic Calculus and familiarity with Real Number system.			
Course Summary	This course covers fundamental topics in calculus and complex analysis, beginning with sequences and series in Module I, exploring convergence tests like the nth-term test, comparison tests, and alternating series. Module II delves into complex numbers and functions, discussing the arithmetic and geometric properties of complex numbers, along with polar and exponential forms. In Module III, the focus shifts to limits, continuity, and differentiability of complex functions, including the Cauchy-Riemann equations and harmonic functions. Finally, Module IV introduces counting principles, including permutations, combinations, the pigeonhole principle, and basic elements of probability.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe and apply convergence tests for sequences and series.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Demonstrate proficiency in manipulating complex numbers and functions.	Ap	C	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Evaluate limits, continuity, and differentiability of real and complex functions.	E	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		1. Calculus: Early Transcendental Functions (6/e), Ron Larson and Bruce Edwards, Cengage Learning ISBN 13: 978-1-285-77477-0. 2. Complex Analysis A First Course with Applications (3/e), Dennis Zill & Patric Shanahan Jones and Bartlett, Learning (2015) ISBN 1-4496-9461-6 3. Discrete Mathematical Structures (6/e), Bernard Kolman, Robert Busby, Sharon C. Ross, Pearson ISBN 978-93-325-4959-3		
Module	**Unit**	**Content**	**Hrs (48 +12)**	**Ext. Marks (70)**
I		**Sequences and Series (Text 1)**		
	1	Section 9.1: Sequences - Sequences (sub section), Limit of a Sequence, Monotonic Sequences and Bounded Sequences.	**13**	Min 15
	2	Section 9.1: Sequences Monotonic Sequences and Bounded Sequences		
	3	Section 9.2: Series and Convergence - Infinite Series, Geometric Series, nth-Term Test for Divergence		
	4	Section 9.3: The Integral Test and p-Series - The Integral Test, p-series and Harmonic Series		
	5	Section 9.4: Comparisons of Series - Direct Comparison Test, Limit Comparison Test		
	6	Section 9.5: Alternating Series - Alternating Series (sub section), Alternating Series Remainder, Absolute and conditional Convergence		
II		**Complex Numbers (Text 2)**		
	7	Section 1.1: Complex numbers and their Properties - The Imaginary Unit, Terminology, Arithmetic Operations, Zero and Unity, Conjugate, Inverses	**13**	Min 15
	8	Section 1.2: Complex Plane - Complex Plane, Vectors, Properties, Distance Again, Inequalities		
	9	Section 1.3: Polar Form of Complex Numbers - Polar Form, Principal Argument, Multiplication and Division, Integer Powers of z, de Moivre's Formula		
	10	Section 1.4: Powers and Roots - Roots, Principal nth Root		
	11	Section 1.5: Sets of Points in the Complex Plane - Circles, Disks and Neighborhoods, Open Sets, Annulus, Domain, Regions, Bounded Sets		
	12	Section 2.1: Complex Functions - Introduction, Function, Real and Imaginary Parts of a Complex Function, Exponential Function		
III		**Complex Analysis (Text 2)**		
	13	Section 3.1: Limits and Continuity - Introduction, Real Limits, Complex Limits (definition only), Real Multivariable Limits (Example 2 and Problems Using Epsilon Delta Definition are optional)		
	14	Section 3.1: Limits and Continuity -		

		Continuity of Real Functions, Continuity of Complex Functions (Example 6 is optional), Properties of Continuous Functions.	**12**	Min 15
	15	Section 3.2: Differentiability and Analyticity - Introduction, The Derivative, Rules of Differentiation		
	16	Section 3.2: Differentiability and Analyticity - Analytic Functions, Entire Functions, Singular Points, An Alternate Definition of $f'(z)$.		
	17	Section 3.3: Cauchy -Riemann Equations - Introduction, A Necessary Condition for Analyticity, A Sufficient Condition for Analyticity		
	18	Section 3.4: Harmonic Functions Introduction, Harmonic Functions, Harmonic Conjugate Functions		
IV	**Introduction to Counting and Probability Theory (Text 3)**			
	19	Chapter 3: Counting Section 3.1 - Permutations	**10**	Min 15
	20	Chapter 3: Counting Section 3.2 - Combinations		
	21	Chapter 3: Counting Section 3.3 – Pigeonhole Principle		
	22	Chapter 3: Counting Section 3.4 – Elements of Probability		
V	**Open Ended**			
	Pattern Recognition for Sequences, Rearrangement of Series, The Ratio Test, The Root Test, Taylor Polynomials and Approximations, Power Series, Taylor Series, Maclaurin Series, Complex Functions as Mappings, Linear Mappings, Special Power Functions, Relations and Di Graphs.		**12**	

References:

1. Calculus, Soo T. Tan, First Edition, Brooks/Cole, Cengage Learning, 2011.
2. Calculus & Analytic Geometry, (9/e)., George B. Thomas & Ross L. Finney, Pearson Publications.
3. Calculus, (7/e), Howard Anton, Biven, & Stephen Davis, Wiley India.
4.Calculus: Early Transcendentals, (4/e)., Dennis G. Zill and Warren S. Wright.
5. Advanced Engneering Mathematics, (10/e), Erwin Kreyszig, John Wiley and Sons.
6.Complex Variables and Applications, (8/e), James Brown and Ruel Churchill, McGraw-Hill International (UK) Ltd
7.Discrete Mathematics, (6/e), Richard Johnsonbaugh, Pearson

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	2	1	3	1	1	1	3	0	0
CO 2	2	1	2	1	1	1	2	0	0
CO 3	2	1	2	1	1	1	3	0	0

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	BSc Mathematics Honours			
Course Title	**MATRIX ALGEBRA AND VECTOR CALCULUS**			
Course Code	**MAT3MN203**			
Type of Course	**Minor**			
Semester	III			
Academic Level	200 – 299			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic Calculus and familiarity with Euclidian Geometry.			
Course Summary	This course covers fundamental concepts in vectors, vector calculus, and matrices. Students will explore vectors in 2-space and 3-space, including dot and cross products, as well as lines and planes in 3-space. The vector calculus portion includes vector functions, partial and directional derivatives, tangent planes, normal lines, curl, divergence, line integrals, double integrals, surface integrals, and triple integrals. Additionally, the course delves into matrix algebra, systems of linear equations, matrix rank, and the eigenvalue problem.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Discuss the geometry of Vectors in two- and three-dimensional spaces	U	C	Internal Exam/ Assignment/ Seminar/ Viva / End Sem Exam
CO2	Discuss the basic concepts of matrices, and evaluate the solutions of system of linear equations using matrices.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Describe the idea of eigen values and eigen vectors.	U	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: Advanced Engineering Mathematics, 6th Edition, Dennis G. Zill, Jones & Bartlett Learning LLC (2018) ISBN: 978-1-284-10590-2.				
Module	**Unit**	**Content**	**Hrs (60)**	**Ext. Marks (70)**
I	**Vectors**		**11**	**Min. 15**
	1	Section 7.1-Vectors in 2 -Space (quick review)		
	2	Section 7.2-Vectors in 3-Space (quick review)		
	3	Section 7.3- Dot Product up to and including Example 5		
	4	Section 7.4- Cross Product up to and including Example 3		
	5	Section 7.5- Lines and Planes in 3-space- upto and including Example 6		
	6	Section 7.5- Lines and Planes in 3-space- From Planes: Vector Equation onwards		
II	**Vector Calculus**		**15**	**Min. 15**
	7	Section 9.1 – Vector Functions		
	8	Section 9.4 – Partial Derivatives		
	9	Section 9.5 – Directional Derivative – upto and including Example 4.		
	10	Section 9.5 – Functions of Three Variables onwards.		
	11	Section 9.6 – Tangent Planes and Normal Lines – upto and including Example 4		
	12	Section 9.6 – Topics from Normal Line onwards		
	13	Section 9.7 – Curl and Divergence -		
III	**Vector Calculus – contd.**			
	14	Section 9.8 – Line Integrals – upto and including Example 5.		**Min. 15**

	15	Section 9.10 – Double Integrals – upto and including Example 2	**12**	
	16	Section 9.13 – Surface Integrals – upto and including Example 4		
	17	Section 9.15 – Tripple Integrals (Examples 5 and 7 are optional)		
IV	**Matrices**		**10**	**Min. 15**
	18	Section 8.1- Matrix Algebra.		
	19	Section 8.2-Systems of Linear Algebraic Equations. Up to and including Example 7		
	20	Section 8.2-Systems of Linear Algebraic Equations. From Homogeneous Systems onwards till end omit chemical equations		
	21	Section 8.3 -Rank of a Matrix.		
	22	Section 8.8-The Eigenvalue Problem.-Up to and including Example 4		
V	**Open Ended**		**12**	
		Vector Spaces, Gram- Schmidt Orthogonalization (for instance, refer sections 7.6 and 7.7) Green's Theorem, Stocke's Theorem and Divergence Theorem (for instance, refer sections 9.12, 9.14 and 9.16) Complex Eigen Values Eigen Values and Singular Matrices. Eigen Values and Eigen Vectors of inverse of A Improper Integrals, Beta and Gama Functions		
		References: **1.** Calculus and Analytic Geometry (9^{th} Edn), George B Thomas, Jr. and Ross L Finney, Addison -Wesley Publishing Company. 2. A Freshman Honors Course in Calculus and Analytic Geometry, Emil Artin (Author), Marvin J Greenberg (Foreword).		

		3. Advanced Engineering Mathematics (10^{th} Edn), Erwin Kreyszig, John Wiley and Sons. 4. Improper Riemann Integrals*:* Ioannis M. Roussos CRC Press by Taylor & Francis Group, LLC(2014) ISBN: 978-1-4665-8808-0 (ebook -pdf)		

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