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	✓	✓	✓	✓	✓