Programme	BSc Mathematics Honours			
Course Code	MAT2CJ101 / MAT2MN100			
Course Title	**INTEGRAL CALCULUS**			
Type of Course	**Major**			
Semester	II			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practicals per week	Total Hours
	4	4	-	60
Pre-requisites	Basic knowledge of Functions, Limits, Continuity and Differentiation (MAT1CJ101 - Differential Calculus).			
Course Summary	The course provides a comprehensive exploration of integral calculus, covering techniques such as indefinite integrals, Riemann sums, definite integrals, properties of integrals, the Fundamental Theorem, L'Hopital's Rule, basic integration formulas, and applications in finding areas between curves, volumes of solids, lengths of plane curves, and areas of surfaces of revolution. Through these topics, students gain proficiency in solving a wide range of mathematical problems involving integration and its applications in various fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Solve definite and indefinite integrals of functions.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End Sem Exam
CO2	Apply the Fundamental Theorem of Calculus and properties of logarithmic and exponential functions to solve differentiation and integration problems.	Ap	P	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
CO3	Apply L'Hôpital's Rule and differentiation techniques to evaluate limits, derivatives, and integrals of inverse trignometric functions.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End Sem Exam

CO4	Apply basic integration techniques, including integration by parts and partial fractions, to evaluate integrals of algebraic and hyperbolic functions.	Ap	P	Internal Exam/Assignment/ Seminar/Viva/ End Sem Exam
CO5	Apply integration techniques to find areas between curves, volumes of solids, and lengths and surface areas of plane curves.	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:

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**		**14**	**Min.15**
	1	Section 4.1 - Indefinite Integrals.		
	2	Section 4.3 - Integration by Substitution - Running the Chain Rule Backward.		
	3	Section 4.5 - Riemann Sums and Definite Integrals. (Example 9 is optional.)		
	4	Section 4.6 - Properties, Area, and the Mean Value Theorem - Topics up to and including Example 6.		
	5	Section 4.6 - Properties, Area, and the Mean Value Theorem- Topics from The Average Value of an Arbitrary Continuous Function onwards.		

II	**Module II**		**11**	**Min.15**
	6	Section 4.7 – The Fundamental Theorem (Example 6 is optional).		
	7	Section 4.8 - Substitution in Definite Integrals.		
	8	Section 6.2 - Natural Logarithms- Topics up to and including The Graph and Range of ln x.		
	9	Section 6.2 - Natural Logarithms. -Topics from Logarithmic Differentiation onwards.		
	10	Section 6.3 - The Exponential Function- Topics up to and including Example 4.		
	11	Section 6.3 - The Exponential Function- Topics from the Derivative and Integral of e^x onwards.		
III	**Module III**		**12**	**Min.15**
	12	Section 6.6 - L' Hopital's Rule		
	13	Section 6.9 - Derivatives of Inverse Trigonometric Functions; Integrals.		
	14	Section 7.1 - Basic Integration Formulas.		
	15	Section 7.2 - Integration by Parts		
	16	Section 7.3 Partial Fractions.		
IV	**Module IV**		**11**	**Min.15**
	17	Section 5.1 - Areas Between Curves. - Topics up to and including Example 2.		
	18	Section 5.1 - Areas Between Curves- Topics from Boundaries with Changing Formulas		

	19	Section 5.2 - Finding Volumes by Slicing. (Example 2 may be done as open ended).		
	20	Section 5.3 - Volumes of Solids of Revolution- Disks and Washers - Topics up to and including Example 4.		
	21	Section 5.5 - Lengths of Plane Curves. - Topics up to and including Example 2.		
	22	Section 5.6 - Areas of Surfaces of Revolution- Topics up to and including Example 2.		
V	**Module V (Open Ended)**		**12**	
	Inverse Functions and their Derivatives, a^x and $\log_a x$, Inverse Trigonometric Functions and their derivatives, Hyperbolic Functions, Integrals and their derivatives, Integration using trigonometric substitutions.			

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	3	0	1	0	3	1	2	2	3	2	3
CO 2	3	3	3	0	1	0	3	1	2	2	3	2	3
CO 3	3	3	3	0	1	0	3	1	2	2	3	2	3
CO 4	3	3	3	0	1	0	3	1	2	2	3	2	3
CO 5	3	3	3	2	3	0	3	1	2	2	3	2	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	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO2	Describe and apply convergence tests for series.	Ap	P	Internal Exam/ Assignment/ Seminar/ Viva / End Sem Exam
CO3	Demonstrate proficiency in manipulating complex numbers and functions.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO4	Evaluate limits, continuity, and differentiability of real and complex functions.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

CO5	Understand counting principles and probability theory.	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		**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		**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, The Ratio Test, Complex Functions as Mappings, Linear Mappings, 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 :

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

Programme	B.Sc Mathematics Honours			
Course Code	MAT2MN104			
Course Title	**GRAPH THEORY AND AUTOMATA**			
Type of Course	**Minor**			
Semester	II			
Academic Level	100 - 199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Higher Secondary Mathematics			
Course Summary	This course introduces students to Graph Theory and Automata, covering topics such as graphs, adjacency matrices, and isomorphic graphs in Module I. In Module II, it explores Eulerian and Hamiltonian graphs, including paths, cycles, and connected graphs. Module III focuses on Planar Graphs, Graph Coloring, Trees, and Spanning Trees. Finally, Module IV delves into Automata, covering concepts like formal languages, grammars, and finite state automata.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand graph structures and properties.	Ap	C	Internal Exam/Assignment/ Seminar/Viva /End Sem Exam
CO2	Understand Eulerian and Hamiltonian graphs.	Ap	C	Internal Exam/Assignment/ Seminar/ Viva /End Sem Exam
CO3	Apply algorithms to Eulerian and Hamiltonion graphs.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva /End Sem Exam
CO4	Understand planar graphs and trees.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva /End Sem Exam
CO5	Explore formal languages and finite state automata.	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: Discrete Mathematics with Applications, Thomas Koshy, Academic Press (2003), ISBN: 978-0124211803.

Module	Unit	Content	Hrs (48+12)	Ext.Marks (70)
I	**Graphs**		**14**	**Min. 15**
	1	8.1 Graphs - Graph, Simple Graph (Example 8.3 is optional).		
	2	8.1 Graphs - Adjacency and Incidence, Degree of a Vertex, Adjacency Matrix (Example 8.5 and proof of Theorem 8.2 are optional).		
	3	8.1 Graphs – Subgraph of a Graph.		
	4	8.1 Graphs - Complete Graph, Cycle and Wheel Graphs (Fibonacci and Paraffins, Lucas and Cycloparaffins are optional).		
	5	8.1 Graphs - Bipartite graph, Complete Bipartite Graph, Weighted Graph (Graphs and Telecommunications, Graphs and Local Area Networks and A Generalised Handshake Problem are optional).		
	6	8.3 Isomorphic Graphs.		
II	**Eulerian and Hamiltonian graphs**		**10**	**Min. 15**
	7	8.4 Paths, Cycles and Circuits – Path, Independent Subsets of the Vertex set, Cycle and Circuit (Proof of theorem 8.3, 8.5, example 8.20 and example 8.21 are optional).		
	8	8.4 Paths, Cycles and Circuits – Connected Graphs (Proof of theorem 8.3, 8.5, example 8.20 and example 8.21 are optional).		
	9	8.5 Eulerian and Hamiltonian graphs- Eulerian Graph (Proof of theorem 8.7, example 8.26, Algorithm Eulerian graph, example 8.27, Algorithm Eulerian circuit, proof of theorem 8.8, example 8.31).		

	10	8.5 Eulerian and Hamiltonian graphs- Hamiltonian Graph (Knight's tour problem, example 8.34, Travelling Salesperson Problem, Example 8.35 are optional)		
III	**Planar Graphs and Trees**		**11**	**Min. 15**
	11	8.6 Planar Graphs- Planar Graph (Proofs of theorems 8.11 and 8.12 are optional).		
	12	8.6 Planar Graphs- Degree of a Rregion, Homeomorphic Graphs.		
	13	8.7 Graph Coloring- Graph Coloring, Chromatic Number, The Four-Color Problem (Example 8.27 is optional).		
	14	9.1 Trees- Trees (Proof of theorem 9.1 and 9.2 are optional).		
	15	9.2 Spanning Trees - Spanning Trees, Kruskal's Algorithm for a Spanning Tree.		
IV	**Automata**		**13**	**Min. 15**
	16	2.1 The Concept of Sets – Alphabet, Length of a Word, Language, Concatenation.		
	17	11.1 Formal Languages - Equality of Words, Concatenation of Languages (Examples 11.2, 11.3, 11.5 and Proof of Theorem 11.1 are optional).		
	18	11.1 Formal Languages – Kleene Closure.		
	19	11.2 Grammars – Grammars, Phase Structure Grammar.		
	20	11.2 Grammars – Derivation and Language.		
	21	11.3 Finite State Automata – up to and including Example 11.30 (Example 11.27 is optional).		

	22	11.3 Finite State Automata – Equivalent Finite State Automata up to and including example 11.35.		
V	**Open Ended Module**		**12**	
	Computer representation of graphs, minimal spanning trees, rooted trees, Digraphs.			

References:

1. Discrete Mathematics and Its Applications (7/e), Kenneth H. Rosen, McGraw-Hill, NY (2007).
2. Discrete Mathematics with Applications (4/e), Susanna S Epp, Brooks/ Cole Cengage Learning(2011).
3. A First Look at Graph Theory, John Clark and Allan Holton, Allied Publishers (1991).

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 :

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

Programme	B. Sc. Mathematics Honours			
Course Code	MAT2FM106(2)			
Course Title	**MATHEMATICS FOR COMPETITIVE EXAMINATIONS - PART II**			
Type of Course	**MDC**			
Semester	II			
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 "Mathematics for Competitive Examinations - Part II" is designed to prepare students for competitive exams by focusing on various reasoning and problem-solving skills. It covers a range of topics including non-verbal reasoning, verbal reasoning, spatial reasoning, and abstract reasoning, each module addressing different aspects of these skill sets.			

Course Outcomes (CO):

CO	**CO Statement**	**Cognitive Level***	**Knowledge Category#**	**Evaluation Tools used**
CO1	Apply mathematical methods to solve problems in verbal reasoning scenarios such as similarity of pairs, odd one out , ranking test etc with improved time management skills.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam

CO2	Understand the basic concepts of logical reasoning in interpreting problems related to blood relations, logical Venn diagrams and direction sense test and solve problems with speed and accuracy.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO3	Understand basic concept of spatial reasoning through tasks like figure classification, counting figure etc and solve problems in competitive examinations with focus on time management skills.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO4	Apply Geometrical and abstract reasoning techniques to solve problems involving cubes, dice and data interpretation with precision accuracy.	Ap	P	Internal Exam/Assignment/ Seminar/ Viva / End Sem Exam
CO5	Apply mathematical and logical problem solving skills to solve problems involving alphabet and number sequences and paper folding and paper cutting.	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)	Ex Marks (50)
		Non-Verbal Reasoning		
I	1	Similarity of Pairs		
	2	What come Next	**9**	**Min 10**
	3	Odd One out		
	4	Coding and Decoding		
	5	Ranking Test		
II		**Reasoning Contd.**		
	6	Blood relations		
	7	Blood relations Contd.	**9**	
	8	Direction Sense Test		**Min 10**
	9	Direction Sense Test contd.		
	10	Logical Venn Diagram		
III		**Spatial Reasoning**		
	11	Figure analogy		
	12	Figure series	**9**	**Min 10**
	13	Figure Classification		
	14	Mirror and Water Images		
	15	Counting of figures		
IV		**Abstract Reasoning**		
	16	Cube and Dice		
	17	Logical and Analytical Reasoning	**9**	**Min 10**
	18	Geometry mensuration		
	19	Data Interpretation		
V		**Open Ended**		

	Alphabet and Number Sequence Test, Paper folding and paper cutting	**9**	

References:

1. A Fast Track Course in MENTAL ABILITY, Amogh Goel, Arihant Publications India limited, 2016. (Primary Reference).
2. The Mental Ability, Logical Reasoning & Problem-Solving Compendium for IAS Prelims General Studies Paper 2 & State PSC Exams, Disha Experts, Disha Publications, 2018.
3. The Pearson Guide to Verbal Ability and Logical Reasoning for the CAT, Nishit K. Sinha, Pearson Education, 2014.

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	3	0	3	0	3	0	0