Enclosure-BMTII

SHREE MANIBHAI VIRANI & SMT. NAVALBEN VIRANI SCIENCE COLLEGE (AUTONOMOUS)

Department of Mathematics

Core Course (Theory) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – III		
Course Code	Course Title	Course Credit and Hours
21BMTCC301	**Core 6:** Fundamentals of Mathematical Analysis (F)	**4 Credits - 4 hrs/wk** (4 Theory)

Course Description:

The course Fundamental of Mathematical Analysis is for those students who have completed the first year of calculus. This course presents foundation concepts in analysis that lay the groundwork for further study in pure and applied mathematics, in particular real analysis courses. Topics includes the nature of proof, set theory, limits of sequences, topics in infinite series, fundamental and the mean value theorem in integral calculus, the Riemann integral, and improper integration.

Course Purpose:

This course aims to provide a basic understanding of mathematical analysis. This course is designed in such a way that students will be able to understand the convergence of sequence and infinite series. Students will be able to define and utilize the concept of Riemann integration, understand the concept of improper integration, and understand the fundamental and mean value theorem of integral calculus.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Blooms taxonomy Level (K_1 to K_6)**
CO_1	Define, demonstrate and utilize the concept of convergence of sequence	K_1,K_2,K_3
CO_2	Define, demonstrate and utilize the concept of convergence of series	K_1,K_2,K_3
CO_3	Define, demonstrate and utilize the concept of Riemann integration	K_1,K_2,K_3
CO_4	Explain the concept of fundamental and mean value theorem of integral calculus	K_2
CO_5	Define and use of improper integration	K_1,K_3

Course Contents	Hours
Unit-I: Sequences	**10**
• Sequences (Definition). • Limit point of a sequence. • Limits Inferior and Superior. • Convergent Sequence. • Non convergent sequence (Definition). • Cauchy's General principle of convergence of sequence. • Algebra of sequences. • Important theorems. • Monotonic sequences.	
Unit-II: Infinite Series	**10**
• Series of non-negative terms. • Geometric series, p-test. • Comparison test. • Cauchy's Root test. • D'Alembert's Ratio test. • Raabe's test. • Logarithmic Test. • Alternating series. • Convergence of power series.	
Unit- III: Riemann Integral	**9**
• Partitions and Riemann sums. • Upper and lower R-integrals. • R-integrability. • The integral as limit. • Some classes of integrable functions. • Properties of R-integrable function.	
Unit- IV: Fundamental and Mean value theorem of integral calculus	**9**
• Derivability of the integral functions. • Fundamental theorem of integral calculus. • Mean value theorem of integral calculus.	
Unit- V: Improper Integral	**10**
• Introduction. • Integration of unbounded function with finite/ infinite limit of integration. • Comparison test for convergence of improper integrals.	

Pedagogic Tools:

- Chalk and board
- Power point presentation
- Seminars
- Online resources

Text Books:

- S. C. Malik and Savita Arora, (2017), Mathematical Analysis, New Age International (P) Ltd, Publishers, 2nd Edition.
- T. M. Apostol, (1996), Mathematical Analysis, Narosa Book Distributors Pvt. Ltd. New Delhi, 2nd Edition.

Reference Books:

- Shantinarayan, (2013), A course of Mathematical Analysis, S. Chand & Sons.
- Walter Rudin, (2017), Principle of Mathematical Analysis, MC Graw-Hill Book & Company, 2nd Edition.
- R.G.Bartle and D.R.Sherbert, (2021), Introduction to Real Analysis, Wiley India Pvt. Ltd. New Delhi, an Indian Adaptation Paperback, Third Edition.

Suggested reading / E-resources:

- http://www.analysiswebnotes.com/contents.htmld/chapters.html
- https://www.math.ucdavis.edu/~hunter/intro_analysis_pdf/intro_analysis.html

Suggested MOOCs:

- https://onlinecourses.swayam2.ac.in/cec21_ma05/preview
- https://ocw.mit.edu/courses/18-100c-real-analysis-fall-2012

Methods of Assessment & Tools:
Components of CIA: 30 marks (Example as below)

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	1st 2 units	$1\frac{1}{2}$ hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 70)	
B	Assignment			04	10
C	Class activity			06	
				Grand Total	**30**
Assignment	• Notes written by the learner on the different topics in the syllabus. • Problem Solving.				

Class activity	• Quiz / Surprise Quiz • Seminar • Situation based question etc.

Note: Any other assessment tools or methods can be adopted as per requirement of the course.

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Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – III		
Course Code	Course Title	Course Credit and Hours
21UMTCC302	**Core 6:** Complex Variables (F)	**3 Credits - 3 hrs/wk**

Course Description:

This course is aimed to provide an introduction to many mathematical theories. This course covers the topic like complex number system, roots, exponential functions, hyperbolic functions, logarithmic functions of complex variable and concept of analytic functions.

Course Purpose:

The topic complex variables provide a wide range of applications which appear in engineering and physical sciences. This course is focusing on the students who is concentrating in either pure mathematics or applied mathematics. Students interested in various fields such as music theory, physics, chemistry, computer science etc may also be interested in this course.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Bloom's taxonomy Level (K_1 to K_6)**
CO_1	Represent the complex numbers in algebraically, and plot geometrically in argand plane.	K1, K3
CO_2	Demonstrate and express the arithmetic operations on complex numbers using either the rectangular form or the trigonometric form.	K1, K2, K3
CO_3	Compute and utilize the magnitude and the argument of a complex number to translate between the rectangular form and the trigonometric form of a complex number.	K2, K3
CO_4	Compute the n^{th} power or root of a complex number using De Moivre's theorem, and apply the results.	K1, K2, K3

CO_5	Verify the differentiability, continuity and limit of function of a complex variable.	K2, K3

Course Contents	**Hrs**
Unit-I: Complex Numbers-Basic Concepts	**9**
• Introduction to complex numbers. • Basic Algebraic properties. • Modulus and complex conjugates. • Argument of a complex number. • Exponential form, polar form. • Products and quotients in exponential form and polar form.	
Unit -II: De' Moivre's theorem and its applications	**10**
• De' Moivre's theorem. • Applications of De'Moivre's theorem. • Roots of a complex number. • Other applications of De Moivre's theorem.	
Unit -III: Expansions using circular form	**6**
• Expansion of $cos\, n\, \theta, sin\, n\, \theta, tan\, n\, \theta$ in terms of $cos\, \theta\, , sin\, \theta\, , tan\, \theta$. • Expansion of $sin^n\theta, cos^n\theta$ in terms of sines and cosines of multiples of θ. • Expansion of $cos\, \theta\, , sin\, \theta\, , tan\, \theta$ in terms of θ.	
Unit -IV: Elementary functions	**10**
• The exponential function • The Logarithmic function • Trigonometric functions • Hyperbolic functions	
Unit -V: Analytic Functions	**10**
• Functions of a complex variable • Limits, Continuity and derivatives • Analytic functions in Cartesian and polar coordinates, examples. • Cauchy Reimann equations.	

Pedagogic Tools:

- Chalk and Talk
- PPT and Videos.
- Assignment
- Group discussion

Text books:

- James Ward Brown and Ruel V. Churchill, (2013), Complex Variables and Applications, 9th edition, McGraw Hill Higher Education.
- Dennis G. Zill and Patrick D. Shanahan, (2013), Complex Analysis- A First Course with Applications, 3rd edition, Jones and Bartlett Publishers, Inc.

Reference books:

- Shanti Narayan and Dr. P. K. Mittal, (1956), Theory of Functions of a Complex variable, S. Chand Publications.

Suggested reading / E-resources:

- https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
- https://www.coursera.org/learn/complex-analysis/

Suggested MOOCs:

- https://www.mooc-list.com/tags/complex-analysis

Methods of Assessment & Tools:
Components of CIA: 30 marks (Example as below)

Sr. No.	**Component**	**Content**	**Duration (if any)**	**Marks**	**Sub Total**
A	Test 1	1st 2 units	$1\frac{1}{2}$ hours	5 (Set for 30)	20
	Test 2	All 5 units	3 hours	15 (Set for 60)	
B	Assignment			5	10
C	Class activity			5	
				Grand Total	**30**
Assignment	• Solution of problem set • Student's handbook • Problem Solving				
Class activity	• Surprise Quiz • Quiz • Seminar				

Core Course (Theory) For the students admitted from A.Y. 2021-2022 & onwards		
Offering Department: **Mathematics**	Offered to: **B.Sc. Mathematics**	
Semester – III		
Course Code	Course Title	Course Credit and Hours
21BMTCC303	Core 8: Discrete Mathematics (Ad)	4 Credits - 4 hrs/wk

Course Description:

This course has mainly been designed with the aim of introducing students to the Lattice Theory and Boolean Algebra. This course covers several important topics of Discrete Mathematics. It covers Set theory, relations, partially ordered sets, different types of lattices, Boolean algebra and Boolean functions, Boolean polynomials, minterm, maxterm, sum of product canonical form, product of sum canonical form and Karnaugh map. It includes practice in reasoning formally and proving theorems. This course is dealing with objects that can consider only distinct, separated values. Also, this course gives us the information of basic properties of meet and join duality principle, maximal and minimal elements, least and greatest member, lattices as ordered sets, types of lattices, lattices as algebraic structures, sub lattices, products and homomorphism.

Course Purpose:

This course aims to gain the conceptual background needed to be able to identify structures of algebraic nature, and discover, prove and use properties about them. Students will be apply relations and to determine their properties. To understand lattices as algebraic structures, homomorphism between lattices and Boolean Algebra. To develop skills and knowledge of standard concepts in Hasse diagrams, complete Lattices, distributive lattices and Boolean algebras. The student will be able to analyze the relationship between posets and lattices and acquire knowledge of fundamental notions from lattice theory.

Course Outcomes: Upon completion of this course, the learner will be able to

CO No.	**CO Statement**	**Blooms taxonomy Level** **(K_1 to K_6)**
CO_1	Understand and utilize the fundamental concepts of Discrete Mathematics and understand and verify the different types of relations.	K_1, K_2, K_3

CO_2	Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, and binary relations.	K_1, K_3
CO_3	Learn about partially ordered sets, lattices and their types.	K_1, K_2, K_3
CO_4	Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems.	K_2, K_3
CO_5	Understand and apply the concepts of Boolean Algebra and it forms.	K_2, K_3

Course Contents	**Hours**
Unit-I: Relations	**10**
• Different types of relations. • Binary relations, Equivalence relations and partitions. • Basic properties of partially ordered sets (poset). • Order isomorphism. • Hasse diagrams. • Dual of a poset, Duality principle. • Lattices as posets. • Properties of lattices.	
Unit-II: Lattices as an algebraic systems	**10**
• Lattices as algebraic systems. • Sub lattices. • Direct product of two lattices. • Homomorphism. • Order isomorphism of two posets. • Isomorphic lattices.	
Unit- III: Some special Lattices	**8**
• Complete lattice. • Bounded lattice. • Distributive lattice. • Complemented lattice. • Modular lattice. • Distributive lattice.	
Unit- IV: Boolean algebra	**9**
• Definition and examples of Boolean algebra. • Direct product of two Boolean Algebra. • Homomorphism. • Atoms of Boolean algebra.	

• Stone's representation theorem. • The set A(x) of all atoms of Boolean algebra and its properties. • Isomorphism of a finite of finite Boolean Algebra and $P(A)$.	
Unit- V: Boolean expressions And Canonical forms	**9**
• Boolean expressions. • Minterms and Maxterms. • Sum of product Canonical form. • Product of sum Canonical form. • Minimization of a Boolean expression by cube array representation. • Karnaugh map.	

Pedagogic Tools:

- Chalk and board
- Power point presentation
- Seminars
- Online resources

Text Books:

- J.R.Trembley and R.Manohar, (2017), Discrete Mathematical Structures with Applications to Computer Science, 2nd edition, Macgraw-Hill International Editions.

Reference Books:

- Liu C. L. (2013), Elements of Discrete Mathematics, 2nd Edition, Mc Graw Hill.
- Mott J. L., Kandel A. and Baker T. P. (2008), Discrete Mathematics for Computer Scientists and Mathematicians, 2nd edition, Prentice Hall India.
- B. A. Davey & H. A. Priestley (2002), Introduction to Lattices and Order, 2nd edition, Cambridge University Press.
- K. D. Joshi (2014), Foundation of Discrete Mathematics, 2nd edition, New Age International Ltd. Publishers.
- J. E. Whitesitt (2010), Boolean algebra and its Applications, Addison-Wesley Publishing, Inc.

Suggested reading / E-resources:

- http://discrete.openmathbooks.org/dmoi3/dmoi.html
- https://www.mit.edu/search/?q=discrete+mathematics

- http://web.mit.edu/6.111/www/s2007/PSETS/pset1.pdf

Suggested MOOCs:

- https://nptel.ac.in/courses/111107058
- https://www.coursera.org/learn/discrete-mathematics

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C	Class activity			06	
				Grand Total	**30**

Assignment	• Problem formulation and its analysis. • Notes written by the learner on the different topics in the syllabus. • Book Review • Chapter review • Problem Solving
Class activity	• Surprise Quiz • Quiz • Seminar • Situation based question etc.

Note: Any other assessment tools or methods can be adopted as per requirement of the course.