CORE COURSES OFFERED BY DEPT. OF MATHEMATICS

BMA23202T	COMPLEX ANALYSIS	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Complex number

Course Objectives:

- To learn the significance of differentiability of complex functions leading to the understanding of Cauchy−Riemann equations.
- To understand the difference as well as relation between complex line integration and real line integration.
- To understand the role of Cauchy−Goursat theorem and the Cauchy integral formula.

Course Outcome:

After successful completion of the course, the students will be able to

CO1: understand the differentiation and integration of a complex function.

CO2: understand about zeros and singularities of a complex function along with residues.

CO 3: apply various properties of Cauchy-Riemann equations to analytic functions

CO 4: apply integral formulae to evaluate complex contour integrals

CO 4: describe the convergence of a complex sequence and expand a function in Taylor's series, Laurent's Series

Module1:Functions, Limits, Continuity and Analytic Function	**15 Hours**
Functions of complex variable, Limits involving the point at infinity, continuity, Derivatives, Differentiation formulas. Analytic functions, examples of analytic functions, elementary analytic functions. Cauchy- Riemann equations, sufficient conditions for differentiability. Harmonic functions, Complex conjugates and determination of complex conjugates.	
Module2:ComplexIntegration and Cauchy's Theorem	**15 Hours**
Definite integrals of functions.Complex Line Integrals, Real line integrals. Simply and multiply connected regions. Cauchy's theorem, Cauchy-Goursat theorem, Cauchy integral formula. Morera's theorem, Liouville's theorem and the fundamental theorem of algebra.	
Module3: Infinite Series	**15 Hours**
Sequences of functions, series of functions. Convergence. Power Series: Definitions, Taylor's series, Laurent's series, circle and radius of convergence. Zeros and Singularities, type of singularities, Poles, Meromorphic functions, Entire functions.	
Module4:Theory of Residues	**15Hours**
Argument Principle, Rouche's theorem, Residues, Calculation of Residues. The Residue theorem. Evaluation of definite integrals.	
Total Lecture hours	**45 Hours**

Text Book(s)

1. M.R. Speigel, Complex Variables, Schaum series.

Reference Books

1. Brown, Ward James and Churchill, Ruel V. *Complex Variables and Applications* (Eighth Edition), McGraw – Hill International Edition, 2009.
2. Bak, Joseph and Newman, Donald J. *Complex analysis* (2nd Edition), Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

CORE COURSES OFFERED BY DEPT. OF MATHEMATICS

BMA23203T	Real Analysis-I	L	T	P	C
		4	0	0	4

Pre-requisite: Fundamental knowledge of real number system.

Course Objectives:

- To provide a deep understanding of the fundamental concepts and principles underlying real line, limits of a function and results related to convergence and divergence of sequences and series of real numbers.

Course Outcome:

After successful completion of the course, the students will be able to

CO1: understand fundamental properties of real line R, including completeness and Archimedean properties.

CO2: understand limits of sets and functions and related theorems.

CO3: understand concept of convergence and divergence of infinite series.

CO4: apply limit theorems to determine the convergence or divergence of real sequences.

CO5: apply various convergence tests to determine the convergence and divergence of both absolutely and conditionally convergent infinite series

Module1:Real Numbers — 12 Hours

Algebraic and order properties of real numbers, Inequalities, absolute value, Triangle Inequality, real line, boundsof a set, supremum and infimum, completeness property of R, the Archimedean property, the density theorem, intervals, Characterization of Intervals, nested interval theorem, The uncountability of R

Module2: Limits — 12 Hours

Limit point of a set, limits of a function, sequential criterion for limits, divergence criteria, limit theorems, Squeeze Theorem, one sided limits, infinite limits and limits at infinity.

Module3: Sequence — 18 Hours

Sequences of real numbers, Limit of a Sequence, Tails of Sequences, Limit Theorems, bounded sequence, Squeeze Theorem, Monotone Sequences, Monotone Convergence Theorem, Subsequence, Bolzano-Weierstrass Theorem, Divergence Criteria, Cauchy sequence, Cauchy Convergence Criterion.

Module4:Infinite Series — 18 Hours

Infinite series, convergence and divergence of infinite series, The n-thTerm Test, Cauchy criterion, Absolute convergence , Tests for Absolute Convergence: Comparison test, Limit Comparison Test, Ratio test, Root test, Raabe's Test, Alternating series,Alternating Series Test, The Dirichlet and Abel Tests.

Total Lecture hours — **48hours**

Text Book(s)

1. Bartle R.G. and Sherbert D. R., Introduction to Real Analysis, 4th Ed., John Wiley and Sons, 2011.

Reference Books

1. Kumar A. and Kumaresan S., Basic Course in Real Analysis, CRC Press, 2014.
2. Ponnusamy S., Foundations of mathematical analysis. Springer Science & Business Media, 2011.

BMA23204T	GROUP THEORY	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

- To Introduce the fundamental concepts and topics of abstract algebra
- To demonstrate the symmetric groups and groups of symmetry
- To Study Fermat's Little theorem as a consequence of the Lagrange's theorem on finite groups.

Course Outcome:

After successful completion of the course, the students will be able to
CO1: recognize the different mathematical objects as groups.
CO2: understand cyclic groups, permutation groups, and different subgroups.
CO3: explain the significance of the notion of cosets, normal subgroups and factor groups.
CO4: learn about Lagrange's theorem and Fermat's Little theorem along with group homomorphism and group isomorphism.

Module 1: Introduction to Groups	**20 Hours**

Groups: Definition, examples and Properties. Symmetries of a square, Dihedral groups, Order of a group, Order of elements of a group. Subgroups, Center of a group.

Module 2: Cyclic Group and Permutation Group	**15 Hours**

Cyclic Groups, Properties of Cyclic group, Fundamental theorem of cyclic groups. Permutations, Permutation Groups, Odd and Even permutations, Alternating groups.

Module 3: Cosets and Lagrange's Theorem	**15 Hours**

Cosets, Properties of cosets, Lagrange's theorem, Fermat's Little theorem. Normal subgroups, Factor groups, Cauchy's theorem for finite abelian groups.

Module 4: Group Homomorphism and Isomorphism	**20 Hours**

Group homomorphism, properties of homomorphism, Kernel of a group homomorphism, Fundamental theorem of Homomorphism, Cayley's theorem, Isomorphism, Properties of isomorphism, First isomorphism theorem.

Total Lecture hours	**60 hours**

Text Book(s)

1. Gallian J. A., Contemporary Abstract Algebra (8th Edition), Cengage Learning India Pvt. Ltd. Delhi, Fourth impression, (2015)

Reference Books

1. Fraleigh John B., A First Course in Abstract Algebra, 7th Edition, (2001)
2. Singh S., Zameeruddin Q., Modern Algebra, 6th Edition, S Chand And Company Ltd. (2021)
3. Dummit David S. and Foote Richard M., Abstract Algebra (2nd Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, (2003)
4. Bhattacharya P.B., Jain S.K., Nagpaul S. R., Basic Abstract Algebra, (Ebook 2nd Ed), Cambridge University Press, (2009)
5. Herstein I. S., Topics in Algebra (Ebook 2nd Ed), John Wiley & Sons, (1975)

BMA23220T	SETS AND LOGIC	L	T	P	C
		4	0	0	4

Pre-requisite: High School Mathematics

Course Objectives:

- To provide a deep understanding of the foundational principles of set theory, mathematical logic and related applications.

Course Outcome:

After successful completion of the course, the students will be able to

CO1: understand foundational principles of set theory.

CO2: apply inclusion-exclusion principle to solve related problems.

CO3: understand the concepts of relations and functions within sets, including their properties, and applications.

CO4: apply knowledge of tautologies and contradictions to identify and construct logical statements.

CO5: apply propositional functions and quantifiers to formalize logical statements and solve problems involving predicates.

Module 1: Sets	**15 Hours**
Sets, subset, superset, universal set, empty set, disjoint sets, Venn diagrams, set operations: union and intersection, complements, differences, symmetric differences; Algebra of sets, finite sets, counting principle, inclusion-exclusion principle, classes of sets, power sets, partitions, principle of mathematical induction.	
Module 2: Relations & functions	**15 Hours**
Product sets, relations, inverse relation, pictorial representatives of relations, composition of relations, types of relations, equivalent relations, partial ordering relations, functions, composition function, one-to-one, onto, and invertible functions, indexed classes of sets, cardinality.	
Module 3: Logic	**15 Hours**
Propositions and compound statements, basic logical operations: conjunction, disjunction, negation; propositions and truth tables, tautologies and contradictions, logical equivalence.	
Module 4: Algebra of Propositions	**15 Hours**
Algebra of propositions, conditional and bi-conditional statements, arguments, propositional functions, quantifiers, negation of quantified statements.	
Total Lecture hours	**60 Hours**

Text Book(s)

1. Seymour L. and Marc Lars L., Theory and problems of discrete mathematics. Schaums Outline Series McGraw Hill, 2007.

Reference Books

1. Halmos P.R., *Naive Set Theory*, Springer, 1974.
2. Kamke E., *Theory of Sets*, Dover Publishers, 1950.

CORE (ELECTIVE) COURSES OFFERED BY DEPT. OF MATHEMATICS

BMA23221T	INTRODUCTION TO PROBABILITY	L	T	P	C
		4	0	0	4

Pre-requisite: Basic properties of Set

Course Objectives

- To provide an overview of probability to the students
- To make the students familiar with the basic concepts and tools which are needed to study situations involving uncertainty or randomness.

Course Outcome

After successful completion of this course, the students will be able to

CO1: understand about basic probability and its applications

CO2: formulate and solve problems involving random variables.

CO3: understand about various univariate distributions such as Binomial, Poisson and Normal distributions.

CO4: apply the theory of distributions to study the joint behavior of two random variables.

Module 1: Basic Probability	**15 hours**
Probability spaces, Conditional probability, Multiplicative law of Probability, Independent events; Bayes' theorem	
Module 2: Random variable	**15 hours**
Definition, Discrete and continuous random variables, Properties, Discrete Probability Distribution, Mean and Variance of Random variable	
Module 3: Probability distribution	**15 hours**
Bernoulli trials, Binomial, Poisson and Normal distribution, Mean and Variance of Binomial and Poisson distribution, Basic properties of Normal distribution, Standard form of Normal distribution.	
Module 4: Marginal distribution	**15 hours**
Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.	
Total Lecture hours	**60 hours**

Text Book(s)

1. Bali, N. P., Goyal M., A text book of engineering Mathematics, Laxmi Publications, Reprint, 2014
2. Ross S. M., Introduction to Probability Models (11th ed.). Elsevier Inc., 2014

Reference Book(s)

1. Hoel P. G., Port S. C and Stone C. J., Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint)