EKLAVYA UNIVERSITY
ज्ञान प्राप्तये लक्ष्य संधानम्
Estd by Madhya Pradesh Niji Vishwavidyalaya (Sthapna Avam Sanchalan) Adhiniyam 2020

School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y101
Paper				Advanced Abstract Algebra –I
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	5	
3	2	0		

Course Objectives:

The main aim of the course is to introduce you to basic concepts from abstract algebra, especially the notion of a group. The course will help prepare you for further study in abstract algebra as well as familiarize you with tools essential in many other areas of mathematics. The other aim of this module is to provide the learner with the skills, knowledge and competencies to carry out their duties and responsibilities in an pure Mathematic environment.Group theory is one of the great simplifying and unifying ideas in modern mathematics. It was introduced in order to understand the solutions to polynomial equations and has its full significance, as a mathematical formulation of symmetry, been understood. It plays a role in our understanding of fundamental particles, the structure of crystal lattices and the geometry of molecules.

Course Outcome:

The Students will be able to:

1.Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

2.Explain Demonstrate accurate and efficient use of advanced algebraic techniques.

3.Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra.

4.Apply problem-solving using advanced algebraic techniques applied to diverse situations in physics, engineering and other mathematical.

5. Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

6.Explain Demonstrate accurate and efficient use of advanced algebraic techniques.

7.Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra.

8.Apply problem-solving using advanced algebraic techniques applied to diverse situations in physics, engineering and other mathematical.

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Student Learning Outcomes (SLO):

Students will:

1.Students will have a working knowledge of important mathematical concepts in abstract algebra such as definition of a group, order of a finite group and order of an element.

2. Students will be knowledgeable of different types of subgroups such as normal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups.

3. Students will be introduced to and have knowledge of many mathematical concepts studied in abstract mathematics such as permutation groups, factor groups and Abelian groups.

4. Students will see and understand the connection and transition between previously studied mathematics and more advanced mathematics. The students will actively participate in the transition of important concepts such homomorphisms & isomorphisms from discrete mathematics to advanced abstract mathematics.

5. Students will gain experience and confidence in proving theorems. A blended teaching method will be used requiring the students to prove theorems give the student the experience, knowledge, and confidence to move forward in the study of mathematics.

Unit	Syllabus	Periods
UNIT - I	Normal and subnormal series of groups, compositions series, Jordan-Holder series.Introduction to Modules, Examples, Submodules , quotient modules, Homomorphism, Isomorphism,Finitely generated modules,Cyclic modules.	11
UNIT - II	Solvable and nilpotent groups,Simple modules,Semisimple modules,Free modules,Schur's Lemma.	11
UNIT - III	Extension fields.Roots of polynomials, algebraic and transcendental extensions splitting,Noetherian &Artinian modules and rings, Hilbert basis theorem, Wedderburn-Artin theorem.	11
UNIT - IV	Perfects fields, finite fields, primitrive elements, algebraically closed fields,Uniform Modules, Primary modules, Noether-Laskar theorem, Fundamental structure theorem of modules over a principle idea domain and its applications to finitely generated:abelian groups	11
UNIT - V	Automorphism of extension, galois extension, fundamental theorem of galoistheory , solution of polynomial equations by radicals, insolubility of general equation of degree,Similarity of linear transformation, Invariant spaces, Reduction to triangular forms, Nilpotent transformation, The primary decomposition theorem.	11

Text Books:

1 1. P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul : Basic Abstract Algebra, Cambridge University press

2 I.N.Herstein : Topics in Albegra, Wiley Eastern Ltd.

3 Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.

References Books:

1 1. M.Artin, Algeabra, Prentice -Hall of India, 1991.

2 P.M. Cohn, Algebra,Vols. I,II &III, John Wiley & Sons, 1982,1989,1991.

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3 N.Jacobson, Basic Algebra, Vols. I , W.H. Freeman, 1980 (also published by Hindustan Publishing Company).

4 S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.

5 I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.I-1996,Vol. II-1999)

6 D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition,1997.

7 Quazi Zameeruddin and Surjeet Singh : Modern Algebra

8 I. Stewart, Galois theory, 2nd edition, chapman and Hall, 1989.

9 J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..

10 Fraleigh , A first course in Algebra Algebra, Narosa,1982.

11 K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

12 S.K.jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.

13 S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.

14 T.Y. Lam, lectures on Modules and Rings, GTM Vol. 189, Springer- Verlag,1999.

15 D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/Cole Advanced Books and Softwares, Pacific groves. California, 1991.

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y102
Paper				Real Analysis – II
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	5	
3	2	0		

Course Objectives:
Have the knowledge of basic properties of the field of real numbers. Describe fundamental properties of the real numbers that lead to the formal development of real analysis. Demonstrate an understanding of limits ad how that are used in sequences, series and differentiation. Construct mathematical proofs of basic results in real analysis.

Course Outcome:
The Students will be able to:
1.Define the real numbers, least upper bounds, and the triangle inequality.
2.Define functions between sets; equivalent sets; finite, countable and uncountable sets. 3.Recognize convergent, divergent, bounded, Cauchy and monotone sequences.
4.Calculate the limit superior, limit inferior, and the limit of a sequence.
5.Recognize alternating, convergent, conditionally and absolutely convergent series.
6.Understand the concept of Riemann integration and Differentiation.
7. Understand Uniform convergence and continuity.
8. Apply the Stone-Weierstrass theorem.
9. Analyze the concept of functions of several variables.
10 Study the applications of Integration and Differential forms.

Student Learning Outcomes (SLO):
Students will:
1.Understand basic properties of R, such as its characterization as a complete and ordered field, Archimedean Property, density of Q and R\Q and unaccountability ofeach interval.
2.Classify and explain open and closed sets, limit points, convergent and Cauchy convergent sequences, complete spaces, compactness, connectedness, and uniform continuity etc. in a metric space.
3.Know how completeness, continuity and other notions are generalized from the real line to metric spaces.
4.Recognize the difference between pointwise and uniform convergence of a sequence of functions.
5.Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability and integrability.
6.Determine the Riemann-Stieltjes integrability of a bonded function and prove a selection of theorems and concerning integration.

Unit	Syllabus	Periods
UNIT - I	Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Rectifiable curves.	11

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UNIT - II	Rearrangement of terms of a series, Riemann's theorem. Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem. Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.	11
UNIT - III	Functions of several variables, linear transformations, Derivatives in an open subset of Rn, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem. Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals. Partitions of unity, Differential forms, Stoke's theorem.	11
UNIT - IV	Lebesgue outer measure, Measurable sets,Regularity, Measurable functions, Borel and Lebesgue measurability, Non-measurable sets. Integration of Non-negative functions. The General integral, Integration of Series, Reimann and Lebesgue Integrals, The Four derivatives, Functions of bounded variations,Lebesgue Differentiation Theorem, Differentiation and Integration.	11
UNIT - V	Measures and outer measures, Extension of a measure, Uniqueness of Extension,Completion of a measure, Measure spaces, Integration with respect to a measure,The L -spaces, Convex functions, Jensen's inequality,Holder and Minkowski inequalities, Completeness of L, Convergence in Measure, Almost uniform convergence.	11

Text Books:

1 Principle of Mathematical Analysis By Walter Rudin(3rd edition) McGraw- Hill, 1976, International student edition.

2 Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill, 2015.

3 Real Analysis By H.L.Roydon, Macmillan Pub.Co.Inc.4th Edition, New York 1962.

References Books:

1 T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.

2 Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York, 1975.

3 A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.

4 G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.

5 E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.

6 P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).

7 I.P. Natanson, Theory of Functions of a Real Variable. Vol. I, Frederick Ungar Publishing Co., 1961.

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8 Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.

9 J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.

10 A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.

11 P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.

12 T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.

13 13. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.

14 R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.

15 Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.

16 Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.

17 Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. New Delhi, 1966.

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School of Basic and Applied Sciences

Class				**M.Sc. Mathematics (Previous)**
Semester/Year				**I Year**
Subject & Paper Code				**Mathematics- MMATH20Y103**
Paper				**Topology – III**
Max. Marks				**60(ETE) + 40(IA) = 100**
Credit			**Total Credits**	
L	**T**	**P**	5	
3	2	0		

Course Objectives:
To train the students in the domain of Topology.To give sufficient knowledge of the subject which can be used by student for further applications in their respective domains of interest.In this course, students will be enable to learn the concepts of topology such as, product topology, connectedness, compactness, separation axioms, the Uryshon lemma, the Tietze Extension theorem.

Course Outcome:
The Students will be able to:
1.Topology uses to analyze complex networks -Ex: Social networks, Biological networks, Internet etc.
2.It applies Differential Topology to probability to identity multivariate interactions.This was used in neuro science recently to deduce how neurons are interacting.
3.This paper discusses using cell phones to actually map out the topology of indoor spaces.
4.Another cool application is in the world of chemistry where one can discuss the shape of molecules by an analysis of the topology of a related graph.
5.There is also an application for medical imaging software and technology.

Student Learning Outcomes (SLO):
Students will:
1.Various topological properties of sets.
2.The properties of continuous functions on different topological spaces.
3. Connected and compact topological spaces and its properties.
4.Various axioms satisfied by topological spaces.
5.Various theorems on normal spaces and complete metric spaces.
6. Define topological spaces, product topology, metric topology, quotient space.
7.Discuss the continuous functions, connected space, compact space, complete metric space, related theorems on Baire space.

Unit	Syllabus	Periods
UNIT - I	Countable and uncountable sets, Infinite sets and the axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem, Cantor's theorem and the continum hypothesis, Zorn's lemma, well-ordering theorem. Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighbourhoods, Interior, exterior and boundary, Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology. Alternate methods of defining a topology in terms of terms of Kuratowski Closure Operator and Neighbourhood	11

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UNIT - II	Continuous functions and homomorphism. First and Second Countable spaces, Lindelof's theorems, Separable spaces, Second countability and separability,Separation axioms T0, T1, T2, T31 ,T4, their Characterizations and basic properties. Urysohn's lemma, Tietze extension theorem.	11
UNIT - III	Compactness, Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-Cech compactification. Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric space. Connected spaces, Connectedness on the real line. Components, Locally connected spaces.	11
UNIT - IV	Tychon off product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms, product spaces. Connectedness, product spaces, Compactness product spaces (Tychonoff's theorem). Countability and product spaces. Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Metrization theorems and Paracompactness- Local finiteness. The Nagata- Smirnov metrization theorem. Paracompactness. The Smirnov metrization theorem.	11
UNIT - V	The fundamental group and covering spaces-Homotopy of paths. The fundamental group,Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra. Nets and filter. Topology and convergence of nets, Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra- filters and Compactness.	11

Text Books:

1 Topology, A First Course By James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

2 Introduction to General Topology By K.D.Joshi, Wiley Eastern Ltd., 1983.

References Books:

1 J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).

2 George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.

3 J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.

4 J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.

5 L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.

6 Thron, Topologically Structures, Holt, Rinehart and Winston,NewYork,1966.

7 N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.

8 R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.

9 W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.

10 E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.

11 S. Willard, General Topology, Addison-Wesley, Reading, 1970.

12 Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.

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13 Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.

14 D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.

15 M.J.Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc.Princeton,N.J.,1963.

16 B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.

17 C. Berge, Topological Spaces, Macmillan Company, New York,1963.

18 S.S. Coirns, Introductory Topology, Ronald Press, New York, 1961.

19 Z.P.Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.

20 K.K.Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y104
Paper				Complex Analysis – IV
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	5	
3	2	0		

Course Objectives:

The objective of this course is to introduce and develop a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, Cauchy-Riemann relations and harmonic functions and to make students equipped with the understanding of the fundamental concepts of complex variable theory. In particular, to enable students to acquire skill of contour integration to evaluate complicated real integrals via residue calculus.

Course Outcome:

The Students will be able to:

1.Know the fundamental concepts of complex analysis.

2. Evaluate complex integrals and apply Cauchy integral theorem and formula.

3 Evaluate limits and checking the continuity of complex function & apply the concept of analyticity and the Cauchy-Riemann equations.

4 Solve the problems using complex analysis techniques applied to different situations in engineering and other mathematical contexts.

5 Establish the capacity for mathematical reasoning through analysing, proving and explaining concepts from complex analysis.

6 Extend their knowledge to pursue research in this field.

Student Learning Outcomes (SLO):

Students will:

1.Represent complex numbers algebraically and geometrically,

2.Define and analyze limits and continuity for functions of complex variables,

3.Understand about the Cauchy-Riemann equations, analytic functions, entire functions including the fundamental theorem of algebra,

4.Evaluate complex contour integrals and apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula,

5.Analyze sequences and series of analytic functions and types of convergence,

6.Represent functions as Taylor and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem'

7.Understand the conformal mapping.

Unit	Syllabus	Periods

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UNIT - I	Complex integration, Cauchy-Goursat theorem, Cauchy's integral formula. Higher order derivatives, Morera's Theorem,Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularities. Meromorphic functions. The argument principle, Rouche's theorem Inverse function theorem.	11
UNIT - II	Residues, Cauchy's residue theorem, Evaluation of integrals, Branches of many valued functions with special reference to arg z, logz and za . Definitions and examples of Conformal mappings. Bilinear transformations, their properties and classifications. Spaces of analytic functions. Hurwitz's theorem. Montel's theorem, Riemann mapping theorem.	11
UNIT - III	Weierstra's factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag- Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation, Schwarz Reflection Principle. Monodromy theorem and its consequences. Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet Problem, Green's function.	11
UNIT - IV	Canonical products, Jensen's formula, Poisson-Jensen formula, Hadamard's three circles theorem, Order of an entire function. Exponent of Convergence, Borel's theorem,Hadamard's factorization theorem.	11
UNIT - V	The range of an analytic function, Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the "1/4-theorem.	11

Text Books:

1 Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979.

2 J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House,1980.

References Books:

1 H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.

2 Complex Function Theory By D.Sarason

3 Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.

4 S. Lang, Complex Analysis, Addison Wesley, 1977.

5 D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.

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6 Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.

7 E. Hille, Analytic Function Theory (2 Vols.) Gonn & Co., 1959. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.

8 C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.

9 M.Heins, Complex Function Theory, Academic Press, 1968.

10 Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.

11 S.Saks and A.Zygmund, Analytic Functions, Monografic Matematyczne, 1952.

12 E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.

13 W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.

14 S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

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School of Basic and Applied Sciences

Class				M.Sc. . Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y105
Paper				Advanced Discrete Mathematics – V (Optional-I)
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
2	2	0		

Course Objectives:
Prepare students to develop mathematical foundations to understand and create mathematical arguments require in learning many mathematics and computer sciences courses. To motivate students how to solve practical problems using discrete mathematics. Also, in this course basic concepts of Graph theory such as Trees, Eulerian Graphs, Matching, Vertex colourings, Edge colourings, Planarity, are introduced.

Course Outcome:
The Students will be able to:
1. Construct mathematical arguments using logical connectives and quantifiers.
2. Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.
3. Validate the correctness of an argument using statement and predicate calculus.
4. Learn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation.
5. Understand the concepts Planarity including Euler identity.
6. Discuss and understand the importance of the concepts Matching's and Colourings'.

Student Learning Outcomes (SLO):
Students will:
1. Construct mathematical arguments using logical connectives and quantifiers.
2. Validate the correctness of an argument using statement and predicate calculus.
3. Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.
4. Learn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation.

Unit	Syllabus	Periods
UNIT - I	Formal Logic-Statements, Symbolic Representation and Tautologies. Quantifiers, Predicates and Validity, Propositional Logic, Semigroups & Monoids- Definitions and Examples of Semigroups and monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids, Direct Products, Basic Homomorphism Theorem.	11

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UNIT - II	**Lattices**-Lattices as partially ordered sets, their properties. Lattices as Algebraic Systems, Sublattices, Direct products, and Homomorphisms, Some Special Lattices e.g., Complete, Complemented and Distributive Lattices. **Boolean Algebras**-Boolean, Algebras as Lattices. Various Boolean Identities. The Switching Algebra example, Subalgebras, Direct Products and Homomorphisms. Join-Irreducible elements, Atoms and Minterms. Boolean Forms and their Equivalence, Minterm Boolean Forms, Sum of Products Canonical Forms, Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND,OR & NOT gates), The Karnaugh Map Method.	11
UNIT - III	**Graph Theory**-Definition of (Undirected) Graphs, Paths, Circuits, Cycles, & Subgraphs. Induced Subgraphs, Degree of a vertex, Connectivity. Planar Graphs and their properties. Trees, Euler's Formula for connected planar Graphs,Complete & Complete Bipartite Graphs. Kuratowski's Theorem (statement only) and its use. Spanning Trees, Cut-sets, Fundamental Cut -sets, and Cycle. Minimal Spanning Trees and Kruskal's Algorithm. Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits. Directed Graphs. In degree and Out degree of a Vertex.Weighted undirected Graphs, Dijkstra's Algorithm, strong Connectivity & Warshall's Algorithm, Directed Trees, Search Trees, Tree Traversals.	11
UNIT - IV	Introductory Computability Theory-Finite State Machines and their Transition Table Diagrams. Equivalence of finite State Machines. Reduced Machines. Homomorphism. Finite Automata. Acceptors. Non- deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions.	11
UNIT - V	**Grammars and Languages**-Phrase-Structure Grammars, Rewriting Rules,Derivations, Sentential Forms, Language generated by a Grammar, Regular, Context-Free, and Context Sensitive Grammars and Languages. Regular sets, Regular Expressions and the Pumping Lemma. Kleene's Theorem, Notions of Syntax Analysis, Polish Notations,Conversion of Infix Expressions to Polish Notations, The Reverse Polish Notation.	11

Text Books:

1 Elements of Discrete Mathematics, C.L.Liu, McGraw-Hill Book Co.

2 Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay & R. Manohar, McGraw-Hill Book Co., 1997.

References Books:

1 Grimaldi, R.P and Ramana, B.V., Discrete and Combinatorial Mathematics-An Applied Introduction, Pearson education, 5th Edition, 2004.

2 Ram, Babu, Discrete Mathematics, Pearson Education, 2007.

3 Liu, C.L, Elements of Discrete Mathematics, 3rd Edition, Tata McGraw Hill, 2008

4 Anami, B.S and Madalli, V.S., Discrete Mathematics, University Press, 2016.

5 Harary, F., Graph Theory, Narosa, 1995

6 K.L.P.Mishra and N.Chandrashekaran .,Theory of Computer Science PHI(2002)

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School of Basic and Applied Sciences

Class				M.Sc. Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y106
Paper				PROBABILITY AND STATISTICS– V (Optional-II)
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
2	2	0		

Course Objectives:
The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.
Specifically, the course aim to-
i) Motivate in students an intrinsic interest in statistical thinking.
ii) Instill the belief that statistics is important for scientific research.

Course Outcome:
The Students will be able to:
1.Compute the probabilities of composite events using the basic rules of probability.
2.Demonstrate understanding the random variable, expectation, variance and distributions.
3.Explain the large sample properties of sample mean.
4. Understand the concept of the sampling distribution of a statistic, and in particular describe the behavior of the sample mean
5.Analyze the correlated data and fit the linear regression models.
6.Demonstrate understanding the estimation of mean and variance and respective onesample and two-sample hypothesis tests.

Student Learning Outcomes (SLO):
Students will:
1.Organize, manage and present data.
2.Analyze statistical data graphically using frequency distributions and cummulative frequency distributions.
3.Analyze statistical data using measures of central tendency, dispersion and location.
4.Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
5.Translate real-world problems into probability models.
6.Derive the probability density function of transformation of random variables.
7.Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.

Unit	Syllabus	Periods
UNIT - I	**Probability -** properties, definitions, scope and examples of probability, sample spaces and events, axiomatic definition of probability, joint and conditional probabilities, independence, total probability, Bayes' rule and applications.	11

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UNIT - II	Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables, probability mass function (pmf),probability density functions (pdf) and properties, expectation, mean, variance and moments of a random variables.	11
UNIT - III	**Study of Special Distributions:** Binomial, Poisson, Negative binomial, Geometric,Rectangular, Exponential, Normal, Gamma, Log-normal distributions. **Bi-Variate Probability Distribution:** Marginal and conditional distributions, Bi variate normal distribution. **Limit Theorems**: Modes of convergence and their interrelationships, Law of large numbers,Central limit theorem.	11
UNIT - IV	**Distribution Functions :** Some special distributions, uniform, exponential, Chi-square,Gaussian, binomial, and poisson distributions, Law of large numbers, Central limit theorem and its significance. **Correlation and Regression:** Regression between two variables, Karl-Pearson correlation coefficient and rank correlation, Multiple regression, Partial and multiple correlation (three variables case only).	11
UNIT - V	**Random Sampling:** Sampling distributions, chi-square, T and F distributions. **Point Estimation:** Probabilities of point estimates, Method of maximum likelihood. Testing of Hypothesis: Fundamental notions, Neyman-Pearson lemma (without proof),Important tests based on normal, Chi-square.	11

Text Books:

1 Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Press, (2009).

2 Anderson, T.W., An Introduction to Multivariate Statistical Analysis, John Wiley (2003).

References Books:

1 D. C. Montgomery and G.C. Runger, "Applied Statistics and Probability for Engineers", 5th edition, John Wiley & Sons, (2009).

2 Robert H. Shumway and David S. Stoffer, "Time Series Analysis and Its Applications with R Examples", Third edition, Springer Texts in Statistics, (2006).

3 Meyer P.L., Introduction to Probability and Statistical Applications, Oxford &IBH (2007).

4 Goon, A.M., Gupta, M.K. and Dasgupta, B., An Outline of Statistical Theory, Vol. I the World Press Pvt. Ltd. (2000).

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EKLAVYA UNIVERSITY
ज्ञान प्राप्ये लक्ष्य संधानम्

School of Basic and Applied Sciences

Class				M.Sc. . Mathematics (Previous)
Semester/Year				I Year
Subject & Paper Code				Mathematics- MMATH20Y107
Paper				Advanced Numerical Analysis-V (Optional-III)
Max. Marks				60(ETE) + 40(IA) = 100
Credit			Total Credits	
L	T	P	4	
2	2	0		

Course Objectives:

This course is designed to introduce the basic concepts of Numerical Mathematics in order to solve the problems arising in various fields of application, for example in science, engineering and economics etc. that do not possess analytical solutions or difficult to deal with analytically. This course addresses development, analysis and application of different numerical methods to solve the problems, viz. system of linear & nonlinear equations, numerical initial and boundary value problems of ordinary differential equations etc.

Course Outcome:

The Students will be able to:

1. Identity and analyze different types of errors encountered in numerical computing.
2. Apply the knowledge of Numerical Mathematics to solve problems efficiently arising in science, engineering and economics etc.
3 .Utilize the tools of the Numerical Mathematics in order to formulate the real-world problems from the view point of numerical mathematics.
4. Design, analyze and implement of numerical methods for solving different types of problems, viz. initial and boundary value problems of ordinary differential equations etc.
5. Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research.
6. Identify the challenging problems in continuous mathematics (which are difficult to deal with analytically) and find their appropriate solutions accurately and efficiently.

Student Learning Outcomes (SLO):

Students will:

1.Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2.learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton and fixed-point iterations methods and convergence analysis of these methods.
3.solve linear and nonlinear systems of equations numerically.
4.apply numerical methods to find eigen value and eigen vectors.
5.handle the functions and data set using interpolation and least square curves.
6.Evaluate the integrals numerically.
7.Learn how to solve initial and boundary value problems numerically.

Unit	Syllabus	Periods

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UNIT - I	Transcendental and Polynomial Equations ,Bisection method,Iteration methods based on first and second degree equation ,Rate of Convergence, **Differentiation:-**Introduction,Numerical Differentiation Optimum choice of step-Length,Extrapolation methods.Partial differentiation method.	11
UNIT - II	General iteration methods,System of non linear equations, Methods for complex roots,Polynomial equation,Choice of an iterative method and Implementation. **Integration:-**Numerical integration,Methods based on interpolation,methods based on undetermined coefficircnts,Composite integration methods,Romberg and Double integration.	11
UNIT - III	System of Linear algebraic equations and Eigen value problems, Direct method,Iteration methods,Eigen values and Eigen vectors,Bounds on Eigen Values,Jacobi Givens Households symmetric matrices, Rutishauser method for arbitrary matrices,Power method,Inverse power methods,Ordinary differential equations initial value problems. Introduction-Difference equations,numerical and single step methods,stability analysis of single step methods,Multistep methods,Predicator-Corrector methods.Stability analysis of multistep methods,Stiff system.	11
UNIT - IV	Interpolation-Introduction, Lagrange and Newton interpolation, Finite Difference operators, Interpolating Polynomials using Finite Differences, Hermite Interpolation, Ordinary Differential equations, initial value problem method.	11
UNIT - V	Picewise and spline interpolation,Bivariate interpolation, approximation, least squares approximation, Uniform approximation, Rational approximation, Choice of the method, Finite Difference methods, Finite element methods.	11

Text Books:

1 Numerical methods for Scientific Engineering Computation by M.K.Jain,S.R.K. Iyengar,R.K.

2 Jain, M.K., Iyengar, S.R.K. and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, 5th Edition. New Age International Publ. New Delhi, 2010

References Books:

1 Sharma, J.N., Numerical Methods for Engineers and Scientists, 2nd Edition. Narosa Publ. House New Delhi/Alpha Science International Ltd., Oxford UK, 2007, Reprint 2010.

2 Bradie, B., A Friendly Introduction to Numerical Analysis. Pearson Prentice Hall, 2006.

3 Atkinson, K.E., Introduction to Numerical Analysis, 2nd Edition. John Wiley, 1989.

4 Scarborough, J.B., Numerical Mathematical Analysis. Oxford & IBH Publishing Co., 2001.

Note:-Use of scientific calculator allowed in examination.

Shama Nidhi Shweta Mehar