



Department of Mathematics

M.Sc. Mathematics

S.No.	Course Code	Course Name	Course Outcomes
SEMESTER - I			
1.	18PMAC11	Core Course – I : Algebra I	<ol style="list-style-type: none">1. Learn the concepts and develop the working knowledge on Groups, Normal Subgroups, Automorphism groups, Finite groups and Rings.2. Understand the concepts and develop the working knowledge on class equation, solvability of groups and finite abelian groups.3. Gain knowledge about Group Theory and Ring Theory mainly, the Sylow's theorems and4. polynomial rings.5. Understand the concepts of homomorphism, isomorphism, and quotient structure, and to apply some of these concepts to real world problems.6. Acquire knowledge about direct product of groups, Structure of finite abelian groups.7. Gain knowledge about ring of polynomials, prime, irreducible elements and their properties, UFD, PID and Euclidean domains, prime ideals, maximal ideals.8. Demonstrate the vector spaces and the concept of linearity.
2.	18PMAC12	Core Course – II: Real Analysis	<ol style="list-style-type: none">1. Learn the basic ingredients of reals and study the properties of functions defined on the Real line.2. Develop a sound knowledge and appreciation of the ideas and concepts related to metric spaces.3. Get the analytical skill about continuity and derivability.4. Inculcate the basic knowledge of differentiation, expansion of functions



			<p>and their applications.</p> <ol style="list-style-type: none"> Inculcate an insight into Riemann integration. Demonstrate the main results on integration and an ability to apply these in examples. Identify uniformly and non-uniformly convergent sequences of functions, and apply results related to uniform convergence.
3.	18PMAC13	Core Course – III : Graph Theory – I	<ol style="list-style-type: none"> Write precise and accurate mathematical definitions of objects in graph theory. Able to formulate problems in terms of graphs, solve graph theoretic problems and apply algorithms taught in the course. Explain basic terminology of a graph. Represent graphs using adjacency matrices. Identify Euler and Hamiltonian cycle. Able to formulate Dual graphs. Know about many different coloring problems for graphs. Able to study the graph concepts in directed graphs.
4.	18PMAC14	Core Course – IV: Statistics	<ol style="list-style-type: none"> Introduce the concept of sampling theory. Present the ideas about the Beta, t, and F distributions. Formulate and analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions using various discrete distributions and estimation theory techniques. Use statistical techniques to solve well-defined problems and present their mathematical work, both in oral and written format. Identify the appropriate hypothesis testing procedure based on the model fitted to the data. Identify the expression of the point estimator to estimate parameters.
5.	18PMA011	Major Elective Course – I:	<ol style="list-style-type: none"> Learn about the use of generating functions for enumeration of



		Combinatorial Mathematics	<p>combinatorial structures, including partitions of numbers, permutations with restricted conditions.</p> <ol style="list-style-type: none">2. Study the solution of recurrence relations; methods of enumeration with restricted conditions.3. Comprehend the features characterizing problems in combinatorial mathematics.4. Develop skills required to analyze and solve problems in combinatorial mathematics.5. Appreciate the overlap between mathematics and other areas of applied and pure mathematics.6. An improved ability to communicate mathematical ideas.7. Describe and explain theories, design principles and empirical results in the area of specialization.
6.	18PMA012	Major Elective Course - I : Automata and Formal Languages	<ol style="list-style-type: none">1. Prove properties of languages, grammars and automata with rigorously formal mathematical methods.2. Design automata, regular expressions and context-free grammars accepting or generating a certain language.3. Describe the language accepted by automata or generated by a regular expression or a context-free grammar.4. An ability to design grammars and automata (recognizers) for different language classes.5. An ability to identify formal language classes and prove language membership properties.6. An ability to prove and disprove theorems establishing key properties of formal languages and automata.7. Design grammars and recognizers for different formal languages.
7.	18PMA013	Major Elective Course - I:	<ol style="list-style-type: none">1. Demonstrate accurate and efficient use of advanced algebraic techniques.



		Modern Applied Algebra	<ol style="list-style-type: none"> 2. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from advanced algebra. 3. Apply problem-solving using advanced algebraic techniques applied to diverse situations in physics, engineering and other mathematical contexts. 4. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from advanced algebra. 5. Analyze an application using a function developed from data. 6. Use the outputs of a Johnson shift counter to generate specialized waveforms utilizing various combinations of the five basic gates. 7. Develop a comparison of the Boolean equations and truth tables for the five basic gates.
SEMESTER – II			
8.	18PMAC21	Core Course – V: Algebra II	<ol style="list-style-type: none"> 1. Inculcate an insight into algebraic structure field. 2. Develop an analytic thinking in the concept of linear transformation. 3. Provide an introduction to the concept of matrices. 4. Learn the Canonical form and Jordan form. 5. Give a thorough knowledge of the various aspects of Trace and Transposes. 6. Provide the concept of determinants using the operation of matrices. 7. Inculcate the basic knowledge of Hermitian and Unitary transformations.
9.	18PMAC22	Core Course – VI: Measure Theory	<ol style="list-style-type: none"> 1. Learn the concept and properties of measure starting with outer measure and then the Lebesgue measure. 2. Study measurable sets and measurable functions and their properties. 3. Understand the basic concepts underlying the definition of the general Lebesgue integral. 4. Study spaces of measurable Lebesgue integrable functions.



			<ol style="list-style-type: none">5. Understand Lebesgue integral and its relation with Riemann integral.6. Apply the theory of the course to solve a variety of problems at an appropriate level of difficulty.
10.	18PMAC23	Core Course – VII: Differential Equations	<ol style="list-style-type: none">1. Appreciate ODE and system of ODEs concepts that are encountered in the real world.2. Work with Differential Equations and systems of Differential Equations in various situations and use correct mathematical terminology, Notation, and symbolic processes in order to engage in work, study, and conversation on topics involving differential equations.3. Determine whether a system of functions is linearly independent using the Wronskian.4. Learn the concepts of series solution of differential equation and solution of Bessel's, Legendre's equations and their properties.5. Solve exact differential equations, linear differential equations and understand the basics of non - linear differential equations.6. Formulate and solve partial differential equations arising in a number of practical problems.7. Determine the general solution of higher order linear equations with constant coefficients.
11.	18PMAC24	Core Course - VIII : Classical Mechanics	<ol style="list-style-type: none">1. Analyze mechanical behavior of particle.2. Obtain simple mathematical and physical relationships between mechanics and materials.3. Achieve mastery in moments and products of Inertia, Equipomental systems.4. Ability to study generalized coordinates, Scleronomic and Rheonomic systems.5. Able to study Lagrange's equations for various systems.



			<ol style="list-style-type: none"> Solve orbit problems using the conservation of angular momentum and total energy. Able to work out the center of gravity and moment of inertia of various plane areas.
12.	18PMAN21	Non - Major Elective Course: Fundamentals of Statistics	<ol style="list-style-type: none"> Enhance the knowledge of statistics in business management. Develop analytical skills in both private and public business organics in the country. Build a culture of informed decision making using statistical models. Describe data with descriptive statistics. Perform statistical analyses and interpret the results of statistical analyses. Calculate and apply measures of location and measures of dispersion - grouped and ungrouped data cases. Apply discrete and continuous probability distributions to various business problems.
SEMESTER – III			
13.	18PMAC31	Core Course – IX: Functional Analysis	<ol style="list-style-type: none"> Gain an insight into normed space. Understand the concept of continuity and boundedness of linear maps. Study the characterization of Hahn – Banach Theorem. Gain knowledge of central concepts of the open mapping and closed graph theorems. Demonstrate the Bounded Linear maps and the uniform boundedness principle on Banach spaces. Learn about Spectrum of a bounded operator and evaluate the spectral radius formula. Demonstrate the concept of weak and weak* convergence. Able to get idea of reflexivity using Helly’s theorem and Milman theorem.



14.	18PMAC32	Core Course - X: Operations Research	<ol style="list-style-type: none">1. Learn the applications of shortest route algorithm.2. Gain knowledge of Queuing model.3. Relate the exponential and Poisson distribution.4. Present the idea of servicing models.5. Learn the necessary and Sufficient Conditions of Unconstrained problems.6. Understand the concept of Direct Search Method of Quadratic Programming.7. Able to know Linear Combinations method and SUMT Algorithm.
15.	18PMAC33	Core Course - XI: Fuzzy Analysis	<ol style="list-style-type: none">1. Gain knowledge about constructing the appropriate fuzzy numbers corresponding to uncertain and imprecise collected data.2. Gain knowledge about finding the optimal solution of mathematical programming problems having uncertain and imprecise data.3. Knowledge about fuzzy cluster analysis and how to solve basic problems using fuzzy cluster analysis.4. Distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.5. Draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.6. Able to define fuzzy sets using linguistic words and represent these sets by membership functions.7. Know fuzzy-set-related notions; such as α-level sets, convexity, normality, support, etc.
16.	18PMAC34	Core Course - XII : Topology	<ol style="list-style-type: none">1. Construct various topologies on a general set and compare them if it is possible2. Construct the product topology on product spaces.



			<ol style="list-style-type: none">3. Be able to give an account of various set theoretic and topological constructions such as products of topological properties.4. Be able to describe the heredity of various topological properties under continuous maps.5. Express the notion of metric space, construct the topology by using the metric.6. Express regularity and normality separation axiom and use them to prove various properties.7. Able to apply Tychonoff's theorem, fundamental metrization theorems to construct several mathematical objects.
17.	18PMA031	Major Elective Course – II: Advanced Numerical Analysis	<ol style="list-style-type: none">1. Understand basics of finite precision arithmetic, conditioning of problems and stability of numerical algorithms.2. Examine approximate solutions to mathematical problems.3. Solve dense systems of linear equations and least squares problems and have a working4. knowledge of LU and QR factorizations for these problems.5. Compute eigen values and eigen vectors of matrices numerically.6. Apply various mathematical operations and tasks, such as interpolation, differentiation, integration, the solutions of linear equations and the solutions of differential equations and partial differential equations.7. Increase the accuracy of numerical approximations by extrapolation.
18.	18PMA032	Major Elective Course - II: Graph Theory - II	<ol style="list-style-type: none">1. Have increased ability in graph theoretic problem solving.2. Calculate the chromatic number and chromatic index of a given graph.3. Calculate the chromatic polynomial of a graph using the algorithm.4. Able to solve Turan's problem.5. Apply the Planarity Algorithm for testing planarity of graphs.6. Be able to implement standard algorithms of graph theory.



19.	18PMA033	Major Elective Course – II : Differential Geometry	<ol style="list-style-type: none">1. Explain the concepts and language of differential geometry and its role in modern mathematics.2. Demonstrate the contact between curves and surfaces.3. Parametrize a plane and a space curve and to calculate its curvatures and Frenet-Serret apparatus and arc-length.4. Gain knowledge of families of curves.5. Present the concept of Geodesic and their properties.6. Identify the principle of curvature of a curve.7. Able to know the minimal and ruled surfaces.
SEMESTER – IV			
20.	18PMAC41	Core Course – XIII: Complex Analysis	<ol style="list-style-type: none">1. Introduce the concept of analytic function, rational function, reflection principle etc.,2. Inculcate an insight into the characterization of some special series.3. Describe and parameterize curves and regions in two-dimensional space.4. Study about the families of circles.5. Evaluate fundamental theorem of calculus and Cauchy's integral formula.6. Find the Taylor series of a function and determine its circle or annulus of convergence.7. Compute the residue of a function and use the residue theory to evaluate a integral over the real line.
21.	18PMAC42	Core Course – XIV: Number Theory and Cryptography	<ol style="list-style-type: none">1. Solve problems in elementary Number Theory.2. Able to effectively express the concepts and results of Number Theory.3. Able to understand the logic and methods behind the major proofs in Number Theory.4. Apply properties of Congruence to solve practical problems.5. Able to understand the principles and theory of error-correcting codes, and the various



			<ol style="list-style-type: none">6. methods for constructing them.7. Apply elementary number theory to cryptography.8. Understand the mathematical ideas underlying the theory of cryptography.
22.	18PMAC43	Core Course – XV: Stochastic Processes	<ol style="list-style-type: none">1. Apply the specialised knowledge in probability theory and random processes to solve practical problems.2. Gain advanced and integrated understanding of the fundamentals of and interrelationship between discrete and continuous random variables and between deterministic and3. stochastic processes.4. Analyse the performance in terms of probabilities and distributions achieved by the determined solutions.5. Demonstrate essential stochastic modeling tools like Markov chains.6. Evaluate the n-step transition probability.7. Learn about renewal theory, the Birth – Death and Yule process.8. Understanding of the relationship between the purpose of a model and the appropriate level of complexity and accuracy.
23.	18PMAC44	Core Course – XVI : Advanced Topology	<ol style="list-style-type: none">1. Able to apply the topological concepts and constructions to real world problems.2. Gain knowledge about the handling of several topological techniques.3. Use ideas and methods of coverings to prove fundamental results related with metrisability and characterizations of Paracompactness.4. Know the importance of paracompactness and can give equivalent characterizations.5. Demonstrate knowledge and understanding of concepts such as connectedness and compactness.6. Able to use and adapt relevant theorems to check whether a subset of a



			topological space is compact or not.
24.	18PMAJ41	Core Course – XVII: Project	<ol style="list-style-type: none">1. Get familiarized with basic concepts of research.2. Identify and state the research topic.3. Design and conduct a research study accordance with the identified research need.4. Develop skill to search online and offline sources to carryout research.5. Assess ways to collect, compile and conduct a data analysis6. Appropriately document the data collected7. Apply academic skills to present the research study findings in a formal academic oral presentations and a written research paper