



### Department of Mathematics

### M.Sc. Mathematics

S.No.	Course Code	Course Name	Course Outcomes
<b>SEMESTER- I</b>			
1.	21PMAC11	Core Course - I: Abstract Algebra	<p><b>CO1[K2]:</b> explain the general theory and properties of algebraic structures in accordance with abstract algebra</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of abstract algebra</p> <p><b>CO3[K4]:</b> investigate different classes of rings</p> <p><b>CO4[K5]:</b> evaluate the method of constructing Galois group of a given polynomial</p> <p><b>CO5[K5]:</b> determine the suitable extension field in which a given polynomial has roots</p>
2.	21PMAC12	Core Course - II: Real Analysis	<p><b>CO1[K2]:</b> explain the basic concepts of real analysis and proof techniques in analysis</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of real analysis</p> <p><b>CO3[K4]:</b> investigate the countability of sets</p> <p><b>CO4[K4]:</b> analyze the properties continuity, differentiability, integrability of the functions <math>f_n</math></p>



			when transferred to the limit $f$ under uniform convergence <b>CO5[K5]:</b> evaluate continuity, differentiability, integrability of the functions
3.	21PMAC13	Core Course - III: Graph Theory and Algorithms	<b>CO1[K2]:</b> explain the basic concepts and definitions of graph theory <b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of graph theory <b>CO3[K4]:</b> investigate the characteristic features of various types of graphs <b>CO4[K5]:</b> determine the efficient algorithm to solve graph optimisation problems <b>CO5[K6]:</b> construct a graph theoretical model for the given practical problem
4.	21PMAC14	Core Course - IV: Mathematical Statistics	<b>CO1[K2]:</b> explain the basic concepts and techniques in sampling theory and theory of statistical inference <b>CO2[K3]:</b> find the distribution of a function of random variables using different methods <b>CO3[K4]:</b> investigate the methods of finding estimator of a parameter <b>CO4[K5]:</b> determine the appropriate sufficient statistics for a parameter <b>CO5[K5]:</b> determine the effective method of finding distribution function of random variables and estimator of a parameter
5.	21PMA011	Elective Course - I: Combinatorial Techniques	<b>CO1[K2]:</b> recognize the techniques of enumerating



			<p>combinatorial structures</p> <p><b>CO2[K3]:</b> apply the techniques to solve enumeration problems</p> <p><b>CO3[K4]:</b> analyze the principle of inclusion and exclusion</p> <p><b>CO4[K5]:</b> evaluate the solution of recurrence relations of sequence of numbers</p> <p><b>CO5[K5]:</b> determine the appropriate techniques to solve enumeration problems</p>
6.	21PMA012	Elective Course - I: Numerical Computation Techniques	<p><b>CO1[K2]:</b> recognize the methods of solving numerically the problems of computational mathematics</p> <p><b>CO2[K3]:</b> apply the methods to solve problems of computational mathematics numerically</p> <p><b>CO3[K4]:</b> analyze the errors caused by approximating the process of computation</p> <p><b>CO4[K5]:</b> evaluate the rate of convergence of the iterative methods</p> <p><b>CO5[K5]:</b> determine the choice of method applied for finding the solution of the problem</p>
7.	21PMA013	Elective Course - I: Formal Languages and Automata Theory	<p><b>CO1[K2]:</b> recognize the techniques, mathematical properties of automata and the relations between various languages and kinds of formalized logics</p> <p><b>CO2[K3]:</b> apply the techniques to identify regular languages, context - free languages</p>



			<p><b>CO3[K4]:</b> analyze the relationship between derivation trees and derivation, the equivalence of PDA's and CFL's</p> <p><b>CO4[K5]:</b> determine the equivalence of two finite automata</p> <p><b>CO5[K5]:</b> determine the efficient algorithm to design abstract self propelled computing device that follow a predetermined sequence of operations automatically</p>
<b>SEMESTER- II</b>			
8.	21PMAC21	Core Course - V: Linear Algebra	<p><b>CO1[K2]:</b> explain the general theory and properties of algebraic structures in accordance with linear algebra</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of linear algebra</p> <p><b>CO3[K4]:</b> analyze the basis of a vector space</p> <p><b>CO4[K4]:</b> investigate different canonical forms of matrix of a linear transformation</p> <p><b>CO5[K5]:</b> determine the similarity of linear transformations</p>
9.	21PMAC22	Core Course - VI: Measure Theory	<p><b>CO1[K2]:</b> explain measurable set, measurable function, Lebesgue integrable of functions, measurable spaces and the properties of Lebesgue measure and Lebesgue Integration</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of Lebesgue</p>



			<p>measure and Lebesgue Integration</p> <p><b>CO3[K4]:</b> appraise the concept of measure and integration in measure spaces</p> <p><b>CO4[K5]:</b> determine the convergence of sequence of measurable functions</p> <p><b>CO5[K5]:</b> recommend the appropriate way of defining a measure on a <math>\sigma</math>- algebra</p>
10.	21PMAC23	Core Course - VII: Ordinary and Partial Differential Equations	<p><b>CO1[K2]:</b> explain the general form of linear ordinary differential equation of first order, second order, partial differential equation of first order and the method of finding solutions</p> <p><b>CO2[K3]:</b> solve linear ordinary differential equations with variable coefficients, linear equations with regular singular points</p> <p><b>CO3[K3]:</b> compute the successive approximations to the solution of initial value problems and the limit of its convergence</p> <p><b>CO4[K4]:</b> examine the linear independence of solutions of linear homogeneous ordinary differential equations with variable coefficients</p> <p><b>CO5[K5]:</b> evaluate the complete integrals of partial differential equations of the first order</p>
11.	21PMAC24	Core Course - VIII: Differential Geometry	<p><b>CO1[K2]:</b> explain the theory of plane and space curves and surfaces in the three dimensional Euclidean space</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of</p>



			<p>results that arise in the context of surface theory</p> <p><b>CO3[K4]:</b> differentiate local intrinsic and non- intrinsic properties of a surface</p> <p><b>CO4[K4]:</b> investigate different types of curvature of curves and surfaces</p> <p><b>CO5[K5]:</b> evaluate the characteristics of developable surfaces</p>
12.	21PMAN21	Non Major Elective Course : Numerical Computation Methods	<p><b>CO1[K1]:</b> state the elementary concepts of numerical methods</p> <p><b>CO2[K2]:</b> explain the methods for solving mathematical problems numerically</p> <p><b>CO3[K3]:</b> apply numerical methods to solve algebraic, transcendental, simultaneous and difference equations and to compute numerical differentiation and integration of functions that are defined by its numerical values</p> <p><b>CO4[K4]:</b> analyze the finite difference operators</p> <p><b>CO5[K4]:</b> analyze the method of interpolation for finding the unknown data value between known data values</p>
<b>SEMESTER- III</b>			
13.	21PMAC31	Core Course - IX: Functional Analysis	<p><b>CO1[K2]:</b> explain the basic concepts, principles and methods of Functional Analysis</p> <p><b>CO2[K3]:</b> apply the analytical techniques and theoretical knowledge to produce the proofs of results that arise in the context of Functional Analysis</p>



			<p><b>CO3[K4]:</b> interpret spectrum of a bounded operator</p> <p><b>CO4[K4]:</b> examine the reflexivity of Banach spaces</p> <p><b>CO5[K5]:</b> determine the weak and weak* convergence of sequences in a normed space</p>
14.	21PMAC32	Core Course - X: Optimization Techniques	<p><b>CO1[K2]:</b> explain the techniques and methods of finding the optimum solution to decision making problems</p> <p><b>CO2[K3]:</b> solve the various optimization problems</p> <p><b>CO3[K4]:</b> categorize the various types of queuing models</p> <p><b>CO4[K4]:</b> examine the functions for extreme points</p> <p><b>CO5[K5]:</b> determine the appropriate method of solving the decision making problem</p>
15.	21PMAC33	Core Course - XI: Topology	<p><b>CO1[K2]:</b> explain the basic concepts of general topology</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of general topology</p> <p><b>CO3[K4]:</b> analyze different topologies on the same set</p> <p><b>CO4[K4]:</b> explore the properties of separation axioms</p> <p><b>CO5[K5]:</b> determine the topology in which the given space is metrizable</p>
16.	21PMAC34	Core Course - XII: Research Methodology	<p><b>CO1[K2]:</b> explain the essential components in writing a research paper</p> <p><b>CO2[K3]:</b> apply the LaTeX techniques in preparing a research document</p> <p><b>CO3[K4]:</b> analyse the different elements in writing a research paper</p>



			<p><b>CO4[K5]:</b> assess the method of preparing the list of works cited and sources in the text</p> <p><b>CO5[K1]:</b> identify the research ethics in documentations</p>
17.	21PMA031	Elective Course - II: Functions of Several Variables	<p><b>CO1[K2]:</b> explain the basic concepts and algebraic facts related to sets of vectors in Euclidean <math>n</math> - space</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of several variables</p> <p><b>CO3[K4]:</b> investigate the differentiability and continuity of functions of several variables</p> <p><b>CO4[K4]:</b> analyze integration of the differential forms – Closed forms and Exact forms</p> <p><b>CO5[K5]:</b> evaluate the integrals of 1-forms, 2-forms in <math>R^3</math></p>
18.	21PMA032	Elective Course - II: Fuzzy Mathematics	<p><b>CO1[K2]:</b> explain the basic concepts and main components of fuzzy set theory</p> <p><b>CO2[K3]:</b> solve fuzzy equations using fuzzy numbers</p> <p><b>CO3[K4]:</b> analyze the different standard fuzzy operations</p> <p><b>CO4[K4]:</b> investigate the different classes of fuzzy measures</p> <p><b>CO5[K5]:</b> evaluate the properties of crisp and fuzzy relations</p>
19.	21PMA033	Elective Course - II: Elements of Stochastic Processes	<p><b>CO1[K2]:</b> explain the general theory and properties of probability distributions and random processes</p> <p><b>CO2[K3]:</b> compute the probability distribution of various random processes</p>





			<p><b>CO3[K4]:</b> classify random processes according to state space and parameterspace</p> <p><b>CO4[K4]:</b> investigate the statistical inference of various processes</p> <p><b>CO5[K5]:</b> evaluate the statistical properties of random processes</p>
20.	21PMAM31	Self-paced Learning (Swayam Course) Introduction to Methods of Applied Mathematics	<p><b>CO1[K1]:</b> identify the background and the key words in Methods of Applied Mathematics</p> <p><b>CO2[K2]:</b> demonstrate independent and self-paced learning for clear understanding of the concept</p> <p><b>CO3[K3]:</b> develop computer and communication skills to broaden their knowledge in the course</p> <p><b>CO4[K3]:</b> use high quality reading resources, communication tools and technology to send assignments and to take up test</p> <p><b>CO5[K4]:</b> analyse critically and apply technical skills to comprehend the ideas or theories in the video lectures</p>
21.	21PMAM32	Self-paced Learning (Swayam Course) Regression Analysis	<p><b>CO1[K1]:</b> identify the background and the key words in Regression Analysis</p> <p><b>CO2[K2]:</b> demonstrate independent and self-paced learning for clear understanding of the concept</p> <p><b>CO3[K3]:</b> develop computer and communication skills to broaden their knowledge in the course</p> <p><b>CO4[K3]:</b> use high quality reading resources, communication tools and technology to send assignments and to take up test</p> <p><b>CO5[K4]:</b> analyse critically and apply technical skills to comprehend the ideas or theories in the video</p>



			lectures
SEMESTER- IV			
22.	21PMAC41	Core Course - XIII: Complex Analysis	<p><b>CO1[K2]:</b> explain the basic concepts, theories, properties of functions of a complex variable</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of analytic functions</p> <p><b>CO3[K4]:</b> analyze the general properties of analytic functions</p> <p><b>CO4[K4]:</b> interpret the several forms of Cauchy's theorem and examine the series and product expansions of analytic functions</p> <p><b>CO5[K5]:</b> evaluate the definite integrals by the method of residues</p>
23.	21PMAC42	Core Course - XIV: Number Theory and Cryptography	<p><b>CO1[K2]:</b> explain the general theory and properties of arithmetical functions, congruence and different types of ciphers in cryptography</p> <p><b>CO2[K3]:</b> apply the abstract concepts to produce proofs of results that arise in the context of number theory</p> <p><b>CO3[K4]:</b> analyze the averages of arithmetical functions</p> <p><b>CO4[K4]:</b> analyze the theory of quadratic residues</p> <p><b>CO5[K5]:</b> determine the existence and non-existence of primitive roots mod <math>p</math></p>
24.	21PMAC43	Core Course - XV: Integral	<b>CO1[K2]:</b> explain the basic types of integral equation



		Equations	<p>and methods of solving integral equations</p> <p><b>CO2[K3]:</b> solve integral equations using various methods and transformations</p> <p><b>CO3[K4]:</b> analyze the properties and different kinds of kernels</p> <p><b>CO4[K4]:</b> examine the solution of Boundary value problems</p> <p><b>CO5[K5]:</b> determine the extremals of the given functional by variational methods</p>
25.	21PMAC44	Core Course - XVI: Mechanics	<p><b>CO1[K2]:</b> explain the mathematical laws and principles at the core of classical mechanics</p> <p><b>CO2[K3]:</b> demonstrate the equation of motion for complicated mechanical system through Lagrangian and Hamiltonian formulation</p> <p><b>CO3[K4]:</b> classify the orbits under central force motion in space dynamics</p> <p><b>CO4[K5]:</b> evaluate the law of momentum conservation under various mechanical system</p> <p><b>CO5[K5]:</b> determine the curve for which some given line integral has a stationary value</p>
26.	21PMAJ41	Core Course - XVII: Project	<p><b>CO1 [K1]:</b> identify the unexplored areas of research</p> <p><b>CO2 [K2]:</b> outline the objectives in formulating a research paper</p> <p><b>CO3 [K2]:</b> explain the stages in writing a thesis – collecting and evaluating sources and drafting documentation</p> <p><b>CO4 [K3]:</b> apply the latest rules of documentation to</p>



			<p>cite print, non-print and Web Publications in a research paper</p> <p><b>CO5 [K6]:</b> prepare a rightly documented research project with adequate discussion, interpretations and evaluation</p>
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