P.P.N. (P.G.) College, Kanpur

96@12 Mahatma Ghandhi Marg, Kanpur -208001

•Telefax: (0512)2361924 • Website: www.ppncollege.org•

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PG MATHEMATICS

COURSE OUTCOMES (COs)

Bachelor (Research) in Mathematics

4th Year of Higher Education

FIRST-YEAR

SEMESTER - I

Real Analysis		**PAPER-I**		**THEORY**	**CREDIT: 05**
CO 1	The subject of the course are designed is such a way that they focus on developing mathematical skills in real analysis.				
CO 2	The students will be able to develop their skills in countable and uncountable sets, Reimann – Stieltjes integral, uniform convergence of sequence and series of functions, power series, functions of several variables, Euclidean spaces, limit of function.				
CO 3	The student can visualise concepts of real analysis.				
CO 4	On successfully completing the course, students have gained knowledge in real analysis.				
Topology		**PAPER-II**		**THEORY**	**CREDIT: 05**
CO 1	Analysis is the lifeline of Modern Mathematics. General topology serves as a key tool for making an in-depth study of the same. It is a language for communicating ideas of continuous geometry. This course aims to teach the fundamentals of point set topology and constitute an awareness of the need for topology in Mathematics.				
CO 2	It provides us with useful tools for studying the local properties of space. The course developed here is intended to give students an insight into various concepts involved in the analysis.				
CO 3	Learning the concepts of metric spaces and topological spaces and their role in mathematics.				
CO 4	To make the students aware of how the concepts of analysis are acting and reacting in the presence of various topological properties.				
CO 5	The students will also learn the concepts related to the characterization of topological spaces and separation axioms.				
Advanced Complex Analysis		**PAPER-III**		**THEORY**	**CREDIT: 05**
CO 1	Understand the basic concepts underlying complex analysis.				
CO 2	Calculate zeros of analytic functions, singularities and their classification.				

		CO 3	Understanding of concepts of Morera's theorem, Maximum modulus principle and minimum modulus principle.			
		CO 4	Get equipped with the fundamental concepts of Gamma functions, Harmonic functions, Entire functions, convex functions, Riemann Zeta function and its properties.			
		CO 5	Get the introduction of the theories of analytic continuation, uniqueness of analytic continuation and power series method.			
		Dynamics of Rigid Bodies		**PAPER-IV**	**THEORY**	**CREDIT: 05**
		CO 1	The object of the paper is to give an extensive knowledge of mechanics, which they have already studied at plus two and U. G. levels as basic idea in each chapter.			
		CO 2	The students get a brief idea of all the principles of dynamics and statics and learn to solve complex problems in mechanics.			
		CO 3	Rigid body mechanics has its application in almost every phase of the real world. Every single mechanism, whether it's a small or a giant machine, has the application of some of the principles of Mechanics.			
		CO 4	In real world no field is free from machines or mechanics. Rigid body mechanics is used extensively to design power generation, and transmission system, from jet engines to gearboxes.			

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FIRST-YEAR

SEMESTER - II

Advanced Real Analysis	PAPER-I		THEORY	CREDIT: 05

CO 1	The course is designed in such a way that the students focus on developing mathematical skills in real analysis.
CO 2	The students will be able to develop their skills in the algebra of sets, measurable sets, Lebesgue measurable theory, measurable function, the L^p space, Jensen inequality, and Holder and Minkowski's inequalities.
CO 3	The subject learns and visualises the idea of mathematical analysis.
CO 4	On successful completion of the course, students have gained knowledge in the field of mathematical analysis and they have the foundation for research work.

Advanced Topology	PAPER-II		THEORY	CREDIT: 05

CO 1	Analysis is the lifeline of Modern Mathematics. General topology serves as a key tool to make an in-depth study of the same. The main objective of this course is to recognise and apply advanced properties of, and techniques for topology to a range of important problems in Analysis.
CO 2	Observation of differences between metric space and Topological Space via different kinds of compactness of Topological spaces.
CO 3	To make students learn the connectedness of topological spaces.
CO 4	To make them learn how the concepts of analysis hold in the presence of various topological properties.
CO 5	The students will be able to apply the concepts related to nets and filters.
CO 6	After completing the course, students gain knowledge of quotient spaces, finite product spaces, projection mapping and product topology. They could also apply concepts such as compactness, connectedness and separation axioms on product spaces.

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SEMESTER – II	**Operations Research**	**PAPER-III**		**THEORY**	**CREDIT: 05**
	CO 1	The field of operations research provides a more robust approach to decision-making than ordinary software and data analysis tools.			
	CO 2	Employing operations research professionals can help companies achieve more complete data sets, consider all available options, predict all possible outcomes and estimate risk.			
	CO 3	An attractive feature of Operation Research is the applicability of the knowledge, skills and tools in various industries.			
	CO 4	Through operation research, we can adopt the scientific methodology in the search for optimal solutions in higher research in various quantitative and qualitative data analysis.			
	Mathematical Statistics	**PAPER-IV**		**THEORY**	**CREDIT: 05**
	CO 1	Gain sound knowledge in theoretical and practical aspects of Statistics.			
	CO 2	Describe complex statistical ideas to non-statisticians in a simple manner.			
	CO 3	Inculcate and develop an aptitude to apply statistical tools to several data-generating fields in real-life problems.			
	CO 4	Understanding of discrete probability density functions and continuous probability density functions.			
	CO 5	Equip with the ideology of sampling distributions and testing of hypothesis.			
	CO6	Get the introduction of Estimator theory, unbiased, consistent, sufficient and efficient estimator.			

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Master in Mathematics/ 5th Year of Higher Education

SECOND YEAR	SEMESTER – III	**Abstract Algebra**	**PAPER-I**		**THEORY**	**CREDIT: 04**
		CO 1	The Subject of the course is designed so that students can focus on developing their skills in Abstract Algebra.			
		CO 2	The students will be able to develop their deep knowledge and mathematics skills in group theory, subgroups, solvable groups, lower and upper central series, Nilpotent groups, Cauchy theorem, action of a group on a set, and sylow subgroups.			
		CO 3	The students learn and visualise the idea of Abstract Algebra.			
		CO4	On successfully completing the course, students have gained knowledge in the field of Abstract Algebra.			
		Functional Analysis	**PAPER-II**		**THEORY**	**CREDIT: 04**
		CO 1	Learn to recognise the fundamental properties of Normed spaces and the transformations between them.			
		CO 2	Master the basic fundamental results of the theory of Banach and Hilbert spaces in modern analysis.			
		CO 3	Gain knowledge of central concepts from functional analysis including Hahn Banach Theorem, Dual spaces, weak convergence and Spectral theory.			
		CO 4	Recognise Hilbert spaces in terms of their geometrical properties.			
		CO 5	Understand how functional analysis uses and unifies ideas from Vector spaces, metric spaces and complex analysis.			
		Fluid Dynamics	**PAPER-III**		**THEORY**	**CREDIT: 04**
		CO 1	Students become capable of identifying and analysing various types of fluid motion, fluid properties and fluid behaviours.			
		CO 2	They become efficient in solving various problems of hydrodynamics and able to explain the effect of fluid properties on a flow system.			
		CO 3	After successfully completing the course, students understand the basic concepts of fluid flow.			
		CO 4	Hydro-dynamics has a vast spectrum of applications in various engineering and industries such as mechanical, chemical, aeronautics, civil, petroleum, etc.			

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	SEMESTER – III	**Special Functions**	**PAPER-IV**		**THEORY**	**CREDIT:04**
		CO 1	To understand the properties of special functions like Gamma and hypergeometric functions.			
		CO 2	To learn how special functions are helpful in differential equations.			
		CO 3	This course aims to introduce hypergeometric forms of well-known special functions.			
		CO 4	To learn about elliptic functions, theta functions and their properties.			
		Computational Mathematics with Python-I	**PAPER-V**		**PRACTICAL**	**CREDIT:04**
		CO 1	The students will be familiarised with features of Python as a programming tool. The course aims to give exposure to basic concepts of the Python programming.			
		CO 2	The course aims to design the Python programs for plotting of curves, solution of partial differential equations and plotting of their solution curves.			
		CO 3	The students will be able to graphically represent data, like bar chart, pie chart, histogram and various computational methods.			
		CO 4	The students will also gain introductory knowledge and motivation for computing in mathematics.			

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SECOND YEAR	SEMESTER - IV	**Advanced Abstract Algebra**	**PAPER-I**		**THEORY**	**CREDIT: 04**
		CO 1	The Subject of the course are designed in such a way that students can focus on Advanced Abstract Algebra.			
		CO 2	The students will be able to develop their deep knowledge in Fields, Modules, galois theory, free modules, simple modules and rings.			
		CO 3	The subject gives visualise and the deep knowledge of Advance Abstract Algebra.			
		CO4	On successful completion of the course, students have gained knowledge in the field Advanced Abstract Algebra and they have the foundation for Research work in Advanced Algebra.			
		Integral equations and boundary value problems	**PAPER-II**		**THEORY**	**CREDIT: 04**
		CO 1	Integral equations and boundary value problems is an important branch of Mathematics and occupies a central position from which development extends in many directions along with the applications in physical and engineering sciences and numerous applications in real-life physical problems.			
		CO 2	After completing this course, the students will gain knowledge about Volterra and Fredholm integral equations.			
		CO 3	The students will be able to solve these integral equations by method of successive approximation and convergence of Fredholm series.			
		CO 4	The students will be able to use Laplace and Fourier transform to solve integral equations.			
		CO 5	The students will learn how to construct Green's function from the given boundary value problem and its applications.			
		Advanced Fluid Mechanics	**PAPER-III**		**THEORY**	**CREDIT: 04**
		CO 1	Students will acquire knowledge of an array of topics in fluid mechanics including the use of the equations of motion in differential form.			
		CO 2	Students understand the properties of fluids, its kinematics and dynamical behaviour through various laws of fluid like continuity, Euler's, Bernoulli's equation, energy and momentum equations.			
		CO 3	Advanced knowledge of potential theory as well as a fundamental understanding of the mechanics of incompressible flow.			
		CO 4	Advanced topics include fluid properties, hydrostatics, laminar and turbulent flow, energy and continuity equations in one dimension.			

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	SEMESTER - IV	**Operator theory**		**PAPER-IV**		**THEORY**	**CREDIT:04**
		CO 1	Understand and apply fundamental theorems from the theory of Normed spaces and Banach spaces.				
		CO 2	Inculcate the understanding of ideas from the theory of Hilbert spaces that could be applied to other areas for example Fourier series.				
		CO 3	Introduce the fundamentals of Spectral theory and the spectral properties of bounded linear operator.				
		CO 4	Gain knowledge of basic concepts of spectral radius, spectral mapping of polynomials, residual spectrum and approximate spectrum.				
		CO 5	Understand the fundamental idea of Banach algebra, Division Algebra, Ideals, Maximal Ideal of complex commutative Banach algebra.				
		Computational Mathematics with Python-II		**PAPER-V**		**PRACTICAL**	**CREDIT:04**
		CO 1	The course objective is to familiarise the students with problem solving using Python programming.				
		CO 2	The course aims to design the Python programs for plotting of curves, solution of partial differential equations and plotting of their solution curves.				
		CO 3	The students will be able to graphically represent data, like bar chart, pie chart, histogram and various computational methods.				
		CO 4	The students will also gain introductory knowledge and motivation for computing in mathematics.				

Head
Department of Mathematics

Convener
IQAC

Convener
NAAC

Principal