Ramakrishna Mission Vivekananda Centenary College

Department of Mathematics (UG)

Consolidated CO-PO-PSO Mapping

Course Code	Course Name	CO no	CO in details	Program Outcomes						Average mapping strength	Program Specific Outcomes					Average mapping strength
				PO1	PO2	PO3	PO4	PO5	PO6		PSO 1	PSO2	PSO3	PSO4	PSO5	
Semester -I																
UGMATHCC01	Calculus, Geometry Differential Equation, Practical	CO1	Recall the basic concepts of conics and classification of quadrics.	3	3	3				3	3					3
		CO2	Construct a variety of differential equations analytically and numerically.			3		3				3				
		CO3	Measure/calculate length, perimeter, area, volume of surface of revolution of a curve and techniques of sketching conics.			3	3	3					3			
		CO4	Develop ability to graphically analyze functions by computer practical.				3		3						3	
UGMATHCC02	Algebra	CO1	Understand complex numbers, way of representing numbers, relationships among numbers, different method for solving polynomial equations.			3		3		3		3				3
		CO2	Solve linear equations.			3		3				3				
		CO3	Demonstrate their ability to graphically or numerically analyze functions by presentation.				3		3						3	
Semester-II																
UGMATHCC03	Real Analysis	CO 1	Describe the real line as a complete, ordered field.	2	2	2				2.5	2					2.5
		CO 2	Use the definitions of convergence as they apply to sequences, and series.			3		3				3				
		CO 3	Determine the basic topological properties of subsets of the real numbers.			2	2	2					2			
		CO 4	Plot the convergence of sequences and series of different test on computer.				3		3					3		

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				PO1	PO2	PO3	PO4	PO5	PO6		PSO1	PSO2	PSO3	PSO4	PSO5	
UGMATHCC04	Differential Equations & Vector Calculus	CO 1	Find general solution of homogenous and non-homogenous equation of higher order and their super position.	2	2	2				2.6	2					2.6
		CO 2	Find power series solutions of differential equations, and develop the ability to apply differential equations to significant applied and/or theoretical problems.			3		3				3				
		CO 3	Describe Euler's equation, method of undetermined coefficients and method of variation of parameters.			2	2	2					2			
		CO 4	Analyse vector functions (graphically or analytically) to find derivatives, tangent lines, integrals, arc length, and curvature.				3		3					3		
		CO 5	Demonstrate their understanding of how physical phenomena are modelled by differential equations and dynamical systems. Implement solution methods using appropriate technology.				3		3						3	
Semester -III																
UGMATHCC05	Theory of Real Functions & Introduction to Metric Spaces	CO 1	Understand the sequential approaches of limit, continuity, uniform continuity and some important properties.	2	2	2				2.5	2					2.5
		CO 2	Recognize the difference between pointwise and uniform convergence of a sequence of functions	2	2	2					2					
		CO 4	Recall the defining properties of a metric space, and determine whether a given function defines a metric and get familiarize with open sets, closed sets and Cantor set.	3	3	3					3					
		CO 3	Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis.			3	3	3					3			

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UGMATHCC06	Group Theory I	CO1	Understand the External direct product of a finite groups, finite abelian groups and Cauchy's theorem.	2	2	2				2.75	2					2.75
		CO2	Understand and classify the permutation of a group, centre of a group, Lagrange's theorem and Fermat's Little theorem.				3		3					3		
		CO3	Apply different properties of group homomorphisms and isomorphisms theorems and Cayley's theorem in solving problems.				3		3					3		
		CO4	Develop the ability to graphically or mathematically analyse the different theorem on Group by presentation.				3		3						3	
UGMATHCC07	Numerical Methods	CO 1	Implement a variety of numerical algorithms using appropriate technology.	3	3	3				2.8	3					2.8
		CO 2	Compare the viability of different approaches to the numerical solution of problems arising in roots of solution of non-linear equations, interpolation and approximation.			2	2	2					2			
		CO 3	Analyse the error incumbent in any such numerical approximation.				3		3					3		
		CO 4	Understand graphically or numerically analyse the different methods of Numerical method by computer practical.				3		3					3		
		CO 5	Numerical differentiate and integrate, solution of linear systems using different method.				3		3						3	

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Semester -IV																
UGMATHCC08	Riemann Integration and Series of Functions	CO 1	Develop a knowledge about Riemann Integration, Fourier series and Power series, hence their properties and applications.	2	2	2				2.22	2					2.22
		CO 2	Recognize the difference between pointwise and uniform convergence of a sequence of functions.	2	2	2					2					
		CO 3	Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.	2	2	2					2					
		CO 4	Demonstrate graphically or analytically analyse integrability conditions, the sequence of functions, series of functions and their natures by presentation.			3		3				3				
UGMATHCC09	Multivariate Calculus	CO1	Evaluate double and triple integrals over rectangular and non-rectangular region and volume by triple integrals in cylindrical and spherical coordinates.			2	2	2		2.8			2			2.8
		CO2	Demonstrate their ability to graphically or numerically analyze Partial differentiation, condition for differentiability relation between divergence theorem by presentation.			3	3	3					3			
		CO3	Analyze the fundamental theorem of calculus and see their relation in calculus, leading to the more generalized version of Stokes' theorem in the setting of differential forms.				3		3					3		
		CO4	Analyze functions of several variables to find limit, continuity and differentiability.				3		3					3		
		CO5	Differentiate vector fields, determine gradient vector fields and find potential functions.				3		3						3	

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UGMATHCC10	Ring Theory and linear Algebra I	CO 1	Assess properties implied by the definitions of rings, factor rings, prime and maximal ideals.			3		3		3		3				3
		CO 2	Use the concepts of isomorphism and homomorphism for rings.			3		3				3				
		CO 3	Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism.			3		3				3				
		CO 4	Analyse and demonstrate examples of ideals and quotient rings.				3		3					3		
		CO 5	Demonstrate graphically or analytically analyze prime and maximal ideals, homomorphism and isomorphism theorem on rings and vector spaces by presentation.				3		3						3	
Semester -V																
UGMATHCC11	Partial Differential Equations and Applications	CO 1	Be familiar with the modelling assumptions and derivations that lead to PDEs.			3		3		3		3				3
		CO 2	Recognize the major classification of PDEs and the qualitative differences between the classes of equations.				3		3					3		
		CO 3	Demonstrate graphically or analytically analyze the solution of Cauchy problem, characteristic for PDE and solution of Heat equation by python languages.				3		3					3		
		CO 4	Be competent in solving linear PDEs using classical solution methods.				3		3						3	

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UGMATHCC12	Group Theory II	CO 1	Explain the concept of group homomorphism, isomorphism and automorphism.			3	3	3		3			3			3
		CO 2	Infer the properties of external and internal direct product and fundamental theorem of finite abelian groups, conjugates, the Class Equation, p-groups, Cayley's theorem and Sylow's theorems.				3		3					3		
		CO 3	Derive and apply Sylow Theorems, Cauchy's theorem and simplicity of An for n ≥5.				3		3					3		
		CO 4	Design graphically or analytically analyse the application of factor groups to automorphism groups, Sylow's theorem and consequences, simplicity of alternating groups and conjugacy in Sn by presentation.				3		3						3	
UGMATHDSE1	Linear Programming	CO 1	Formulate optimization problems and solve them using different methods.				3		3	3					3	3
		CO 2	Place a Primal linear programming problem into standard form and use the Simplex Method or Revised Simplex Method to solve it and find the dual, and identify and interpret the solution of the Dual Problem from the final tableau of the Primal problem.				3		3						3	
		CO 3	Explains the Transportation Problem and Assignment Problem, formulate them as an LPP and hence solve the problem.				3		3						3	
		CO 4	To understand the theory of games for solving simple games.				3		3						3	
UGMATHDSE2	Probability and Statistics	CO 1	Compute probabilities and conditional probabilities in appropriate ways.				3		3	3				3		3
		CO 2	Represent and statistically analyse data both graphically and numerically.				3		3					3		
		CO 3	Demonstrate the ability of conditional probabilities statistically analyse data both graphically and numerically by presentation.				3		3						3	
		CO 4	Solve word problems using combinatorial analysis.				3		3						3	

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Semester -VI																
UGMATHCC13	Metric Spaces and Complex Analysis	CO 1	Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties, and apply the concept and consequences of analyticity and the Cauchy Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.	3	3	3				2.8	3					2.8
		CO 2	Applies the theory into application of the power series expansion of analytic functions, and understand the basic methods of complex integration and its application in contour integration.			3		3				3				
		CO 3	Demonstrate the knowledge of Cauchy sequences, Cantor's theorem, Heine-Borel property, contracting mapping, Homeomorphism and Banach fixed point theorem, through their application to ordinary differential equation.			3		3				3				
		CO 4	Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.			2	2	2					2			
		CO 5	Analyse weather a sequence in a metric space is convergent or not.				3		3					3		
UGMATHCC14	Ring Theory and Linear Algebra II	CO 1	Demonstrate knowledge of polynomial ring, integral domain, unique factorization domain and Euclidean domain.	2	2	2				2.22	2					2.22
		CO 2	Interpret the knowledge of dual space and basis, eigen space of linear operator and the minimal polynomial for a linear operator.	3	3	3					3					
		CO 3	Develop the knowledge of inner product space, least squares approximation, normal and self-adjoint operator, spectral theorem.			2		2				2				
		CO 4	Apply unique factorization domain and its applications, Cayley Hamilton theorem and its consequences, orthogonal projections and spectral theorem.			2		2				2				

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UGMATHDSE3 or UGMATHDSE4	Mechanics	CO 1	Understand the virtual work, stable and unstable equilibrium.	3	3	3				2.5	3					2.5
		CO 2	Understand degree of freedom, D'Alembert's Principle, compound pendulum and conservation of momentum and energy.	2	2	2					2					
		CO 3	Solve the problems on stability of nearly orbit, motion in a particle in 3D and motion on a smooth sphere, cone and any surface.				2		2					2		
UGMATHDSE3 or UGMATHDSE4	Bio Mathematics	CO 1	Demonstrate knowledge of SI, SIR, SIRS and SIC.	2	2	2				2.66	2					2.66
		CO 2	Illustrate knowledge about different types of models and applications.			3	3	3					3			
		CO 3	Demonstrate the knowledge of Growth model, decay model, lake pollution model limited growth of population and battle model by practical.			3	3	3					3			
UGMATHDSE3 or UGMATHDSE4	Point Set Topology	CO 1	Define and illustrate the concept of countable set and uncountable set, cardinal numbers and cardinal arithmetic, Zorns lemma and ordinal numbers.	3	3	3				2.75	3					2.75
		CO 2	Demonstrate the concept of topological spaces and continuous functions, product topology and quotient topology, metric topology and Baire category theorem.	2	2	2					2					
		CO 3	Define connectedness, compactness, and totally bounded spaces prove a selection of related theorems.	3	3	3					3					
		CO 4	Students will demonstrate the ability of topological spaces and analyze some important theorem by presentation.			3		3				3				

Grand Average PO 2.74 Grand Average PSO 2.742

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Department of Mathematics (PG)

Consolidated CO-PO-PSO Mapping

Course Code	Course Name	Co Name	CO in details	Program Outcomes				Average mapping strength	Program Specific Outcomes						Average mapping strength
				PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
SEMESTER I															
PGMATHCC101	Algebra-I	CO1	Define algebraic structures	2				2.6	2						2.6
		CO2	Construct substructures		2	2				2					
		CO3	Analyse a given structure in detail	3	3						3				
		CO4	Compare structures viz. Groups, rings, fields		3	3						3			
		CO5	Develop new structures based on given structures				3							3	
PGMATHCC102	Real Analysis	CO1	Demonstrate an understanding of limits and how that are used in sequences, series and differentiation.	3				3	3						3
		CO2	Appreciate how abstract ideas and region methods in mathematical analysis can be applied to important practical problems.		3	3				3					
		CO3	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	3	3						3				
		CO4	Comprehend regions arguments developing the theory underpinning real analysis		3	3						3			
		CO5	Construct rigorous mathematical proofs of basic results in real analysis.			3	3						3		
PGMATHCC103	Complex Analysis	CO1	Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem	3				2.8	3						2.8
		CO2	Apply the theory into application of the power series expansion of analytic functions, and understand the basic methods of complex integration and its application in contour integration		2	2				2					
		CO3	Analyse the concept of metric space and some important theorem on complex analysis for solving different problems	3	3						3				
		CO4	Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral Formula		3	3						3			
		CO5	Compute Laurent series and its examples, absolute and uniform convergence of power series				3							3	

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PGMATHCC104	Ordinary and Partial Differential Equations	CO1	Identify real phenomena as models of partial derivative equations.	2				2.6	2						2.6
		CO2	Classify differential equations and solve them.	3	3						3				
		CO3	Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialisation.		3	3						3			
		CO4	Extract information from partial derivative models in order to interpret reality.		2	2						2			
		CO5	Solve the basic application problems described by differential equations.			3	3						3		
PGMATHCC105	Numerical Analysis	CO1	Understanding the theoretical and practical aspects of the use of numerical analysis.	2				2.8	2						2.8
		CO2	Understanding of common numerical analysis and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.	3					3						
		CO3	Proficiency in implementing numerical methods for a variety of multidisciplinary applications.	3	3						3				
		CO4	Establishing the limitations, advantages, and disadvantages of numerical analysis.		3	3						3			
		CO5	Deriving numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations and the solution of differential equations.			3	3						3		
PGMATHCC106	Computer Programming in C++ and Numerical Practical using Gnu- Octave / Scilab / Matlab	CO1	Reading, understanding and tracing the execution of programs written in C++ language.	3				2.8	3						2.8
		CO2	Solving a linear system of equations using an appropriate numerical method.		2	2				2					
		CO3	Performing an error analysis for a given numerical method.			3	3						3		
		CO4	Developing programs GNU-OCTAVE /SCILAB/ MATLAB that perform operations using derived data types.			3	3						3		
		CO5	Solving an algebraic or transcendental equation using an appropriate numerical method.				3							3	
		CO6	Developing the C++ code for a given algorithm.				3							3	

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SEMESTER II															
PGMATHCC201	Algebra II	CO1	Understand the Matrix theory, determinants and their application to systems of linear Equations	2				2.5	2						2.5
		CO2	Apply the knowledge of Eigenvalues, diagonalization of matrices and reduction of systems of linear equations into simpler systems of easily tractable nature.		2	2				2					
		CO3	Apply the concept of Vector theory: subspace, basis, linear independence, inner product spaces etc. in real-world problems		3	3						3			
		CO4	Comprehend the applications of matrix algebra.			3	3						3		
PGMATHCC202	Measure and Integration	CO1	Conceptualisation of simple functions.	3				2.7	3						2.7
		CO2	Apply the concepts of integration for the study in subsequent chapters namely, signed and product measure.		2	2				2					
		CO3	Generalize the classical Lebesgue integral on real sets.		3	3						3			
		CO4	Integration of functions on arbitrary measure space and bounded functions on sets of finite measure.				3							3	
PGMATHCC203	General Topology	CO1	Define and illustrate the concept of countable set and uncountable set, cardinal numbers and cardinal arithmetic, Zorns lemma and ordinal numbers.	3				3	3						3
		CO2	Define and illustrate the concept of topological spaces and continuous functions, product topology and quotient topology, metric topology and Baire category theorem.	3					3						
		CO3	Define connectedness, compactness, and totally bounded spaces and prove a selection of related theorems.		3	3				3					
		CO4	Analyse topological spaces and some important theorem.	3	3						3				

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PGMATHCC204	Classical Mechanics & Theory of Relativity	CO1	Explain Lagrangian and Hamiltonian formulation of Classical Mechanics.	2				2.15	2						2.15
		CO2	State the conservation principles involving momentum, angular momentum and energy and understand that they follow from the fundamental equations of motion.	3					3						
		CO3	Understand Newton's laws and motion of particle under central force field.	2					2						
		CO4	Describe the basic concepts of the theory of relativity.	2					2						
		CO5	Differentiate facts from wrong general public ideas about the theory of relativity.	3	3						3				
		CO6	Discuss postulates of the special theory of relativity and their consequences.	3	3						3				
PGMATHCC205	Linear Algebra & Multivariate Calculus	CO1	Characterize a set of vectors and linear systems using the concept of linear independence.	3				3	3						3
		CO2	Visualize and manipulate multivariable and vector valued functions presented in graphical, numeric, and symbolic form.	3	3						3				
		CO3	Identify and construct linear transformations of a matrix and characterize them as onto, one-to-one.			3	3						3		
		CO4	Solve linear systems represented as linear transforms and express them in other forms, such as matrix equations and vector equations.				3							3	
		CO5	Differentiate multivariate functions in all directions and learn several applications of multivariate derivatives.				3							3	

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PGMATHCC206	Integral Transforms & Integral Equations	CO1	Understand the Calculus of Variations, Euler-Lagrange's equations.	2				2.8	2						2.8
		CO2	Obtain solution of a boundary value problem using integral equations.		3	3						3			
		CO3	Obtain minimum surface of revolution from a variational formulation.		3	3						3			
		CO4	Obtain the solution of Wave, Heat and Laplace equations using integral transform technique.			3	3						3		
		CO5	Construct Green's function and master the concept of various Integral Equations: Fredholm and Voltera type.				3							3	
SEMESTER III															
PGMATHCC301	Functional Analysis	CO1	Work with a complete orthogonal set in a Hilbert space, weak and weak * topologies on normed linear spaces.		2	2		2.8		2					2.8
		CO2	Compare the differences between basis and Schauder basis.	3	3						3				
		CO3	Investigate the best approximation of a given vector by vectors in given subspace.	3	3						3				
		CO4	Work with Fredholm and other integral operator as a linear operator.		3	3						3			
		CO5	Compute the dual spaces of certain Banach spaces.				3							3	
PGMATHCC302	Dynamical System Analysis	CO1	Describe the main features of dynamical systems and realise as systems of ordinary differential equations	3				2.6	3						2.6
		CO2	Understand the origin of dissipation and its effect on the orbits of dynamical systems, abstract dynamical system, discrete dynamical system and chaotic dynamical system	2					2						
		CO3	Use a range of specialised analytical techniques which are required in the study of dynamical systems		2	2				2					
		CO4	Identify fixed points of simple dynamical systems, and study the local dynamics around these fixed points, in particular to discuss their stability and bifurcations	3	3						3				
		CO5	Explain and prove special properties of finite-dimensional Hamiltonian systems, in particular conservation laws, Liouville's Theorem and Poincare's Recurrence Theorem		3	3						3			

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PGMATHCE301	Advanced Real Analysis	CO1	Understand the concept of extended real numbers, Lebesgue and Borel measures on real line.	3				2.65	3						2.65
		CO2	Understand the measurability of real sets.	2					2						
		CO3	Understand the measurability of extended real valued functions.	2					2						
		CO4	Solve problems relating to determinations of measures of finite, infinite sets.		3	3						3			
		CO5	Construct different Borel sets.				3							3	
		CO6	Construct measurable, non-measurable sets and functions.				3							3	
PGMATHCE302	Advanced Complex Analysis –I	CO1	Understand Infinite products of complex numbers.	2				2.66	2						2.66
		CO2	Understand the concept of Spherical metrics, Normal Convergence, Picard's Theorem.	3					3						
		CO3	Use the Mittag-Leffler Theorem, Gamma functions, Weierstrass' Factorization.		3	3						3			
PGMATHCE303	Algebraic Topology-I	CO1	Understanding the fundamental concepts and methods in algebraic topology.	3				2.66	3						2.66
		CO2	Explain particular homotopy and homology theory.	2					2						
		CO3	Formulate and solve problems of a geometrical and topological nature in mathematics.		3	3						3			

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PGMATHCE304	Differential Manifold-I	CO1	Realize the behaviours of different surfaces, normal curvatures, principle curvatures, Gaussian and mean curvatures.	3				2.8	3						2.8
		CO2	Understand the first and second fundamental forms.	2					2						
		CO3	Evaluate 1st and 2nd fundamental forms of surface patches.	3					3						
		CO4	Analyse and characterize different curves and surfaces.	3	3						3				
		CO5	Construct differential maps between smooth surfaces.		3	3						3			
PGMATHCE305	Cosmology-I	CO1	Understanding of our galaxy.	2				2.66	2						2.66
		CO2	Contrast and compare our galaxy with other galaxies as to type, contents, age, luminosity, motion, and size.	3	3						3				
		CO3	Using cosmological models to analyze the size, age, structure, and motion of the universe overall.	3	3						3				
PGMATHCE306	Mathematical biology-1	CO1	Use sophisticated mathematical techniques in the analysis of mathematical models in biology.		2	2		2.66		2					2.66
		CO2	Apply and extend classical models in mathematical biology.		3	3						3			
		CO3	Construct mathematical models for biological systems like phytoplankton-zooplankton system, Microbial population model, Discrete and Continuous population models.				3							3	
PGMATHCE307	Operation Research-I	CO1	Show the Kuhn-Tucker optimality conditions.	2				2.8	2						2.8
		CO2	Formulate and solve problems as networks and graphs.			3	3						3		
		CO3	Construct linear integer programming models and discuss the solution techniques.				3							3	
		CO4	Develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transhipment problems.				3							3	
		CO5	Solve the problems using special solution algorithms.				3							3	

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Course Code	Course Name	Co Name	CO in details	Program Outcomes				Average mapping strength	Program Specific Outcomes						Average mapping strength
				PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
PGMATIICE308	Continuum Mechanics-I	CO1	Describe motion, deformation and forces in a continuum.	2				2.5	2						2.5
		CO2	Understand constitutive models for elastic and viscoelastic solids.	3					3						
		CO3	Derive equations of motion and conservation laws for a continuum.		2	2				2					
		CO4	Solve simple boundary value problems for solids.		3	3						3			
PGMATHAE301	Programming in Python & LaTex	CO1	Understand the fundamentals of Python Language and the basics of LaTeX.	3				2.5	3						2.5
		CO2	Acquire the basic skills required for Python programming.	2					2						
		CO3	Solve Mathematical problems using Python programs.		2	2				2					
		CO4	Learn to prepare a LaTeX document, article and a project report.		3	3						3			
SEMESTER IV															
PGMATIICC401	Number Theory	CO1	Use congruence as a tool to reduce a hard labour of work in some calculations.	2				2.5	2						2.5
		CO2	Find primitive roots.	2					2						
		CO3	Establish existing identities using Mobius inversion formula.	3	3						3				
		CO4	Solve a Diophantine equation and system of Diophantine equations.			3	3						3		

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Course Code	Course Name	Co Name	CO in details	Program Outcomes				Average mapping strength	Program Specific Outcomes						Average mapping strength
				PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
PGMATHCC402	Discrete Mathematics	CO1	Understand the basic combinatorics, induction, inclusion exclusion, pigeon hole principle.	2				2.2	2						2.2
		CO2	Understand more advance topics in combinatorics: recurrence relations, generating functions.	3					3						
		CO3	Understand the basic logical concepts, analyzing arguments, quantification theory.	2					2						
		CO4	Apply the concepts to real life problems such as network theory, data structure, optimization etc.		2	2				2					
		CO5	Construct the method of deduction for validity of truth.		2	2				2					
PGMATHCE401	Advanced Real Analysis -II	CO1	Solve problems relating to determinations of measures of finite, infinite sets.		3	3		3				3			3
		CO2	Constructing measurable, non-measurable sets and functions.			3	3						3		
		CO3	Construct different Borel sets.				3							3	
PGMATHCE402	Advanced Complex Analysis II	CO1	Classify singularities, Integration of functions on C, applications to counting zeros and poles.	2				2.66	2						2.66
		CO2	Evaluate definite real integrals.		3	3						3			
		CO3	Construct Mobius transformation between regions.		3	3						3			
PGMATHCE403	Algebraic Topology – II	CO1	Explain the fundamental concepts of algebraic topology and their role in modern mathematics and applied contexts.	3				2.7	3						2.7
		CO2	Apply problem-solving using algebraic topology techniques applied to diverse situations in physics, engineering and other mathematical contexts.		2	2				2					
		CO3	Demonstrate accurate and efficient use of algebraic topology techniques.	3	3						3				
		CO4	Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from algebraic topology.	3	3						3				

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Course Code	Course Name	Co Name	CO in details	Program Outcomes				Average mapping strength	Program Specific Outcomes						Average mapping strength
				PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
PGMATHCE404	Differential Manifold-II	CO1	Understand the normal curvature of a surface, its connection with the first and second fundamental form and Euler's theorem.	3				2.25	3						2.25
		CO2	Understand the concept of topological manifolds.	2					2						
		CO3	Understand the concept of Lie group.	2					2						
		CO4	Solve problems using Stoke's theorem, line integral and Green's theorem.		2	2				2					
PGMATHCE405	Cosmology-II	CO1	Understand the concept of advanced cosmology.	2				2.33	2						2.33
		CO2	Use an understanding of our galaxy to contrast and compare it with other galaxies as to type, contents, age, luminosity, motion, and size.		2	2				2					
		CO3	Use cosmological models to analyze the size, age, structure, and motion of the universe overall.	3	3						3				
PGMATHCE406	Mathematical Biology-II	CO1	Apply and extend classical models in mathematical biology.		2	2		2.33		2					2.33
		CO2	Construct mathematical models for biological systems like Continuous models for two, three or more interacting populations, Interaction of Ratio-dependent models.		2	2				2					
		CO3	Use sophisticated mathematical techniques in the analysis of mathematical models in biology.		3	3						3			
PGMATHCE407	Operations Research-II	CO1	Define and formulate linear programming problems and solve them using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.	3				2.6	3						2.6
		CO2	Understand the concept of Queuing theory, simulation, Theory of Inventory Control, Information theory, Coding theory and Geometric Programming.	3					3						
		CO3	Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship.	2					2						
		CO4	Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.		2	2				2					
		CO5	Effectively communicate ideas, explain procedures and interpret results and solutions in written and electronic forms to different audiences.		3	3						3			

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				PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
PGMATHCE408	Continuum Mechanics-II	CO1	Describe the physical properties of a fluid.		2	2		2.75		2					2.75
		CO2	Demonstrate the application point of hydrostatic forces on plane and curved surfaces.		3	3						3			
		CO3	Calculate the pressure distribution for incompressible fluids.		3	3						3			
		CO4	Calculate the hydrostatic pressure and force on plane and curved surfaces.			3	3						3		
PGMATHCC403	Project Work	CO1	Demonstrate a sound technical knowledge of their selected project topic.	2				2.5	2						2.5
		CO2	Design engineering solutions to complex problems utilising a systems approach.		2	2				2					
		CO3	Undertake problem identification, formulation and solution.	3	3						3				
		CO4	Conduct an engineering project.		3	3						3			
PGMATHSS04	Seminar Presentation	CO1	Show competence in identifying relevant information, defining and explaining topics under discussion.	3				2.5	3						2.5
		CO2	Demonstrate depth of understanding, use primary and secondary sources.		2	2				2					
		CO3	Demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness.		2	2				2					
		CO4	Evaluate information and use and apply relevant theories.		3	3						3			
							Grand Average PO	2.64						Grand Average PSO	2.63

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Department of Mathematics (PHD)

Consolidated CO-PO-PSO Mapping

Course Code	Course Name	COs	CO Description	PO				Average mapping strength	PSO				Average mapping strength
				1	2	3	4		1	2	3	4	
Semester I													
PHDMATH01	Research Methodology	CO 1:	Understand the objectives, motivation and types of research	3				3		3			3
		CO 2:	Define and formulate a research problem				3		3				
		CO 3:	Collect data (primary or secondary) based on the formulated problem and analyse the data.		3						3		
		CO 4:	Analyse the data with hypothesis testing, generalization and interpretation.			3						3	
		CO 5:	Discuss the application of results and write the thesis.			3						3	
PHDMATH02	Computer Applications	CO 1:	Explain and use TeX and LaTeX.		2			2.8	3				3
		CO 2:	Understand the advantages of LaTeX over other more traditional software's.	3						3			
		CO 3:	Prepare handouts and presentations using LaTeX.				3				3		
		CO 4:	Understand the core Python scripting elements such as variables and flow control structures.	3							3		
		CO 5:	Use Python to read, write, demonstrations files.			3						3	
PHDMATH03	Literature review	CO 1:	Identify and retrieve relevant publications within a field of research and write a literature review by searching the literature systematically.		3			3	3				3
		CO 2:	Select representative scientific sources from several perspectives relevant to the assignment.		3					3			
		CO 3:	Write a research proposal for obtaining Financial assistance from national funding agencies.				3					3	
		CO 4:	Draw conclusions related to the research problem and give recommendations towards new research opportunities.				3				3		
		CO 5:	Represent and systematically structure a discussion on the theories and experimental results and define, design and write a literature review independently			3					3		
PHDMATH 04	Algebraic Topology	CO 1:	Understanding the fundamental concepts and methods in algebraic topology.	3				3	3				3
		CO 2:	Explain particular homotopy and homology theory.	3					3				
		CO 3:	Formulate and solve problems of a geometrical and topological nature in mathematics.		3					3			
		CO 4:	Apply problem-solving using algebraic topology techniques and theorems including the Fundamental theorem of Algebra, Separation Theorem in the plane, Selfert – van Kampen Theorem.	3			3		3				

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Course Code	Course Name	COs	CO Description	PO				Average mapping strength	PSO				Average mapping strength
				1	2	3	4		1	2	3	4	
PHDMATH05	Complex Analysis	CO 1:	Understand Infinite products of complex numbers.	3				3	3				3
		CO 2:	Understand the concept of Spherical metrics, Normal Convergence, Picard's Theorem	3					3				
		CO 3:	Use the Mittag-Leffler Theorem, Gamma functions, Weierstrass' Factorization.	3					3				
		CO 4:	Classify singularities, Integration of functions on C, applications to counting zeros and poles.	3					3				
		CO 5:	Evaluate definite real integrals.		3					3			
		CO 6:	Construct Mobius transformation between regions.		3					3			
PHDMATH06	Cosmology	CO 1:	Understanding of our galaxy.	3				3		3			3
		CO 2:	Contrast and compare our galaxy with other galaxies as to type, contents, age, luminosity, motion, and size.			3					3		
		CO 3:	Using cosmological models to analyze the size, age, structure, and motion of the universe overall.			3					3		
							Grand Average PO	2.97				Grand Average PSO	3

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