Department of Mathematics

B.Sc. Mathematics

S.No.	Course Code	Course Name	Course Outcomes
		SEMESTER- I	
1.	21UMAC11	Core Course - I : Differential Calculus	**CO1[K2]:** describe tangent, normal, pedal equation of plane curves with the help of derivative **CO2[K2]:** exemplify curvature, radius of curvature, evolute of plane curves and envelope of a family of plane curves encountered in the study ofcalculus **CO3[K3]:** sketch a plane curve given its equation without computing the large number of points required for a detailed plot **CO4[K4]:** investigate homogeneous function and Euler's theorem **CO5[K5]:** determine the asymptotes of the given function
2.	21UMAC12	Core Course - II : Analytical Geometry-3D	**CO1[K1]:** describe three – dimensional Cartesian co-ordinates and geometricobjects line, plane, sphere on the co-ordinate system **CO2[K2]:** explain the properties of direction cosines of a line **CO3[K3]:** manipulate the different forms of equations of lines, planes, spheres **CO4[K4]:** differentiate the different forms of equations of lines, planes, spheres **CO5[K5]:** determine the appropriate form of equation of lines, planes, Spheres
3.	21UMAS11	Skill Enhancement	**CO1[K2]:** recognize the properties of double and triple integrals, beta and

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		Course I : Integral Calculus and Fourier Series	gamma functions **CO2[K3]:** use the integration techniques to integrate double integrals over a region and triple integrals over a three dimensional region **CO3[K3]:** calculate the area of a region using double integrals and the volume of a solid using triple integrals **CO4[K4]:** investigate the reduction formula for integrals that contain transcendental functions **CO5[K5]:** determine the appropriate Fourier series expansion of bounded integrable function
SEMESTER- II			
4.	21UMAC21	Core Course - III : Classical Algebra	**CO1[K1]:** outline the equivalence relation, divisibility in Z, congruences and reciprocal equations **CO2[K2]:** explain the properties of divisibility, congruences and the types of reciprocal equations **CO3[K3]:** solve linear congruences and cubic, biquadratic equations **CO4[K4]:** investigate the types of reciprocal equations and examine the natureand position of roots of polynomial equations **CO5[K5]:** determine the nature and position of roots of polynomial equations
5.	21UMAC22	Core Course - IV : Summation of Series and Trigonometry	**CO1[K1]:** state the binomial series representation of functions, exponential series and logarithmic series, definition of hyperbolic functions **CO2[K2]:** identify the general term in series expansion of functions and characteristic property of hyperbolic functions **CO3[K3]:** use trigonometric formulae to sum the trigonometric series and to

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			findthe expression for sin nθ, cos nθ, $sin^n\theta$, $cos^n\theta$ **CO4[K4]:** investigate the methods of summation of trigonometric series **CO5[K5]:**determine the appropriate method to find the sum of trigonometricseries
6.	21UMAS21	Skill Enhancement Course - II: Data Interpretation	**CO1[K2]:** describe the method of collecting data, characteristics of data, the typeof classification of data in terms of statistical survey **CO2[K3]:** draw inference from data represented using bar graphs, pie charts,line graphs **CO3[K4]:** interpret data diagrammatically and graphically **CO4[K5]:** evaluate the method of collecting data and representation of data **CO5[K6]:** prepare questionnaires for collection of data and arrange data according to classification
SEMESTER- III			
7.	21UMAC31	Core Course - V : Sequences and Series	**CO1[K2]:** explain the fundamental concepts of sequences and series of real numbers **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise inthe context of sequences and series of real numbers **CO3[K3]:** apply the standard tests to test the convergence of series of real numbers **CO4[K4]:** investigate the limits of sequences of real numbers **CO5[K5]**: determine the behaviour of monotonic sequences
8.	21UMAC32	Core Course - VI : Mathematical Statistics	**CO1[K2]:** explain the basic statistical methods and techniques in data analysis **CO2[K3]:** apply the statistical methods and techniques to find numerical

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			measures of quantitative data **CO3[K3]:** calculate mathematical expectation and generating function of random variables **CO4[K4]:** analyze the properties of distribution functions of random variables **CO5[K5]:** determine the curve that best fit the given data
9.	21UMAN31	Non Major Elective Course - I : Fundamentals of Mathematics	**CO1[K1]:** state the elementary mathematical facts **CO2[K2]:** explain the method of simplifying algebraic and rational expressions and the basic concepts related to sets, logarithms **CO3[K3]:** solve linear equations and problems on sets, permutations and combinations **CO4[K4]:** investigate the general term of Arithmetic and Geometric progression **CO5[K4]:** analyze different forms of a set and various set theoretic operations
10.	21UMAS31	Skill Enhancement Course - III: Astronomy	**CO1[K1]:** describe astronomical objects and phenomenon **CO2[K2]:** summarize the identities of spherical trigonometry **CO3[K3]:** calculate various measures in horizon **CO4[K4]:** examine the relationships between the trigonometric functions of sides and angles of a spherical triangle **CO5 [K4]**: analyze the occurrence of astronomical twilight
SEMESTER- IV			
11.	21UMAC41	Core Course - VII : Mechanics	**CO1[K2]:** explain the fundamental concepts and principles of Mechanics **CO2[K3]:** apply the principles and methods to find the resultant of forces on bodies concerned in statics **CO3[K4]:** examine the velocity and acceleration of moving particles in

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			various forms of motion **CO4[K4]:** investigate the motion of a particle under the action of central forces **CO5[K5]:** evaluate the kinematic quantities of projectile motion
12.	21UMAC42	Core Course - VIII : Sampling Theory	**CO1[K2]:** explain the important elements of sampling and the different sampling methods **CO2[K3]:** apply sampling techniques to draw inferences about a population in statistical investigation **CO3[K3]:** apply the statistical tool "Analysis of Variance" for testing the significance at different level of significance **CO4[K4]:** analyze the various methods for obtaining estimation of population parameters **CO5[K5]:** determine the optimum test statistic in solving Testing of Hypothesis Problems
13.	21UMAM41	Self-paced Learning (Swayam Course) Basic Calculus 1 and 2	**CO1[K1]:** identify the background and the key words in Basic Calculus 1 and 2 **CO2[K2]:** demonstrate independent and self-paced learning for clear understanding of the concept **CO3[K3]:** develop computer and communication skills to broaden theirknowledge in the course **CO4[K3]:** use high quality reading resources, communication tools and technology to send assignments and to take up test **CO5[K4]:** analyse critically and apply technical skills to comprehend the ideas prescribed

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14.	21UMAM42	Self-paced Learning (Swayam Course) Multivariable Calculus	**CO1[K1]:** identify the background and the key words in Multivariable calculus **CO2[K2]:** demonstrate independent and self-paced learning for clear understanding of the concept **CO3[K3]:** develop computer and communication skills to broaden their knowledge in the course **CO4[K3]:** use high quality reading resources, communication tools and technology to send assignments and to take up test **CO5[K4]:** analyse critically and apply technical skills to comprehend the ideas prescribed
15.	21UMAN41	Non Major Elective Course - II: Introduction to Numerical Computations	**CO1[K1]:** state the elementary concepts of numerical methods **CO2[K2]:** explain the methods for solving mathematical problems numerically **CO3[K3]:** apply numerical methods to solve algebraic, transcendental and simultaneous equations **CO4[K4]**: examine the method of finding the curve of best fit for the given data **CO5[K4]**: analyze the method of interpolation for finding the unknown data value between known data values
16.	21UMAS41	Skill Enhancement Course - IV: Statistical Distributions	**CO1[K2]:** explain the basic concepts of discrete probability distributions and continuous probability distributions **CO2[K3]:** compute the various parameters of probability distributions **CO3[K3]:** derive the moment generating function and cumulant generating function of probability distributions **CO4[K4]:** interpret the recurrence relation for parameters of distributions **CO5[K5]:** determine the limiting form of distributions of random variables
SEMESTER- V			

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17.	21UMAC51	Core Course - IX : Abstract Algebra	**CO1[K2]:** explain the fundamental concepts of groups and rings **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise inthe context of groups and rings **CO3[K3]:** apply the composition operation of permutation group to compute inverse of a permutation and express a permutation as a product of disjoint cycles / transpositions **CO4[K4]:** analyze the properties of groups, subgroups, rings, subrings **CO5[K5]:** determine the group/ring axioms on a set and the isomorphism ofgroups / rings
18.	21UMAC52	Core Course - X : Real Analysis	**CO1[K2]:** explain the basic concepts of real analysis and proof techniques in analysis **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise inthe context of real analysis **CO3[K4]:** analyze the behavior of absolutely convergent and conditionally convergent series **CO4[K4]:** analyze the properties connectedness, completeness and compactnessin a metric space **CO5[K5]:** determine continuity, discontinuity and uniform continuity of thefunctions on the real line
19.	21UMAC53	Core Course - XI : Operations Research	**CO1[K2]:** explain the solution procedure for solving Linear Programming Problems and the basic concepts related to theory of games andqueues **CO2[K3]:** solve the linear programming problems using various methods **CO3[K3]:** apply the maximin - minimax principle, graphical method and

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			dominance property to find the optimum strategy and value of thegame **CO4[K4]:** analyse the characteristics of Poisson queueing models **CO5[K5]:** evaluate the optimality of solutions of optimization problems
20.	21UMAC54	Core Course - XII : Differential Equations and Laplace Transforms	**CO1[K2]:** explain the methods of solving ordinary and partial differential equations and the techniques of the Laplace transform **CO2[K3]:** solve the ordinary differential equations using various methods **CO3[K3]:** apply Laplace transform techniques to solve ordinary differentialequations **CO4[K4]:** analyze the method of solving simultaneous differential equations **CO5[K5]:** evaluate the complete integrals of partial differential equations of thefirst order
21.	21UMAO51	Major Elective Course - I : Numerical Methods	**CO1[K2]:** explain the methods of solving the problems in science numerically **CO2[K3]:** apply numerical methods to obtain approximate solutions of algebraic, transcendental and differential equations **CO3[K3]:** solve simultaneous linear algebraic equations using numericalmethods **CO4[K4]:** examine the method of interpolation to estimate the unknown data values when they are unequally spaced **CO5[K5]:** evaluate the eigen values and eigenvectors of a matrix

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22.	21UMAO52	Major Elective Course - I : Calculus of Finite Differences	**CO1[K2]:** explain the concepts of difference operators and their properties **CO2[K3]:** solve the linear difference equations and to find numerical solution ofordinary differential equations **CO3[K3]:** apply numerical techniques to compute numerical differentiation andintegration of given functions **CO4[K4]:** analyze the relations connecting the difference operators **CO5[K5]:** determine the method of interpolation to estimate the unknown datavalue between known data values when they are equally spaced
23.	21UMAO53	Major Elective Course - I : Probability Theory and Theory of Attributes	**CO1[K2]:** explain the basic concepts of probability and association of attributes **CO2[K3]:** calculate probability of various events using theory of probability **CO3[K3]:** calculate coefficient of association between attributes **CO4[K4]:** analyze the independence and association of attributes **CO5[K5]:** determine the consistency of attributes
24.	21UMAO54	Major Elective Course - II : Discrete Mathematics	**CO1[K2]:** explain the basic concepts related to functions, semigroups, monoids, recurrence relation and logic **CO2[K3]:** compute the inverse of functions and the composition of two or more functions **CO3[K3]:** solve the recurrence relations using the generating function **CO4[K4]:** analyze the axioms and properties of the algebraic structures semigroup and monoids

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			CO5[K5]: assess the truth values of statements with reference to propositional logic
25.	21UMAO55	Major Elective Course - II : Integral Transforms	**CO1[K2]:** explain the general form and properties of various integral transforms **CO2[K3]:** find the Fourier, Hilbert and Z-Transform of given functions **CO3[K3]:** solve the boundary value and initial value problems using the integral transforms **CO4[K4]:** analyze the properties of integral transforms **CO5[K5]:** determine the appropriate integral transform that simplifies the computational techniques considerably
26.	21UMAO56	Major Elective Course - II : Coding Theory	**CO1[K2]:** explain the fundamental concepts of coding theory, types of error andcontrol code techniques **CO2[K3]:** apply the concepts of perfect codes, hamming codes, extended codes and golay codes for error detection and correction **CO3[K3]:** compute a generator matrix, a parity check matrix and generator polynomial for various codes **CO4[K4]:** analyze the theoretical principles of source coding and the notion of various decoding techniques **CO5[K5]:** determine the basis for the linear code
SEMESTER- VI			
27.	21UMAC61	Core Course - XIII : Linear Algebra	**CO1[K2]:** explain the basic concepts and general theory of vector spaces, inner product spaces and matrices **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise

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			inthe context of linear algebra **CO3[K3]:** compute the inverse of a matrix using Cayley – Hamilton theorem and find eigen values and eigen vectors of a matrix **CO4[K4]:** analyze the properties of vectors in an inner product space **CO5[K5]:** determine the basis of a vector space
28.	21UMAC62	Core Course - XIV : Complex Analysis	**CO1[K2]:** explain the basic concepts and properties of functions of a complex variable **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise inthe context of complex analysis **CO3[K3]:** compute the value of the integral, residues and poles for complex valued functions **CO4[K4]:** analyse the properties of bilinear transformations and series expansion of analytic functions in the region of convergence **CO5[K5]:** determine the continuity, differentiability, analyticity of complex functions
29.	21UMAC63	Core Course - XV : Graph Theory	**CO1[K2]:** explain the basic concepts of graph theory **CO2[K3]:** apply the abstract concepts to produce proofs of results that arise inthe context of graph theory **CO3[K3]:** provide matrix representations, the chromatic index, chromatic polynomial of a graph and demonstrate various operations on graphs **CO4[K4]:** examine the characterizations of various graphs **CO5[K5]:** evaluate the realisation graph of a degree sequence and determinethe Eulerian / Hamiltonian graphs

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30.	21UMAC64	Core Course - XVI : Vector Calculus	**CO1[K2]:** explain the basic concepts of vector differentiation and vector integration **CO2[K3]:** compute the curl, divergence and line integral of vector valued functions **CO3[K3]:** calculate the curvature and torsion of the given curve **CO4[K4]:** analyze the properties of curl and divergence **CO5[K5]:** evaluate Green's, Gauss's Divergence and Stoke's theorem for the vector valued functions
31.	21UMAJ61	Core Course - XVII : Project	**CO1 [K2]**: express their views with apt illustrations and critical support **CO2 [K3]:** organize the views and format them into a research paper **CO3 [K4]:** analyze the views which take about various approaches to the definition terms **CO4 [K5]:** evaluate the findings of the study **CO5 [K6]:** compile the Documentation as per the latest Research Methodology
32.	21UMAO61	Major Elective Course - III : Resource Management Techniques	**CO1[K2]:** explain the basic concepts and solution procedure related to Transportation problem, Assignment problem, Sequencing problem and Inventory control problem **CO2[K3]:** solve the Transportation problem, Assignment problem andSequencing problem for optimum solution **CO3[K3]:** compute the optimum value of the various costs and factors that are

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			involved in inventory control **CO4[K4]:** analyze the different models of sequencing and inventory control problems **CO5[K5]:**evaluate the optimality of solutions of transportation and assignment problems
33.	21UMAO62	Major Elective Course - III : Project Network Techniques	**CO1[K2]:** explain the network techniques, network methods of project management and the various element of a network **CO2[K3]:** compute event times, activity times and floats for each activity of thenetwork **CO3[K3]:** apply the network rules to draw the network diagram of a project whose activities inter-relationships are stated **CO4[K4]:** analyse the kinds of time estimates in PERT system **CO5[K5]:** determine the critical path of the given network
34.	21UMAO63	Major Elective Course - III : Mathematical Programming Techniques	**CO1[K2]:** explain the techniques and the computational procedure for solving mathematical programming problems **CO2[K3]:** solve integer programming problems and non-linear programming problems by various methods **CO3[K3]:** apply dynamic programming and geometric programming approach to find solution of practical problems **CO4[K4]:** analyse the different methods of dynamic programming and geometric programming approach **CO5[K5]:** evaluate the optimality of solutions of integer programming problems and non-linear programming problems
35.	21UMAS6P	Skill Enhancement	**CO1[K2]:** explain the script, syntax, commands, functions in Octave

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		Course - VI: Practical – Computational Methods in Octave	programming **CO2[K3]:** apply the built – in math functions and extensive function libraries towrite syntax of octave programming **CO3[K3]:** solve linear and nonlinear problems numerically using octave programming **CO4[K4]:** analyze the matrix – based syntax and functions for matrix operationsin Octave programming **CO5[K5]:** assess the compatibility of syntax and functions in Octaveprogramming
36.	21UMAE61	Comprehensive Examination	**CO1[K1]:** identify the various tools in techniques in Mathematics **CO2[K2]**: interpret mathematical definitions and statements **CO3[K2]:** explain the mathematical facts and concepts **CO4[K3]:** articulate the mathematical problems and the methods of solving it **CO5[K4]:** examine the results of mathematical problems

Courses Offered to the Departments

S.No	Course Code	Course Name	Course Outcomes
		SEMESTER- I	
1.	21UPHA11/21UCHA11	Allied Course - I: Mathematics - I	**CO1[K2]:** express the relation between roots and coefficients of polynomial equations **CO2[K2]:** calculate the derivative, integral, Laplace transform of functions **CO3[K3]:** solve algebraic and transcendental equations numerically **CO4[K4]:** investigate homogeneous function and Euler's theorem **CO5[K5]:** determine the appropriate Fourier series expansion for functions
2.	21UCSA11/21UITA11 /21UCAA11	Allied Course-I: Mathematical Foundations	**CO1[K1]:** define the discrete objects in the context of mathematical structures for computer science and applications **CO2[K2]:** recognize the properties of set operations and types of functions **CO3[K3]:** calculate the rank, inverse matrix of a matrix **CO4[K4]:** analyze the truth values of statements with reference to propositional logic **CO5[K5]:** determine the appropriate algorithm to solve graph optimization problems

SEMESTER- II			
3.	21UPHA21/21UCHA21	Allied Course - II: Mathematics - II	**CO1[K2]:** indicate the binomial series representation of functions and the exponential series **CO2[K2]:** explain gradient of a scalar valued function, divergence and curl of a vector valued function and its properties, rank of a matrix **CO3[K3]:** compute inverse of a matrix using Cayley-Hamilton theorem, eigen values and eigen vectors of a square matrix **CO4[K4]:** appraise equivalent definitions of a group, properties of a group **CO5[K5]:** determine the mathematical function that has the best fit to a series of data points
4.	21UCSA21/21UITA21 /21UCAA21	Allied Course - II: Operations Research	**CO1[K1]:** state the scope, phases of operations Research and the classification of optimization models **CO2[K2]:** explain the computational algorithms for various optimization methods **CO3[K3]:** compute optimum solution of the linear programming, transportation, and assignment problems **CO4[K4]:** examine the solutions of the optimization problems **CO5[K6]:** formulate the mathematical expression of the linear programming model from the study of the situation and derive solutions to the problem
SEMESTER- III			

5.	21UCSA31	Allied Course - III: Numerical Methods For Scientific Computation	**CO1[K2]:** explain the methods of solving the problems in science numerically **CO2[K3]:** apply numerical methods to obtain approximate solutions of algebraic, transcendental and differential equations **CO3[K3]:** apply numerical techniques to compute numerical differentiation and integration of given functions **CO4[K4]:** analyze error arising in numerical computation of solutions to mathematical and applied problems **CO5[K5]:** determine the method of interpolation to estimate the unknown data value between known data values