PROGRAMME OUTCOMES AND COURSE OUTCOMES

PROGRAMME NAME: BSC MATHEMATICS

PROGRAMME OUTCOMES

PO 1	**Critical Thinking**
1.1	Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.
1.2	. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.
1.3	Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.
PO 2	**Effective Citizenship**
2.1	Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.
2.2	Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations
2.3	Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.
PO 3	**Effective Communication**
3.1	Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language
3.2	Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.
3.3	Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking.

PO 4	Interdisciplinarity
4.1	Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.
4.2	Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.
4.3	Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PROGRAMME SPECIFIC OUTCOMES

PSO 01	Understand the basic concepts and tools of Mathematical logic, Set theory, Number theory, Geometry, Calculus, Algebra, Abstract structures, Linear Algebra, Analysis, Laplace transforms, Fourier series, Graph theory, and Optimization and methods of proofs.
PSO 02	Model real world problems into Mathematical problems and find solutions and understand the application of Mathematics in other Sciences and Engineering.

COURSE OUTCOMES

CORE COURSE 1	SET THEORY, DIFFERENTIAL CALCULUS
CO 1	Understand Relations and Functions.
CO 2	Understand limit of a function, limit laws, continuity, Inverse functions and their derivatives.
CO 3	Understand successive differentiation and Leibnitz theorem.
CO 4	Understand functions of several variables, limit and continuity, partial derivatives, chain rule, homogenous functions and Euler's theorem on homogenous functions.
CO 5	Understand bisection method, Regula-falsi method and Newton Raphson method to solve algebraic and transcendental equations.
CORE COURSE 2	**INTEGRAL CALCULUS AND LOGIC**
CO 1	Understand Hyperbolic functions
CO 2	Understand Reduction formulae for trigonometric functions and evaluation of definite integrals
CO 3	Understand Polar coordinates
CO 4	Understand Double integrals in Cartesian and polar form.
CO 5	Understand triple integrals in rectangular, cylindrical and spherical co-ordinates
CO 6	Understand Substitution in multiple integrals
CO 7	Understand Numerical integration: Trapezoidal rule, Simpson's 1/3rd rule
CO 8	Understand Logic and methods of proofs

CO 9	Understand Propositional functions, truth set and Negation of quantified statements
CORE COURSE 3	**ANALYTIC GEOMETRY AND APPLICATIONS OF DERIVATIVES**
CO 1	Understand cartesian equation of conics, eccentricity, polar equations for a conic, lines, circles
CO 2	Understand Tangnts, Normals and Asymptotes
CO 3	Understand Curvature, Radius of curvature, Centre of Curvature, Circle of curvature and Evolutes of Cartesian and polar curves,
CO 4	Understand Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem and Taylors Theorem
CO 5	Understand extreme values of functions, monotonic functions, first derivative test, concavity and curve sketching
CO 6	Understand Indeterminate forms
CORE COURSE 4	**NUMBER THEORY AND APPLICATIONS OF INTEGRALS**
CO 1	Understand Division algorithm, Greatest common Divisor, Euclidean Algorithm, Diophantine equation ax+by =c.
CO 2	Understand Primes and their distribution, fundamental theorem of arithmetic, the sieve of Eratosthenes
CO 3	Understand Basic properties of congruence
CO 4	Understand Picard's little theorem, Wilson's theorem and Euler's theorem
CO 5	Understand Substitution and the area between curves, Arc length, Areas and length in polar co-ordinates
CO 6	Understand Volumes using cross sections, volumes using cylindrical shells and areas of surfaces of revolution
CORE COURSE 5	**SET THEORY, THEORY OF EQUATIONS AND COMPLEX NUMBERS**
CO 1	Understand finite and infinite sets, Countable and Uncountable sets, Cantor's theorem
CO 2	Understand Roots of equations, Relations connecting the roots and coefficients of an equation, Transformation of equations, The cubic equation, Character and position of roots of an equation.
CO 3	Understand Descarte's rule of signs, De Gua's Rule, Limits to the roots of an equation, Rational roots of equations, Newton's method of divisors, Symmetric functions of roots of an equation, Symmetric functions involving only the difference of the roots of f(x)=0, Equations whose roots are symmetric functions of α, β, γ.
CO 4	Understand Reciprocal equations.
CO 5	Understand Cubic equation, Equation whose roots are the squares of the difference of the roots, Character of the Roots, Cardan's Solution
CO 6	Understand Roots of complex numbers, General form of De Moivre's theorem, the nth roots of unity, the nth roots of -1, Factors of xn-1 and xn+1, the imaginary cube roots of unity.
CO 7	Understand polar form of complex numbers, powers and roots.

CORE COURSE 6	**REAL ANALYSIS I**
CO 1	Understand Algebraic Properties, Order Properties and Absolute values of $\mathbb{R}$. Understand the Completeness Property of $\mathbb{R}$ and its applications to derive Archimedean Property and Density theorem
CO 2	Understand intervals in the real line.
CO 3	Understand Sequences and their Limits, Limit Theorems, Monotone Sequences.
CO 4	Understand Subsequences and the Bolzano-Weierstrass Theorem, The Cauchy Criterion
CO 5	Understand Infinite Series, Absolute Convergence.
CO 6	Understand Comparison test, Root test, Ratio test, Integral test and Raabe's test for Absolute convergence.
CO 7	Understand Alternating series test, Dirichlet's test and Abel's test for Non Absolute convergence.
CO 8	Understand Continuous Functions, composition of continuous functions and continuous functions on intervals.
CORE COURSE 7	**ABSTRACT ALGEBRA**
CO 1	Understand definition and elementary properties of Groups, Subgroups and Cyclic groups
CO 2	Understand Groups of Permutations, orbits, Alternating groups and theorem of Lagrange
CO 3	Understand group homomorphisms, factor Groups
CO 4	Understand Fundamental Homomorphism Theorems
CO 5	Understand definition and properties of rings and fields
CO 6	Understand Ring homomorphisms and isomorphisms
CO 7	Understand zero divisors, integral domains, characteristic of a ring and their properties
CORE COURSE 8	**DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS**
CO 1	Understand Separable ODEs, Exact ODEs, Linear ODEs, Bernoulli equation and methods to solve these ODEs
CO 2	Understand the theorem of Existence and Uniqueness of solutions of first and second order ODEs
CO 3	Understand Homogeneous Linear ODEs of Second Order and solve homogeneous linear ODEs of second order with constant coefficients and Euler-Cauchy equation
CO 4	Understand Nonhomogeneous ODEs and solve by variation of parameters
CO 5	Understand Laplace Transform and inverse Laplace Transformation
CO 6	Understand The first and the second shifting theorems and their applications
CO 7	Understand the methods to find Laplace transforms of derivatives and integrals of functions
CO 8	Understand the method of differentiating and integrating Laplace transform
CO 9	Solve ordinary differential equations and integral equations using Laplace transform

CORE COURSE 9	**VECTOR CALCULUS**
CO 1	Understand lines and planes in space
CO 2	Understand curves in space, their tangents, normal, curvature, tangential and normal curvature of acceleration
CO 3	Understand Directional derivatives and gradient vectors, tangent planes and differentials. Solve extreme value problems using Lagrange multipliers
CO 4	Understand Partial derivatives with constrained variables and Taylor's formula for two variables
CO 5	Understand Line integrals. Solve for work, circulation and flux using line integrals
CO 6	Understand path independence conservative fields and potential functions
CO 7	Understand Green's theorem and solve problems using Green's theorem
CO 8	Understand Surface area and surface integrals
CO 9	Understand Stoke's theorem and solve problems using Stoke's theorem
CO 10	Understand Divergence theorem and solve problems using Divergence theorem
CORE COURSE 10	**REAL ANALYSIS II**
CO 1	Understand Uniform Continuity, Monotone and Inverse Functions
CO 2	Understand Riemann Integral and Riemann-integrable Functions
CO 3	Understand Fundamental Theorem of Calculus
CO 4	Understand Improper Integrals
CO 5	Understand Beta and Gamma Functions and their properties
CO 6	Understand Transformations of Gamma Function and Duplication formula
CO 7	Understand Pointwise and Uniform Convergence of sequence of functions and Interchange of Limits
CO 8	Understand Series of Functions
CO 9	Understand the concept of Metric Spaces
CORE COURSE 11	**COMPLEX ANALYSIS**
CO 1	Understand Analytic Function, Cauchy–Riemann Equations. Laplace's Equation
CO 2	Understand Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithmic functions and General Power of complex numbers
CO 3	Understand line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula and derivatives of analytic functions
CO 4	Understand convergence of Sequences and Series of complex functions
CO 5	Understand power series, functions given by power series, Taylor series, Maclaurin's Series and Laurent Series
CO 6	Understand singularities and zeros of complex functions
CO 7	Understand residue integration method and integrate real integrals

CORE COURSE 12	**NUMERICAL METHODS, FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS**
CO 1	Understand Interpolation techniques: Interpolation with unevenly spaced points, Lagrange interpolation, Newton's divided differences interpolation, Finite difference operators and finite differences, Newton's interpolation formulae and Central difference interpolation.
CO 2	Understand Numerical differentiation using difference formulae
CO 3	Understand Picard's method, Solution by Taylor series method, Euler method and Runge- Kutta methods.
CO 4	Understand Fourier Series: Arbitrary period, Even and Odd Functions, Half-Range Expansions and Fourier Integrals.
CO 5	Understand Partial Differential equations, Solution by Separating Variables.
CO 6	Understand the use of Fourier Series in solving PDE: D'Alembert's Solution of the Wave Equation. Characteristics and solving Heat Equation by Fourier Series.
CO 7	Understand Laplacian in Polar Coordinates
CORE COURSE 13	**LINEAR ALGEBRA**
CO 1	Understand the concept of Vector spaces, subspaces, linear combinations ad system of equations.
CO 2	Understand the concept of Linear Dependence and Linear Independence, Bases and Dimension, Maximal Linearly Independent Subsets and solves problems.
CO 3	Understand the concept of Linear Transformations, Null Spaces, and Ranges, The Matrix Representation of a Linear Transformation.
CO 4	Understand Rank of a matrix, Elementary transformations of a matrix, Invariance of rank through elementary transformations, Normal form, Elementary matrices.
CO 5	Understand the concept System of linear homogeneous equations Null space and nullity of matrix, Range of a matrix, Systems of linear non homogeneous equations.
CO 6	Understand Eigen values, Eigen vectors, Properties of Eigen values, Cayley-Hamilton theorem.
DISCIPLINE SPECIFIC ELECTIVE COURSE 2	**OPERATIONS RESEARCH**
CO 1	Understand convex sets, convex functions, their properties, local and global extrema and quadratic forms
CO 2	Understand LPP, formulate and solve using graphical method
CO 3	Understand General LPP, canonical and standard forms of LPP
CO 4	Understand simplex method and solve LPP
CO 5	Understand basic solution, degenerate solution, basic feasible solution, optimum basic feasible solution, fundamental properties of solution and simplex method

CO 6	Understand primal-dual pair, formulation of dual and duality theorems
CO 7	Understand LP formulation of transportation problem and its solution
CO 8	Understand Mathematical formulation of Assignment problem and Hungarian Assignment method
CO 9	Understand problem of sequencing, Processing ‘n’ jobs through ‘2’ machines, Processing ‘n’ jobs through ‘k’ machines
CO 10	Understand basic terms in Game theory, The Maximin-Minimax Principle, Solution of game with saddle point, Solution of 2x2 game without saddle point, Graphic solution of 2xn and mx2 games and Arithmetic method for nxn Games.
COMPLEMENTARY ELECTIVE COURSE I	**INTRODUCTION TO COMPUTERS AND PROGRAMMING**
CO 1	Familiarize with the hardware components of a digital computer
CO 2	Understand the basic idea of how data is represented in computers
CO 3	Familiarize with types of software
CO 4	Ability to design algorithmic solutions to problems
COMPLEMENTARY ELECTIVE COURSE I	**PROGRAMMING IN C**
CO 1	Understand the building blocks of C programming language
CO 2	Familiarize with program control structures in C
CO 3	Learn procedural programming using functions
CO 4	Understand user defined data types
COMPLEMENTARY ELECTIVE COURSE III	**WEB TECHNOLOGY WITH DATABASE MANAGEMENT SYSTEM**
CO 1	Develop skills to design a web page using HTML
CO 2	Understand HTML Forms and CSS Styling
CO 3	Develop skills to develop database and retrieve data using SQL
CO 4	Learn basics of server-side programming with PHP
COMPLEMENTARY ELECTIVE COURSE IV	**COMPUTATION USING PYTHON**
CO 1	Learn Python for expressing computation
CO 2	Familiarize with Familiarize with functions and modules in python
CO 3	Understand object-oriented programming concepts
CO 4	Learn the techniques for data visualization in python
COMPLEMENTARY ELECTIVE COURSE V	**LAB 1 – PROGRAMMING IN C, WEB PROGRAMMING AND PYTHON PROGRAMMING**
CO 1	Achieve skills to use C language for problem solving
CO 2	Understand SQL and basic web programming
CO 3	Achieve skills to use Python for problem solving

COMPLEMENTARY ELECTIVE COURSE I	**BASIC STATISTICS**
CO 1	understand the different types of data.
CO 2	compute various measures of central tendency, measures of variation
CO 3	analyse the relationship between two variables.
CO 4	acquire knowledge in time series data and compute various index numbers.
COMPLEMENTARY ELECTIVE COURSE II	**PROBABILITY THEORY AND RANDOM VARIABLES**
CO 1	evaluate the probability of events
CO 2	understand the concept of random variables with examples in real life
CO 3	calculate the probability distribution of discrete and continuous random variables
CO 4	understand the change of variable technique
COMPLEMENTARY ELECTIVE COURSE III	**PROBABILITY DISTRIBUTIONS**
CO 1	compute mathematical expectation of a random variable.
CO 2	familiarize with different discrete probability distribution associated with real life situations.
CO 3	understand the characteristics of different continuous distributions
CO 4	identify the appropriate probability model that can be used.
COMPLEMENTARY ELECTIVE COURSE IV	**STATISTICAL INFERENCE**
CO 1	understand the uses of Chebychev's Inequality and Central Limit Theorem
CO 2	apply various method of estimation
CO 3	understand the concept of testing statistical hypotheses and its importance in real life situation
CO 4	apply ANOVA