Programme Specific Outcome of B.Sc., Mathematics

- Think in a critical manner.
- Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
- Formulate and develop mathematical arguments in a logical manner.
- Acquire good knowledge and understanding in advanced areas of mathematics and statistics, chosen by the student from the given courses.
- Understand, formulate and use quantitative models arising in social science, business and other contexts.

Course Outcome of B. Sc. Mathematics

Course Outcome of Analytical Geometry 3D and Vector Calculus

Students will able to

- Describe the various forms of equation of a plane, straight line, Sphere, Cone and Cylinder.
- Find the angle between planes, Bisector planes, Perpendicular distance from a point to a plane, Image of a line on a plane, Intersection of two lines
- Define coplanar lines and illustrate
- Compute the angle between a line and a plane, length of perpendicular from a point to a line
- Define skew lines
- Calculate the Shortest distance between two skew lines
- Find and interpret the gradient curl, divergence for a function at a given point. • Interpret line, surface and volume integrals
- Evaluate integrals by using Green's Theorem, Stokes theorem, Gauss's Theorem

Course Outcome of Theory of Equation, Theory of Numbers and Inequalities

Students will able to

- Describe the relation between roots and coefficients
- Find the sum of the power of the roots of an equation using Newton's Method. • Transform the equation through roots multiplied by a given number, increase the roots, decrease the roots, removal of terms
- Solve the reciprocal equations.
- Analyse the location and describe the nature of the roots of an equation. • Obtain integral roots of an equation by using Newton's Method. • Compute a real root of an equation by Horner's method.
- Illustrate the Division and Euclidean Algorithm
- Describe the properties of prime numbers
- Show that every positive integer can be expressed as product of prime power in unique way
- Write a formula for the number of positive integers less than n that are relatively prime to n

• Define congruences and describe the properties of congruences • Find the Sum, product of all the divisiors of N.
• Find the smallest number with N divisors.
• Solve the system of linear congruences
• State Chinese Remainder Theorem, Fermat's and Wilson's theorem
• Prove that Arithmetic Mean > Geometric Mean
• Prove some simple inequalities by using AM>GM
• State and Prove Weirstrass, Schwartz's inequality.

Course Outcome of Complex Analysis

Students will able to
• Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers.
• Calculate exponentials and integral powers of complex numbers. • Write equation of straight line, circle in complex form
• Define reflection points, concyclic points, inverse points
• Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.
• Determine whether a given function is analytic.
• Define Bilinear transformation, cross ratio, fixed point.
• Write the bilinear transformation which maps real line to real line, unit circle to unit circle, real line to unit circle.
• Find parametrizations of curves, and compute complex line integrals directly. • Use Cauchy's integral theorem and formula to compute line integrals. • Represent functions as Taylor, power and Laurent series.
• Classify singularities and poles.
• Find residues and evaluate complex integrals, real integrals using the residue theorem.

Course Outcome of Modern Analysis

Students will able to
• Define countable, uncountable sets
• Write Holders and Minkowski inequality
• Define and recognize the concept of metric spaces, open sets, closed sets, limit points, interior point.
• Define and Illustrate the concept of completeness
• Determine the continuity of a function at a point and on a set.
• Differentiate the concept of continuity and uniform continuity
• Define connectedness
• Describe the connected subset of R.
• Define compactness
• Characterize the concept of compactness in metric space.
• Construct rigorous mathematical proofs of basic results in modern analysis

Course Outcome of Statics

Students will able to
• Define Resultant, Component of a Force, Coplanar forces, like and unlike parallel forces, Moment of a force and Couple with examples.

- Prove the Parallelogram of Forces, Triangle of Forces, Converse of the Triangle of Forces, Polygon of Forces, Lami's Theorem, Varignon's theorem of moments. • Find the resultant of coplanar couples, equilibrium of couples and the equation to the line of action of the resultant.
- Discuss Friction, Forces of Friction, Cone of Friction, Angle of Friction and Laws of friction.
- Define catenary and obtain the equation to the common catenary. • Find the tension at any point and discuss the geometrical properties of a catenary.

Course Outcome of Dynamics

Students will able to

- Define Projectile, impulse, impact and laws of impact.
- Prove that the path of a projectile is a parabola.
- Find the direct and oblique impact of smooth elastic spheres.
- Define Simple Hormonic Motion and find its Geometrical representation. • Find the Composition of Simple Hormonic Motion and the differential equation of a central orbit.
- Find the law of force if the orbit is given and vice versa.

Course Outcome of Linear Algebra

Students will able to

- Define Vector Space, Quotient space Direct sum, linear span and linear independence, basis and inner product.
- Discuss the linear transformations, rank, nullity.
- Find the characteristic equation, eigen values and eigen vectors of a matrix. • Prove Cayley- Hamilton theorem, Schwartz inequality, Gramschmidt orthogonalisation process.
- Solve the system of simultaneous linear equations.

Course Outcome of Numerical Analysis

Students will able to

- Define Basic concepts of operators Δ,E, ∇
- Find the difference of polynomial
- Solve problems using Newton forward formula and Newton backward formula. • Derive Gauss's formula and Stirling formula using Newton forward formula and Newton backward formula.
- Find maxima and minima for differencial difference equation
- Derive Simpson's 1/3 ,3/8 rules using trapezoidal rule
- Find the solution of the first order and second order equation with constant coefficient
- Find the summation of series finite difference techniques
- Find the solution of ordinary differential equation of first by Euler,Taylor and Runge-Kutta methods

Course Outcome of O.R.

Students will able to

- Define nature and feature of Operations Research
- Find the replacement period of equipment that fails suddenly/gradually • Define EOQ
- Find inventory decisions costs using deterministic inventory problems with no shortages /with shortages
- Find EOQ problems with price breaks
- Define CPM and PERT
- Define basic components of Network and find critical path

- Define queue charecteristics , transient and steady state
- Define Kendal notations solution of queue models (M/M/1):(∞/FIFO), (M/M/1):(N/FIFO)
- Define Two persons sum games ,maximin-minimax principle, saddle points. • Find graphical solution of 2×n and m×2 games
- Find general solution of m×n rectangular games

Course Outcome of Coding Theory

Students will able to

- Define basic assumption of binary codes , blocked codes .
- Define basic assumption of channel,symmetric codes ,information rate. • Define encoding ,decoding ,CMLD and ICMLD
- Define linear codes,subspaces,scalar product andorthogonal complement. • Define REF and RREF and parity check matrix and cosets.
- Define hamming bound and generator matrix
- Define BCH codes
- Define perfect , related codes and cyclic linear codes.

Course Outcome of Mathematical Statistics

Students will able to

- Define probability density function, probability distribution
- Derive mathematical expectation, binomial, poisson, normal distribution • Solve the problems of large samples and small samples
- Discuss the moment generating functions, chi-square distribution • Compute the analysis of variance, one way and two way classifications, Latin square design

Course Outcome of Sequence and Series

Students will able to

- Define different types of sequence.
- Discuss the behaviour of the geometric sequence.
- Prove properties of convergent and divergent sequence.
- Verify the given sequence in convergent and divergent by using behaviour of Monotonic sequence.
- Prove Cauchy's first limit theorem, Cesaro's theorem, Cauchy's Second limit theorem.
- Explain subsequences and upper and lower limits of a sequence. • Give examples for convergence, divergence and oscillating series. • Discuss the behaviour of the geometric series.
- Prove theorems on different test of convergence and divergence of a series of positive terms.
- Verify the given series is convergent or divergent by using different test.

Course Outcome of Differential equations and its applications

Students will able to

- Extract the solution of differential equations of the first order and of the first degree by variables separable, Homogeneous and Non-Homogeneous methods. • Find a solution of differential equations of the first order and of a degree higher than the first by using methods of solvable for p, x and y.
- Compute all the solutions of second and higher order linear differential equations with constant coefficients, linear equations with variable coefficients. • Solve simultaneous linear equations with constant coefficients and total differential equations.
- Form partial differential equations.
- Find the solution of First order partial differential equations for some standard types.

- Use inverse Laplace transform to return familiar functions
- Apply Laplace transform to solve second order linear differential equation and simultaneous linear differential equations.

Course Outcome of Graph Theory

Students will able to
- Describe the origin of Graph Theory.
- Illustrate different types of graph theory.
- Explain independent sets and covering sets and some basic theorems. • Discuss degree sequences and operations on graphs.
- Explain connectedness and components and some theorems.
- Characterize tree.
- Derive some properties of planarity and Euler's formula.
- Find chromatic number and chromatic polynomials for graphs. • Prove Five colour theorem.
- Explain basic properties of directed graphs.

Course Outcome of Integral Calculus and Fourier Series

Students will able to
- Solve Basic Integral Calculus problems.
- Explain properties of definite integrals.
- Prove reduction formulae and solve some problems by using this formulae. • Evaluate double and triple integrals.
- Apply change variable method to find the value of double and triple integral. • Explain properties of Beta functions.
- Derive relation between Beta and Gamma functions.
- Evaluate integrals by using Beta and Gamma functions.
- Find Fourier series expansions for given functions.
- Find Cosine and Sine series expansions for given functions.

Course Outcome of Differential Calculus and Trigonometry

Students will able to
- Find Maxima and minima of function of two variables.
- Explain subtangent and subnormal.
- Find angle of intersition of two curves.
- Find circle, radius and centre of curvature.
- Expand $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ by using Demoivre's theorem.
- Expand $\cos^n\theta$, $\sin^n\theta$ and $\tan^n\theta$ in terms of θ.
- Define hyperbolic functions.
- Define inverse hyperbolic functions.

Course Outcome of Linear Programming

Students will able to
- Define basic feasible solutions, Slack and Surplus variable.
- Explain simplex method.
- Demonstrate Big-M method

- Illustrate two phase method
- Prove dual of the dual is primal.
- Interpret dual simplex method.
- Define transportation problem.
- Find a basic feasible solution to the transportation problem by using North west corner rule, Vogel's approximation method.
- Apply Modi method to solve transportation problem.
- Illustrate Assignment problem and Travelling salesman problem.

Course Outcome of Fuzzy Algebra

Students will able to
- Define fuzzy sets, α-cuts, fuzzy complements.
- Discuss types of operations on fuzzy sets, t-norms, fuzzy arithmetic. • Explain extension principle of fuzzy sets, fuzzy numbers.
- Illustrate fuzzy relations, binary fuzzy relations, fuzzy equivalence relations. • State some applications of fuzzy sets.

Course Outcome of Ancillary mathematics I

Students will able to
- Define characteristic equation of matrices and illustrate.
- State Cayley Hamilton Theorem
- Compute inverse of a matrix using Cayley – Hamilton Theorem. • Find Eigen values and Eigen vectors of a given matrix.
- Solve equations of the first order but of higher degree solvable by dy/dx , y, x. • Compute complementary function and particular integral of the type e^{ax}, cos ax, sin ax.
- Derive expression for sinnθ, cosnθ and tannθ, $\sin^n\theta$, $\cos^n\theta$
- Expand sinθ, cosθ, tanθ in powers of θ
- Define hyperbolic and inverse hyperbolic functions

Course Outcome of Ancillary Mathematics –II

Students will able to
- Define Moments, Skewness and Kurtosis.
- Fit a straight line, Parabola for the given data.
- Calculate the correlation coefficient for the given data.
- Compute Rank correlation for the given data.
- Find intermediate values by using Newton's forward and backward formula and Lagrange's formula.
- Apply Laplace transform to solve differential equations
- Obtain Fourier series expansions for the given functions.
- Compute Cosine and Sine series expansions for the given functions.

Course Outcome of Statistics

Students will able to
- Define Moments Skewness and Kurtosis.
- Fit a straight line.
- Calculate the correlation coefficient for the given data.
- Compute Rank correlation for the given data.

• Define attributes, consistency of data, independence of data.
• Find index numbers for the given data.
• Define Probability, Conditional probability.
• Derive Baye's theorem.

Course Outcome of Modern Algebra

Students will able to
• Define subgroup, center, Normalizer of a subgroup.
• Find cycles and transpositions of a given permutations.
• Prove Lagrange's theorem ,Euler's theorem and Fermats theorem • Define cyclic groups .
• Prove a group has no proper subgroup if it is cyclic group of prime order. • Define normal subgroups , quotient groups and index of a subgroup. • Define homomorphism ,kernel ofa homomorphism,isomorphism. • Prove Cayley's theorem , the fundamental theorem of homomorphism for groups
• Define rings , zero divisors of a ring , integral domain , field and prove theorems

Faculty Member

1. **Dr. R.C. Kashyap**
2. **Dr. P. Kumar**
3. **Dr. V. Tomer**