DEPARTMENT OF MATHEMATICS

VISION

Our Guiding Principle :

Pure Mathematics is in its way the poetry of Logical Ideas – Albert Einstein

To discover the poetry of logical ideas and to understand the world and solve its problems.

MISSION

- To achieve excellence in Teaching and Research in Mathematics as an Under Graduate Department.
- To offer and administer a Curriculum
- Relevant to our Students
- To improve their employability
- To make our students solvers of scientific and socio-economic problems.
- To converge discipline / branches of knowledge in Science – Arts – Commerce, through study of Mathematics.
- Mathematics is the Queen of all Sciences and King of all Arts.

Mathematics is not about numbers, equations, computations or algorithms: It is about UNDERSTANDING – William Paul Thurston

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PROGRAM OUTCOME OF MATHEMATICS

Each graduate in mathematics should be able to demonstrate fundamental systematic knowledge of mathematics and its applications in engineering, science, technology and mathematical sciences. It should also enhance the subject specific knowledge and help in creating jobs in various sectors.

PO-1: DISCIPLINARY KNOWLEDGE:

Capability of demonstrating comprehensive knowledge of mathematics and understanding of one or more disciplines which form a part of an undergraduate program me of study. This also leads to study of related areas like computer science and statistics. Thus, this programme helps learners in building a solid foundation for higher studies in mathematics.

PO-2: COMMUNICATIONS SKILLS:

i. Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.
ii. Ability to use mathematics as a precise language of communication in other branches of human knowledge.
iii. Ability to communicate long standing unsolved problems in mathematics.
iv. Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.
v. Ability to explain the development of mathematics in the civilizational context and its role as queen of all sciences.
vi. Demonstrate educational skills in areas of analysis, geometry, algebra, mechanics, differential equations etc.

PO-3: CRITICAL THINKING AND ANALYTICAL REASONING:

i. Ability to employ critical thinking in understanding the concepts in every area of mathematics.
ii. Ability to analyze the results and apply them in various problems appearing in different branches of mathematics.
iii. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modelling and solving real life problems.

PO-4: PROBLEM SOLVING:

i. Capability to solve problems in computer graphics using concepts of linear algebra.

ii. Capability to solve various models such as growth and decay models, radioactive decay model, drug assimilation, LCR circuits and population models using techniques of differential equations.

iii. Ability to solve linear system of equations, linear programming problems and network flow problems. Ability to provide new solutions using the domain knowledge of Mathematics acquired during this program.

iv. Apply knowledge, understanding and skills to identify the difficult/unsolved problems in mathematics and to collect the required information in possible range of sources and try to analyses and evaluate these problems using appropriate methodologies.

PO-5: RESEARCH-RELATED SKILLS:

i. Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics.

ii. To know about the advances in various branches of mathematics.

iii. Fulfil one's learning requirements in mathematics, drawing from a range of contemporary research works and their applications in diverse areas of mathematical sciences

PO-6: INFORMATION/DIGITAL LITERACY:

i. Capability to use appropriate software to solve system of equations and differential equations.

ii. Capability to understand and apply the programming concepts of C++ to mathematical investigations and problem solving.

PO-7: Self-directed learning:

Ability to work independently and do in-depth study of various notions of mathematics. Apply one's disciplinary knowledge and skills in mathematics in newer domains and uncharted areas. Identify challenging problems in mathematics and obtain well-defined solutions.

PO-8: Moral and ethical awareness/reasoning:

Ability to identify unethical behaviour such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects.

PO-9: Lifelong learning:

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning. exhibit subject-specific transferable

knowledge in mathematics relevant to job trends and employment opportunities. The skills and knowledge gained has intrinsic beauty, which also leads to proficiency in analytical reasoning. This can be utilized in modelling and solving real life problems.

PROGRAMME SPECIFIC OUTCOME

After successful completion of three-year degree program in Mathematics a student should be able to:

PSO-1: Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others.

PSO-2: This helps them to learn behave responsibly in a rapidly changing interdependent society. Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. They also share ideas and insights while seeking and benefitting from knowledge and insight of others. This helps them to learn behave responsibly in a rapidly changing interdependent society.

PSO-3: Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.

PSO-4: Completion of this programme will also enable the learners to join teaching profession in primary and secondary schools.

PSO-5: This programme will also help students to enhance their employability for government jobs, jobs in banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

COURSE OUTCOME MATHEMATICS HONOURS

PAPER (CC-I): CALCULUS
CO-1:
- ❖ After completing the course, students are expected to be able to use Leibnitz's rule to evaluate derivatives of higher order.

CO-2:
- ❖ Learn the geometry of various types of functions its curvature and asymptotes & able to trace curve of cartesian curve, polar curve.

CO-3:
- ❖ Evaluate the area, volume using the techniques of integrations and gain details about conic and how to sketch conic.

CO-4:
- ❖ Able to identify the difference between scalar and vector, acquired knowledge on some the basic properties of vector functions and its limit, Continuity and derivative.

PAPER (CC-II): ALGEBRA-I
CO-1:
- ❖ Introduction to complex analysis. Understand the importance of roots of real and complex polynomials and learn various methods of obtaining roots. Employ De Moivre's theorem in a number of applications to solve numerical problems

CO-2:
- ❖ Familiarize with relations, equivalence relations and partitions.
- ❖ Gain knowledge about integer, divisibility, Congruence, Prime.

CO-3:
- ❖ Recognize consistent and inconsistent systems of linear equations by the row echelonform of the augmented matrix.
- ❖ Learn basic about vector space, Linear Independence & Dependence and Rank & Linear Transformation of Vector Space.

CO-4:
- ❖ Find eigenvalues and corresponding eigenvectors for a square matrix. Rank nullity of Matrix and its properties

PAPER (CC-III): REAL ANALYSIS -I

This course will enable the students to:

CO-1:

❖ Comprehend rigorous arguments developing the theory underpinning real analysis.

❖ Understand many properties of the real line ... and learn to define sequence in terms of functions from ... to a subset of $\mathbb{R}$.

CO-2:

❖ Learn Countability of set and Interval in $\mathbb{R}$. Density and Archimedean property of Field.

CO-3:

❖ Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.

CO-4:

❖ Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

PAPER (CC-IV): ORDINARY DIFFERENTIAL EQUATION

The course will enable the students to:

CO-1:

❖ Understand the genesis of ordinary differential equations and its types, order & degree & formulation of ODE.

❖ Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

CO-2:

❖ Learn how to handle linear differential equation with constant coefficient and variable coefficient & know how to solve series solution of special function.

CO-3:

❖ Learn to handle power series solution of second order ODE.

CO-4:

❖ Learn the Laplace Transformation, its properties and inverse of Laplace Form.

PAPER (CC-V): REAL ANALYSIS-II
CO-1:
  ❖ Understand limits and their use in sequences, series. Continuity & Discontinuity of function and their properties & theorem based on limit.
  CO-2:
  ❖ Student will be to understand Differentiation and Fundamental Theorem in Differentiation and various rules.
CO-3:
  ❖ Geometrical representation and problem solving on MVT, Rolls theorem, Cauchy theorem.
  CO-4:
  ❖ Expansion of a function using Taylor series and Mac-Laurine Series.
  ❖ Finding extreme values of function of one variable.

PAPER (CC-VI): ALGEBRA-II (GROUP THEORY)
CO-1:

  ❖ Recognize the Mathematical objects called groups.
  ❖ Link the fundamental concepts of groups and symmetries of geometrical objects.
  ❖ Generate Groups Using Given Specific Conditions, Order Of Group, Order Of Elements In Group & Different Properties Of Group.
  ❖ Learn About Subgroup And Test Of Subgroup, Centre And Centralizer Of Group.
CO-2:
  ❖ Learn About Special Types Of Groups Such As Abelian Group, Cyclic Group Symmetry Group, Permutation Groups.
CO-3:

  ❖ Explain the significance of the notions of cosets, normal subgroups, and factor groups.
  ❖ Analyze consequences of Lagrange's theorem. Learn about structure preserving maps between groups and their consequences.
CO-4:
  ❖ Detail Study on Group Homomorphism & Group Isomorphism.

PAPER (CC-VII): PARTIAL DIFFERENTIAL EQUATION

CO-1:
- ❖ Learn about basic of PDE and its Order & Degree. Procedure to formulate PDE and its working rules to solve the PDE using Paffian methods.

CO-2:
- ❖ Student will be able to learn more courses non-linear partial differential equations of first order.

CO-3:
- ❖ Learn to solve linear PDE with constant coefficient (reducible/irreducible) and both homogeneous and non-homogeneous category.

CO-4:
- ❖ Learn to solve $Rr + Ss + Tt = V$ type PDE by using Monge's Method and Laplace Equation.

PAPER (CC-VIII): NUMERICAL ANALYSIS

This course will enable the students to:

CO-1:

- ❖ Learn about number system, Different types of error & Floating point representation.
- ❖ Obtain numerical solutions of algebraic and transcendental equations.

CO-2:

- ❖ Find numerical solutions of system of linear equations and check the accuracy of the solutions.

CO-3:

- ❖ Learn about various interpolating and extrapolating methods.

CO-4:

- ❖ Learn about numerical integration using newton cotes rules for different number of nodes.
- ❖ Solve initial and boundary value problems in differential equations using numerical methods.
- ❖ Apply various numerical methods in real life problems.

PAPER (CC-IX): REAL ANALYSIS -III

CO-1:
❖ Learn about Riemann Integration, its Properties & Fundamental theorem of calculus.

CO-2:
❖ Learn what is improper integral, its types and how to handle it. What is the relation between converge and improper integral and convergence of beta & gamma function?

CO-3:
❖ Gain knowledge about uniform continuity & uniform converge and relation between them and how to test UC of function.

CO-4:
❖ Detail study of power series and its radius of convergence, Abel's summation formula.

PAPER (CC-X): ALGEBRA -III (RING THEORY AND LINEAR ALGEBRA)

CO-1:
  ❖ Know the fundamental concepts in ring theory such as the concepts of ideals, quotientrings, integral domains, and fields.
  ❖ Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

CO-2:
  ❖ Learn about Ring Homomorphism and integral Domain.

CO-3:
  ❖ Understand The Concepts Of Vector Spaces, Subspaces, Bases, Dimension And TheirProperties.
  ❖ Recognize Consistent And Inconsistent Systems Of Linear Equations By The Row EchelonForm Of The Augmented Matrix, Using Rank.
  ❖ Find Eigenvalues and Corresponding Eigenvectors for A Square Matrix.

CO-4:
  ❖ Relate Matrices and Linear Transformations, Compute Eigen Values and Eigen Vectors of LinearTransformations.
  ❖ Learn Properties Of Inner Product Spaces And Determine Orthogonality In Inner ProductSpaces.
  ❖ Realize Importance of Adjoint of a Linear Transformation And Its Canonical Form.

PAPER CC-XI: CALCULUS-III (MULTIVARIATE CALCULUS)

This Course Will Enable the Students to:

CO-1:
- ❖ Learn Conceptual Variations While Advancing From One Variable To Several Variables In Calculus.
- ❖ Limit , Continuity And Partial Differentiation Of Function Of Two Or More Variable.

CO-2:
- ❖ Extreme Value $f(x, y, z)$ Using subsidiary condition and Lagrange Multiplier Method.

CO-3:
- ❖ Learn about multiple integral, Inter-Relationship Amongst The Line Integral, Double And Triple Integral Formulations.

CO-4:
- ❖ Introduction To Vector Function and Vector Calculus Such as Directional Derivative, Grad, Divergence, Curl and Limit, Continuity, Derivative and Integration
- ❖ Realize Importance of Green, Gauss and Stokes' Theorems in Other Branches of Mathematics.
- ❖ Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

PAPER (CC-XII): C^{++}-PROGRAMMING

This course will enable the students to:

CO-1:
- ❖ Understand and apply the structured programming concepts of C++ which is important for mathematical investigation and problem solving.

CO-2:
- ❖ Use different library functions for computational objectives also operators and expressions.
- ❖ Represent the outputs of programs visually in terms of well formatted text and plots.

CO-3:
- ❖ Concept of control statements and looping and its application in programs.

CO-4:
- ❖ Learn to write programs using of functions , arrays, pointer variables.

PAPER (CC-XIII): COMPLEX ANALYSIS

This course will enable the students to:

CO-1:

❖ Details study of topology of metric space and behavior of sequence in a metric as well as complete metric space.

CO-2:

❖ Visualize complex numbers as points of $\mathbb{R}^2$ and stereographic projection of complex plane on the Riemann sphere.

❖ Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy-Riemann equations.

CO-3:

❖ Learn the role of Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals.

CO-4:

❖ Apply Liouville's theorem in fundamental theorem of algebra.

❖ Understand the convergence, term by term integration and differentiation of a power series.

❖ Learn Taylor and Laurent series expansions of analytic functions,

PAPER (CC-XIV): LINEAR PROGRAMMING

This course will enable the students to:

CO-1:

❖ Analyze and solve linear programming models of real-life situations.

❖ Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.

❖ Understand the theory of the simplex method.

CO-2:

❖ Know about the relationships between the primal and dual problems, and to understand sensitivity analysis.

CO-3:

❖ Learn about the applications to transportation problem.

CO-4:

❖ Learn about the applications to Assignment problem.

PAPER (DSE-I): NUMBER THEORY

This course will enable the students to:

CO-1:

- ❖ Learn about some important results in the theory of numbers including the prime number theorem.
- ❖ Learn about number theoretic functions, modular arithmetic and their applications.
- ❖ Familiarize with modular arithmetic and find primitive roots of prime and composite numbers.

CO-2:
- ❖ Know about open problems in number theory, namely, the Goldbach conjecture and twin-prime conjecture.

CO-3:
- ❖ Study congruence and Chinese remainder theorem.

CO-4:
- ❖ Wilson's theorem and their consequences and Euler's Function and its application.
- ❖ Apply public crypto systems, in particular, RSA.

PAPER (DSE-II): DISCRETE MATHEMATICS

This course will enable the students to:

CO-1:

- ❖ Learn about different methods of proof, predicates and quantifiers.
- ❖ Basic counting principle and permutations and combinations.

CO-2:

- ❖ Concept of recurrence relations, generating function and its solution using recurrence relation.

CO-3:

- ❖ Understand Boolean algebra and Boolean functions, logic gates, their applications.
- ❖ Concept of binary and n-ary relations, partially ordered sets, lattices and their types.

CO-4:

- ❖ Assimilate various graph theoretic concepts and familiarize with their applications.

PAPER (DSE-III): DIFFERENTIAL GEOMETRY

This course will enable the students to:

CO-1:

- ❖ Explain the basic concepts of tensors.
- ❖ Understand role of tensors in differential geometry.
- ❖ Learn various properties of curves including Frenet-Serret formulae and their applications.

CO-2:

- ❖ Study about osculating circle and sphere, Evolutes and Involutes of Curve.

CO-3:
- ❖ Know the Interpretation of the curvature developable associated with space curves and curves on surface, Minimal surface.

CO-4:
- ❖ Understand the role of Gauss's Theorem Egregious and its consequences.
- ❖ Apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

DSE -4: (PROJECT):

- ❖ It's an initial stage of learning advanced cum research related topics of pure and applied mathematics.
- ❖ It helps to learn prepare ppt, poster.
- ❖ Students learn how to write Introduction, Abstract, Review, Bibliography of a project.
- ❖ Students learn how to solve research problem.

GENERIC ELECTIVE (I AND III): CALCULUS, MULTIVARIATE CALCULUS AND ODE

CO-1:
- ❖ Learn the geometry of various types of functions its curvature and asymptotes.
- ❖ Evaluate the area, volume using the techniques of integrations.

CO-2:
- ❖ Learn Conceptual Variations While Advancing from One Variable to Several Variables in Calculus.
- ❖ Limit, Continuity and Partial Differentiation of Function of Two Or More Variable.

CO-3:
- ❖ Understand the genesis of ordinary differential equations and its types, order & degree & formulation of ODE.
- ❖ Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.

CO-4:
- ❖ Learn how to handle linear differential equation with constant coefficient.

GENERIC ELECTIVE (IIAND IV): (GROUP ALGEBRA AND LINEAR ALGEBRA)

CO-1:
- ❖ Recognize the Mathematical objects called groups.
- ❖ Link the fundamental concepts of groups and symmetries of geometrical objects.
- ❖ Generate Groups using given specific conditions, Order of Group, Order of Elements in Group & Different Properties of Group.
- ❖ Learn About Subgroup and Test of Subgroup, Centre and Centralizer of Group.

CO-2:
- ❖ Learn About Special Types of Groups Such as Abelian Group, Cyclic Group Symmetry Group, Permutation Groups.

CO-3:
- ❖ Understand the Concepts of Vector Spaces, Subspaces, Bases, Dimension and TheirProperties.
- ❖ Recognize Consistent and Inconsistent Systems of Linear Equations by the Row EchelonForm of the Augmented Matrix, Using Rank.
- ❖ Find Eigenvalues and Corresponding Eigenvectors for A Square Matrix.

CO-4:
- ❖ Relate Matrices and Linear Transformations, Compute Eigen Values and Eigen Vectors of Transformations