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COURSES OBJECTIVES AND OUTCOMES

Class: B. Sc. III (Major Physics, Chemistry & Mathematics)

Subject: **Mathematics** Course Type: **DISCIPLINE SPECIFIC ELECTIVE**

Paper Code: **MATH301TH** Title of Paper: **Matrices** Credits: **6**

Course Learning Objective

- Work with matrices and determine if a given square matrix is invertible.
- To represent real-life data in a matrix.
- Learn to solve systems of linear equations and application problems requiring them.
- Applications of Matrices in Physics, Chemistry, life Sciences, Engineering etc.
- Learn to compute determinants and know their properties.
- Learn to find and use eigenvalues and eigenvectors of a matrix.
- Learn about and work with vector spaces and subspaces.

Course Learning Outcomes

After the completion of the course, Students will be able to:

- Find the inverse of a square matrix.
- Solve the matrix equation Ax = b using row operations and matrix operations.
- Apply matrices to solve the problems of Physics, Chemistry, life Sciences, Engineering etc.
- Find the determinant of a product of square matrices, of the transpose of a square matrix, and of the inverse of an invertible matrix

- Find the characteristic equation, eigenvalues and corresponding eigenvectors of a given matrix.
- Determine if a given matrix is diagonalizable.

Class: B. Sc. II (Major Mathematics)

Subject: **Mathematics** Course Type: **Skill Enhancement Course**

Paper Code: **MATH301TH** Title of Paper: **Integral Calculus** Credits: **4**

Course Learning Objective

The main objective of this course is to introduce:

- The different methods to find the indefinite and definite and integrals of different types of functions such as integration by parts, trigonometric substitutions, completing the square, partial fractions.
- Application of integrations: Area of a region under a graph of a continuous function, arc length, volume of a solid of revolution, surface area.
- Double and triple integrals

Course Learning Outcomes

After the completion of the course, Students will be able to:

- Demonstrate the ability to integrate knowledge and ideas of definite and indefinite integrals in a coherent and meaningful manner and use appropriate techniques for solving such problems.
- To Calculate the areas of curved regions by using integration methods
- To Find the volume of a solid of revolution using various methods
- To Compare different integration methods for determining volume
- To Calculate the arc length of a curve and the surface area of a solid of revolution
- To evaluate double and triple integrals.
- Apply change variable method to find the value of double and triple integral.

Class: M. Sc. Mathematics 3rd Semester

Subject: Mathematics

Paper Code: **M303** Title of Paper: **Analytic Number Theory**

Course Learning Objectives

The main objectives of the course are to help students develop an understanding of :

- Arithmetic functions and their utility in the analytic theory of numbers including the distribution of primes.
- The use of generating functions as an essential tool in understanding a variety of combinatorial phenomena that arise in the additive theory of numbers and elsewhere.
- The relationship between combinatorial and analytic aspects of the theory of numbers
- Apply the Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.
- To understand the function τ and σ, the Mobius inversion formula, the Greatest Integer Function. and its Application to the Calendar.
- How to apply these concepts and techniques in various applications such as Application to the Calendar.

Course Learning Outcomes: On successful completion of this course, the student will be able to:

- Understand the divisibility theory in the Integers, the Fundamental Theorem of Arithmetic, the Sieve of Eratosthenes and the Goldbach Conjecture.
- Study the theory of congruences and basic properties of congruences.
- Analyse Fermat's Theorem, Fermat's Factorization Method, the Little Theorem and the Wilson's Theorem.
- Acquire knowledge of the Theoretic Functions: The function τ and σ, the Mobius inversion formula, the Greatest Integer Function and its Application to the Calendar.
- Attain mastery to solve problems using Euler's Phi Function, Euler's Theorem, some properties of Phi Function and their applications to Cryptography.
- Understand the primitive roots, the Quadratic Reciprocity Law and Theory of Indices.

- Study in detail the Quadratic Congruences with composite moduli.

Class: M. Sc. Mathematics 2nd Semester

Subject: Mathematics

Paper Code: **M203** Title of Paper: **Partial Differential Equations**

Course Learning Objectives

- Introduce students to how to solve linear Partial Differential with different methods.
- To learn how to classify the partial differential equations.
- Student will gain a clear intuitive understanding of the concept of partial differential equation and its relevance to describing physical phenomena such as diffusion and wave propagation.
- To derive Laplace, heat and wave equations in one dimension and two dimensions.
- 4. Find the solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.
- Students will learn the separation of variables method to solve linear parabolic, elliptic and hyperbolic partial differential equations

Course Learning Outcomes

After the completion of the course, students will be able to

- Understand the Basic concepts related to partial Differential equations of first order and various methods to solve these equations.
- Understand the classification of second order partial differential equations, their canonical forms and concept of adjoint operators.
- Derivation of Laplace equation/Poisson equation/ heat equation/wave equations from basic concepts and their basic properties.
- Solve the Laplace equation (elliptic equation), Heat equation (Parabolic equation) and Wave equation (hyperbolic equation) by variable separable method and solve some boundary value problems by some standard methods.

- Derive the Laplace, Heat and Wave Equations in various coordinate systems and solve them.
- Learn the use of theory and solutions/tools in solving the dynamical problems arising in engineering and physical sciences.

Class: M. Sc. Mathematics 2nd Semester

Subject: Mathematics

Paper Code: **M204** Title of Paper: **Classical Mechanics**

Course Learning Objectives

This Course Enables the Students:

- To distinguish between 'inertia frame of reference' and 'non-inertial frame of reference'
- To know how to impose constraints on a system in order to simplify the methods to be used in solving physics problems
- To know what central, conservative and central-conservative forces mathematically understand the conservative theorems of energy, linear momentum and angular Momentum.
- To know the importance of concepts such as generalized coordinates and constrained motion
- To establish that Kepler's laws are just consequences Newton's laws of gravitation and that of motion
- To understand Poisson brackets, understand canonical transformations
- To develop an understanding of Lagrangian and Hamiltonian formulation which allow for simplified treatments of many complex problems in classical mechanics and provides the the foundation for the modern understanding of dynamics.

Course Learning Outcomes:

After the successful completion of this course, it is expected that a student will be able to

- State and derive the conservation principle involving momentum, angular momentum and energy as well as understand that they follow the fundamental equation of motion.

- Learn about the generalized coordinates, Lagrangian, Hamiltonian and Hamilton-Jacobi's formulation of Classical mechanics and develop their understanding about equivalence of these formulations with the Newton's Law of motion.
- Derive and use the Lagrange's, Hamilton's and Hamilton-Jacobi's equation of motion for finding the solution of a dynamical problem.
- Derive the Hamilton's principle and the principle of least action by applying the concept of variational calculus.
- Developed the knowledge of modern mechanics like Hamiltonian formulations of classical mechanics and their applications in appropriate physical problems.
- To apply Legendre transformations and the Hamilton's equations of motion, cyclic coordinates and Conservation Theorems, Hamilton's equations from Hamilton's principle, the principle of least action.
- To learn Canonical transformations with examples of harmonic oscillator, Poisson's brackets, Equations of motion and conservation theorems in the Poisson Bracket formulation. Hamilton-Jacobi (HJ) theory