# Course Outcomes

## Mathematics

## FIRST YEAR / SEMESTER I
## Paper 1: Differential Equations

Students will be able to:

**CO1.** Distinguish between linear, nonlinear, partial and ordinary differential equations.

**CO2.** States the basic existence theorem for 1st order ODE's and use the theorem to determine a solution interval and Recognize and solve a variable separable, homogenous, an exact differential equations.

**CO3.** Recognize and solve a linear differential equation by use of an integrating factor and solve equations of Bernoulli, Ricatti and Clairaut.

**CO4.** Make a change of variables to reduce a differential equation to a known form.

**CO5.** Find particular solutions to initial value problems and Solve basic application problems described by first order differential equations.

**CO6.** Use the existence theorem for boundary value problems to determine uniqueness of solutions and the Wronskian to determine if a set of functions is linearly independent.

**CO7.** Build solutions to differential equations by superposition of known solutions.

**CO8.** Find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.

**CO9.** Construct a second solution to a second order differential equation by reduction of order

**CO10.** Find the complete solution of a homogeneous differential equation with constant coefficients by examining the characteristic equation and its roots and a non-homogeneous differential equation with constant coefficients by the method of undetermined coefficients.

**CO11.** Write a differential equation with constant coefficients in operator form and find the complete solution by using an annihilator operator.

**CO12.** Find the complete solution of a differential equation with constant coefficients by variation of parameters.

**CO13.** Solve basic application problems described by second order linear differential equations with constant coefficients and a Cauchy-Euler Equation.

## FIRST YEAR / SEMESTER II
## Paper 2: Solid Geometry

Students will be able to:

**CO1.** Understand geometrical terminology for angles, triangles, quadrilaterals and circles

**CO2.** Measure angles using a protractor

**CO3.** Use geometrical results to determine unknown angles recognize line and rotational symmetries

**CO4.** Find the areas of triangles, quadrilaterals and circles and shapes based on these.

**CO5.** Geometry helps students to develop their inductive and deductive reasoning skills and to apply these skills in the advanced study of geometric relationships.

**CO6.** In this course students will explore the basic concepts and methods of Euclidean Geometry while deepening their understanding about plane and solid geometry.

**CO7.** Course topics include reasoning and proof, line and angle relationships, two and three-dimensional figures, coordinate plane geometry, geometric transformations, surface area and volume. Core processes include reasoning, problem solving and communication. Successful completion of this course will earn the student a high school credit and will prepare them for Algebra.

## SECOND YEAR / SEMESTER III
## Paper 3: Abstract Algebra

The students who succeeded in this course

**CO1.** Will be able to define algebraic structures.

**CO2.** Will be able to construct substructures.

**CO3.** Will be able to analyze a given structure in detail.

**CO4.** Will be able to develop new structures based on given structures.

**CO5.** Will be able to compare structures.

## SECOND YEAR / SEMESTER IV
## Paper 4: Real Analysis

The student will be:

**CO1.** Apply mathematical concepts and principles to perform numerical and symbolic computations.

**CO2.** Use technology appropriately to investigate and solve mathematical and statistical problems.

**CO3.** Write clear and precise proofs.

**CO4.** Communicate effectively in both written and oral form.

**CO5.** Demonstrate the ability to read and learn mathematics and/or statistics independently

## THIRD YEAR / SEMESTER V
## Paper 5: Ring Theory and Vector Calculus

The student will be compute and analyze:

**CO1.** Scalar and cross product of vectors in 2 and 3 dimensions represented as differential forms or tensors,

**CO2.** The vector-valued functions of a real variable and their curves and in turn the geometry of

such curves including curvature, torsion and the Frenet-Serre frame and intrinsic geometry, Scalar and vector valued functions of 2 and 3 variables and surfaces, and in turn the geometry of surfaces,

**CO3.** Gradient vector fields and constructing potentials,

**CO4.** Integral curves of vector fields and solving differential equations to find such curves,

**CO6.** The differential ideas of divergence, curl, and the Laplacian along with their physical interpretations, using differential forms or tensors to represent derivative operations,

**CO6.** The integral ideas of the functions defined including line, surface and volume integrals - both derivation and calculation in rectangular, cylindrical and spherical coordinate systems and understand the proofs of each instance of the fundamental theorem of calculus, and

**CO7.** Examples of the fundamental theorem of calculus and see their relation to the fundamental theorems of calculus in calculus 1, leading to the more generalized version of Stokes' theorem in the setting of differential forms.

## THIRD YEAR / SEMESTER V

## Paper 5: Linear Algebra

**CO1.** Apply mathematical methods involving arithmetic, algebra, geometry, and graphs to solve problems.

**CO2.** Represent mathematical information and communicate mathematical reasoning symbolically and verbally

**CO3.** Interpret and analyze numerical data, mathematical concepts, and identify patterns to formulate and validate reasoning.

**CO4.** Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces,

**CO5.** Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism,

**CO6.** Compute with the characteristic polynomial, eigenvectors, Eigen values and Eigen spaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result,

**CO7.** Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt Orthogonalization, and

**CO8.** Identify self-ad joint transformations and apply the spectral theorem and orthogonal decomposition of inner product spaces, the Jordan canonical form to solving systems of ordinary differential equations.

## Paper 6: Laplace Transforms

Students will be able to:

**CO1.** Find the Laplace transform of a function by definition and by use of a table.

**CO2.** Find the inverse Laplace transform of a function.

**CO3.** Write piecewise functions using the unit step function.

**CO4.** Find transforms using the first and second translation theorems.

**CO5.** Find the convolution of two functions and the transform of a convolution.

**CO6.** Find the transforms of derivatives and integrals.

**CO7.** Find the transform of a periodic function.

**CO8.** Solve a basic integro-differential equation using the Laplace transform.

**CO9.** Solve linear differential equations with constant coefficients and unit step input functions using the Laplace transform

## THIRD YEAR / SEMESTER VI
## Cluster Paper 7: Integral Transforms

**CO1.** On successful completion of the course, students will be able to recognize the different methods of finding Laplace transforms and Fourier transforms of different functions.

**CO2.** They apply the knowledge of L.T, F.T, and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems.

## THIRD YEAR / SEMESTER VI
## Cluster Paper 8: Advanced Numerical Analysis

Student will be able to:

**CO1.** Understands the nature and operations of Numerical Analysis, demonstrates familiarity with theories and concepts used in Numerical Analysis, and identifies the steps required to carry out a piece of research on a topic in Numerical Analysis

**CO2.** Expected to recognize and apply appropriate theories, principles and concepts relevant to Numerical Analysis, critically assess and evaluate the literature within the field of Numerical Analysis, analyze and interpret information from a variety of sources relevant to Numerical Analysis

**CO3.** The ability to compare the computational methods for advantages and drawbacks, choose the suitable computational method among several existing methods, implement the computational methods using any of existing programming languages, testing such methods and compare between them, identify the suitable computational technique for a specific type of problems, and develop the computational method that is suitable for the underlying problem.

**CO4.** Compare the viability of different approaches to the numerical solution of problems arising in roots of solution of non-linear equations, interpolation and approximation; numerical differentiation and integration, solution of linear systems.