DEPARTMENT OF MATHEMATICS

A. PROGRAMME OUTCOMES (PO)

- Evaluate the role of science, mathematics, and technology in addressing current issues facing local and global communities.
- Drives scientific and societal advancement through technological innovation and entrepreneurship.
- Acquire domain knowledge
- Strengthen critical thinking and reasoning skills
- Develop effective communication skills
- Imbibe human values, inclusiveness attitude and socio-cultural sensitivity
- Build up self-esteem and competence to face challenges
- Attain life-readiness through problem-solving skills and competencies
- Work effectively in groups to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own.
- Develop appropriate methods of research, investigation, and design, to solve problems in science, mathematics, and technology.

B. PROGRAMME SPECIFIC OUTCOMES (PSO)

- Be able to explain the core ideas and the techniques of mathematics at the college level.
- Be able to recognize the power of abstraction and generalization, and to carry out investigative mathematical work with independent judgment.
- Be able to setup mathematical models of real world problems and obtain solutions in structured and analytical approaches with independent judgment.
- Be able to carry out objective analysis and prediction of quantitative information with independent judgment.
- Be able to communicate effectively about mathematics to both lay and expert audiences utilizing appropriate information and communication technology.
- Be able to work independently, and to collaborate effectively in team work and team building.
- Be able to conduct self-evaluation, and continuously enrich themselves through lifelong learning.

C. COURSE OUTCOMES (CO)

FIRST SEMESTER

MM1B01: FOUNDATION OF MATHEMATICS

On completion of this course, successful students will be able to:

- Lay a foundation on set theory, relations, functions, logic and theory of equations.
- Prove statements about sets and functions; analyze statements using truth tables.

- Familiarize mathematical symbols and standard methods of proofs.
- Determine roots of the equation, connecting the roots and coefficients of an equation.

SECOND SEMESTER

MM2B01: ANALYTIC GEOMETRY, TRIGONOMETRY AND DIFFERENTIAL CALCULUS

On completion of this course, successful students will be able to:

- Find the equation to tangent, normal at a point on a conic.
- Find the polar equation of a line, circle, tangent and normal to conics.
- Familiarize real and imaginary parts of a circular and hyperbolic functions of a complex variable.
- Solve a system of linear equations using the inverse of a matrix
- Familiarize successive differentiation and indeterminate forms.

THIRD SEMESTER

MM3B01: CALCULUS

After completing this course the learner should be able to

- Find the higher order derivative of the product of two functions.
- Expand a function using Taylor's and Maclaurin's series.
- Conceive the concept of asymptotes and obtain their equations.
- Learn about partial derivatives and its applications.
- Find the area under a given curve, length of an arc of a curve when the equations are given in parametric and polar form.
- Find the area and volume by applying the techniques of double and triple integrals

FOURTH SEMESTER

MM4B01 : Vector Calculus, Theory of Numbers and Laplace Transform

After completing this course the learner should be able to

- Represent vectors analytically and geometrically, and compute dot and cross products for presentations of lines and planes,
- Analyze vector functions to find derivatives, tangent lines, integrals, arc length, and curvature
- Compute limits and derivatives of functions of 2 and 3 variables,

- Apply derivative concepts to find tangent lines to level curves and to solve optimization problems,
- Evaluate double and triple integrals for area and volume,
- Differentiate vector fields.
- Determine gradient vector fields and find potential functions
- Analyse the fundamental theorem of calculus and see their relation to the fundamental theorems of calculus in calculus , leading to the more generalised version of Stokes' theorem in the setting of differential forms.
- Evaluate line integrals directly and by the fundamental theorem.
- To know Basic Properties of congruences, Fermat theorem, Wilson theorm and Euler's phi function and problems based on these.
- Laplace transform, linearity, first shifting, existence and derivatives of laplace transform.

FIFTH SEMESTER

MM5B01: MATHEMATICAL ANALYSIS

After completing this course the learner should be able to

- Describe the real line as a complete, ordered field
- Determine the basic topological properties of subsets of the real numbers
- Use the definitions of convergence as they apply to sequences, and functions.
- Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line.
- Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis
- Produce rigorous proofs of results that arise in the context of real analysis.
- Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style.

MM5B02: DIFFERENTIAL EQUATIONS

After studying this course the students should be able to

- Describe various type of Differential equations, Partial Differential equations with example and how to sole the equations.
- Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution.
- Identify and obtain the solution of Clairaut's equation.
- Fine the complementary function and particular integrals of linear differential equation.

- Familiarize the orthogonal trajectory of the system of curves on a given surface.
- Method of solution of the differential equation $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$
- Describe the origin of partial differential equation and distinguish the integrals of first order linear partial differential equation into complete, general and singular integrals.
- Use Lagrange's method for solving the first order linear partial differential equation
- Solve differential equations of first order using graphical, numerical, and analytical methods,
- Solve and apply linear differential equations of second order (and higher).
- Solve linear differential equations using the Laplace transform technique,
- Find power series solutions of differential equations, and develop the ability to apply differential equations to significant applied and/or theoretical problems.
- Demonstrate their ability to write coherent mathematical proofs and scientific arguments needed to communicate the results obtained from differential equation models
- Demonstrate their understanding of how physical phenomena are modeled by differential equations and dynamical systems
- Implement solution methods using appropriate technology.

MM5B03: ABSTRACT ALGEBRA

After completing this course the learner should be able to

- Describe, analyze and demonstrate the abstract concept groups, abelian groups, subgroups, cyclic groups, cosets, normal subgroups, permutation groups, factor groups, rings, commutative rings, fields, ideals, quotient rings etc.
- Assess properties implied by the definitions of groups, cyclic groups, subgroups, rings, integral domain and fields.
- Use various canonical types of groups (including cyclic groups and groups of permutations) and canonical types of rings (including polynomial rings and modular rings).
- Use the concepts of isomorphism and homomorphism for groups and rings
- Produce rigorous proofs of propositions arising in the context of abstract algebra.

MM5B04 : FUZZY MATHEMATICS

After the completion of this course the student will be able to:

- Understanding the shortcomings of set theory and need for the new generalized fuzzy set theory to overcome the shortcomings

- To familiarize the basic concepts in fuzzy set theory and fuzzy theory operations with examples.

- To construct the appropriate fuzzy numbers corresponding to uncertain and imprecise collected data.
- To handle the real world problem in engineering having uncertain and imprecise data.
- To find the optimal solution of mathematical programming problems having uncertain and imprecise data.

Open course

MM5D02: APPLICABLE MATHEMATICS

After the completion of this course the student will be able to

- Understanding the basic operations of Mathematics
- Applies shortcut methods for solving problems
- Apply mathematical concepts and principles to perform computations
- Apply mathematics to solve real life problems
- Create, use and analyze graphical representations of mathematical relationships
- Communicate mathematical knowledge and understanding
- Apply technology tools to solve problems
- Perform abstract mathematical reasoning
- Learn independently
- Compute limits, derivatives, and definite & indefinite integrals of algebraic, logarithmic and exponential functions
- Analyze functions and their graphs as informed by limits and derivatives
- Familiarize with basic operations on real numbers, logarithms and quadratic equations
- Identify the definitions of trigonometric ratios and their applications to problems involving heights and distance
- Get basic ideas of two dimensional geometry and graphing straight lines
- Use various methods to compute the probabilities of events
- Acquires basic ideas of derivatives, standard results and various rules for finding the derivatives of functions
- Differentiate integration from differentiation and integration of simple functions.
- Acquires the basic arithmetic skills involving percentages, averages, time and rates, elementary algebra and geometry.

SIXTH SEMESTER

MM6B01: REAL ANALYSIS

After the completion of this course the student will be able to:

- Understand the term sequences, series and its convergence. Knowledge about various test and problems based on the tests.

- Illustrate the convergence properties of power series.
- Identifies Continuity and Discontinuity of various functions in different contexts.
- Distinguish Uniform continuity from continuity and related theorems.
- Understand partitions and their refinement.
- Understand Integrability and theorems on integrability.

- Recognize the difference between pointwise and uniform convergence of a sequence of functions

- Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.
- Develops a knowledge about Riemann Integration and applies into problems.
- Determine the Riemann integrability and the Riemann Stieltjes integrability of a bounded function and prove a selection of theorems concerning integration.

MM6B02: COMPLEX ANALYSIS

On completion of this course, the students will be able to

- Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers.

- Define and analyze limits and continuity for complex functions as well as consequences of continuity.
- Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties.

- Determine whether a given function is differentiable, and if so find its derivative.
- Use differentiation rules to compute derivatives.
- Write complex numbers in polar form.
- Evaluate exponentials and integral powers of complex numbers.
- Find all integral roots and all logarithms of nonzero complex numbers.
- Apply the concept and consequences of analyticity and the Cauchy Riemann equations and of results on harmonic and entire functions including the fundamental theorem of Find parameterizations of curves, and compute complex line integrals directly.

- Understand the theory and techniques of complex integration.
- Applies the theory into application of the power series expansion of analytic functions.

- Understand the basic methods of complex integration and its application in contour integration.

- Analyze sequences and series of analytic functions and types of convergence.

- Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula
- Algebra.
- Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.
- Use the Cauchy Residue Theorem to evaluate integrals and sum series.

- Identify the isolated singularities of a function and determine whether they are removable, poles, or essential

- Compute Laurent series at an isolated singularity, and determine the residue.

- Understand uses of improper integrals in various situations.

- Use the residue theorem to compute complex line integrals and real integrals.

MM6B03: DISCRETE MATHEMATICS

After the completion of this course the student will be able to

- Understand the new topics Graph Theory, Cryptography, Poset and Lattices.
- Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.

- Understand the properties of trees and able to find a minimal spanning tree for a given weighted graph.
- Understand Eulerian and Hamiltonian graphs.

- Applies the basic logic of Cryptography into various problems.

- Compare and contrast a range of different cryptosystems from an applied viewpoint.

- List and elaborate the differences between secret key and public key cryptosystems.
- Identify the different approaches to quantifying secrecy.

- Recognize the different modes of operation for block ciphers and their applications.

- Explain the role of hash functions in Information Security.
- Discuss the place of ethics in the Information Security Area.
- Recognize lattices, complete ordered sets and their varieties.

- Know the main representation theorems of lattices.

MM6B04: LINEAR ALGEBRA AND METRIC SPACES

Upon completion of this course, students should be able to:

- Understand the idea about vector space and metric space

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

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

- Compute with the characteristic polynomial, eigenvectors, eigenvalues and Eigen spaces, as well as the geometric and the algebraic multiplicities of an eigen value and apply the basic diagonalization result.
- Recall the defining properties of a metric space, and determine whether a given function defines a metric.
- Determine how that a function is or is not a metric.
- Show that a set in a metric space is or is not open and/or closed.
- Show that a function between metric spaces is or is not continuous.
- Show that a sequence in a metric space is or is not convergent.
- Show that a metric space is or is not complete.
- Familiarize with open sets, closed sets and Cantor set.

MM6D01 : OPERATIONS RESEARCH

Upon completion of this course, students should be able to:

- Understand the new term LPP.

- Applies the theory into different types of problems.

- Understand Transportation Problem, Assignment problem and Queuing models

- Solving problems using different methods

- Formulate and model a linear programming problem from a word problem and solve them graphically in 2 and 3 dimensions, while employing some convex analysis
- Place a Primal linear programming problem into standard form and use the Simplex Method or Revised Simplex Method to solve it
- Find the dual, and identify and interpret the solution of the Dual Problem from the final tableau of the Primal problem
- Be able to modify a Primal Problem, and use the Fundamental Insight of Linear Programming to identify the new solution, or use the Dual Simplex Method to restore feasibility

- Interpret the dual variables and perform sensitivity analysis in the context of economics problems as shadow prices, input values, marginal values, or replacement values.
- Explain the concept of complementary slackness and its role in solving primal/dual problem pairs.
- Classify and formulate integer programming problems and solve them with cutting plane methods, or branch and bound methods.
- Formulate and solve a number of classical linear programming problems and such as the minimum spanning tree problem, the assignment problem, (deterministic) dynamic programming problem, the knapsack problem, the XOR problem, the transportation problem, the maximal flow problem, or the shortest path problem, while taking advantage of the special structures of certain problems.

- Understands duality theorems and dual simplex method.
- Uses dual simplex method to find optimal solutions.
- Explains the Transportation Problem and formulate it as an LPP and hence solve the problem.
- Determine that an Assignment Problem is a special case of LPP and hence solve by Hungarian method.
- Identifies the Queuing models, their various forms and methods of solutions.

Project

- Demonstrate library research skills in the area of mathematics,

- Critique mathematical presentations
- Produce a mature oral presentation of a non-trivial mathematical topic.