12. PO12 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

Course outcomes

SEMESTER 1
MTS1B01 : BASIC LOGIC AND NUMBER THEORY

- Prove results involving divisibility, greatest common divisor, least common multiple and afew applications.
- Understand the theory and method of solutions of lde.
- Solve linear congruent equations.
- Learn three classical theorems viz. Wilson's theorem, fermat's little theorem and euler'stheorem and a few important consequences.

SEMESTER II

MTS2B02 : CALCULUS OF SINGLE VARIABLE – 1

- To apply in the problem of sketching of curves and in the solution of some optimization problems of interest in real life.

SEMESTER – III
MTS3B03 : CALCULUS OF SINGLE VARIABLE–2

- To handle vectors in dealing with the problems involving geometry of lines, curves, planes and surfaces in space and have acquired the ability to sketch curves in plane and space given in vector valued form.

SEMESTER – IV
MTS4B04 : LINEAR ALGEBRA

- To learn the fundamentals of linear algebra by capturing the ideas geometrically, by justifying them algebraically and by preparing them to apply it in several different fields such as data communication, computer graphics, modelling etc.

SEMESTER – V
MTS5B05 : ABSTRACT ALGEBRA

- To understand the abstract notion of a group, learn several examples.
- To check whether an algebraic system forms a group or not and are introduced to some fundamental results of group theory.

SEMESTER – V
MTS5B06 : BASIC ANALYSIS

- To learn and deduce rigorously many properties of real number system by assuming a few fundamental facts about it as axioms. In particular they will learn to prove archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
- To know about sequences, their limits, several basic and important theorems involving sequences and their applications. For example, they will learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e (euler constant).
- To understand some basic topological properties of real number system such as the concept of open and closed sets, their properties, their characterization and so on.
- To understand some basic topological properties of real number system such as the concept of open and closed sets, their properties, their characterization and so on.

- To get a rigorous introduction to algebraic, geometric and topological structures of complex number system, functions of complex variable, their limit and continuity and so on. Rich use of geometry, comparison between real and complex calculus-areas where they agree and where they differ, the study of mapping properties of a few important complex functions exploring the underlying geometry etc. Will demystify student's belief that complex variable theory is incomprehensible.

SEMESTER – V
MTS5B07 : NUMERICAL ANALYSIS

- Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. To find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.
- Understand the concept of interpolation and also learn some well known interpolation techniques.
- Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
- Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.

SEMESTER – V
MTS5B08 : LINEAR PROGRAMMING

- Solve linear programming problems geometrically
- Understand the drawbacks of geometric methods
- Solve lp problems more effectively using simplex algorithm via. The use of condensed tableau of a.w. tucker
- Convert certain related problems, not directly solvable by simplex method, into a form that can be attacked by simplex method.
- Understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization
- Understand game theory
- Solve transportation and assignment problems by algorithms that take advantage of the simpler nature of these problems

SEMESTER – VI
MTS5B09 : INTRODUCTION TO GEOMETRY AND THEORY OF EQUATIONS

- Understand several basic facts about parabola, hyperbola and ellipse (conics) such as their equation in standard form, focal length properties, and reflection properties, their tangents and normal.
- Recognise and classify conics.
- Understand Kleinian view of Euclidean geometry.
- Understand affine transformations, the inherent group structure, the idea of parallel projections and the basic properties of parallel projections.
- Understand the fundamental theorem of affine geometry, its use in the proof of median theorem, Ceva's theorem, Menelaus' theorem etc.
- Learn to solve polynomial equations upto degree four.

SEMESTER – VI
MTS6B10 : REAL ANALYSIS

- State the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.

- Understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
- Realise the difference between continuity and uniform continuity and equivalence of these ideas for functions on closed and bounded interval.
- Understand the significance of uniform continuity in continuous extension theorem.
- Develop the notion of Riemann integrability of a function using the idea of tagged partitions And calculate the integral value of some simple functions using the definition.
- Understand a few basic and fundamental results of integration theory.
- Formulate Cauchy criteria for integrability and a few applications of it. In particular they learn to use Cauchy criteria in proving the non integrability of certain functions.
- Understand classes of functions that are always integrable
- Understand two forms of fundamental theorem of calculus and their significance in the practical
  Problem of evaluation of an integral.
- Find a justification for 'change of variable formula' used in the practical problem of evaluation of an integral.
- Prove convergence and divergence of sequences of functions and series
- Understand the difference between pointwise and uniform convergence of sequences and series of functions
- Answer a few questions related to interchange of limits.
- Learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
- Understand the notion of improper integrals, their convergence, principal value and evaluation.
- Learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

SEMESTER – VI
MTS6B11 : COMPLEX ANALYSIS

- To understand the difference between differentiability and analyticity of a complex function and construct examples.
- To understand necessary and sufficient condition for checking analyticity.
- To know of harmonic functions and their connection with analytic functions
- To know a few elementary analytic functions of complex analysis and their properties.
- To understand definition of complex integral, its properties and evaluation.
- To know a few fundamental results on contour integration theory such as Cauchy's theorem, Cauchy-Goursat theorem and their applications.
- To understand and apply Cauchy's integral formula and a few consequences of it such as Liouville's theorem, Morera's theorem and so forth in various situations.
- To see the application of Cauchy's integral formula in the derivation of power series expansion of an analytic function.
- To know a more general type of series expansion analogous to power series expansion viz. Lau- rent's series expansion for functions having singularity.
- To understand how Laurent's series expansion lead to the concept of residue, which in turn provide another fruitful way to evaluate complex integrals and, in some cases, even real integrals.
- To see another application of residue theory in locating the region of zeros of an analytic function.

SEMESTER – VI
MTS6B12 : CALCULUS OF MULTI VARIABLE

- Understand several contexts of appearance of multivariable functions and their representation using graph and contour diagrams.
- Formulate and work on the idea of limit and continuity for functions of several variables.
- Understand the notion of partial derivative, their computation and interpretation.
- Understand chain rule for calculating partial derivatives
- Get the idea of directional derivative, its evaluation, interpretation, and relationship with partial derivatives.
- Understand the concept of gradient, a few of its properties, application and interpretation.
- Understand the use of partial derivatives in getting information of tangent plane and normal Line.
- Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method.
- Find a few real life applications of Lagrange multiplier method in optimization problems.
- Extend the notion of integral of a function of single variable to integral of functions of two and three variables.
- Address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula.
- Realise the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. In the evaluation of double and triple integrals.
- See a few applications of double and triple integral in the problem of finding out surface area, mass of lamina, volume, centre of mass and soon.
- Understand the notion of a vector field, the idea of curl and divergence of a vector field, their evaluation and interpretation.
- Understand the idea of line integral and surface integral and their evaluations.
- Learn three major results viz. Green's theorem, gauss's theorem and stokes' theorem of multivariable calculus and their use in several areas and directions.
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SEMESTER – VI
MTS6B13 : DIFFERENTIAL EQUATIONS

- Students could identify a number of areas where the modelling process results in a differential equation.
- They will learn what an ode is, what it means by its solution, how to classify des, what it means by an IVP and so on.
- They will learn to solve des that are in linear, separable and in exact forms and also to analyse the solution.
- They will realise the basic differences between linear and non linear des and also basic results that guarantees a solution in each case.
- They will learn a method to approximate the solution successively of a first order IVP.
- They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
- They will learn to find out a series solution for homogeneous equations with variable coefficients near ordinary points.
- Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.
- Students learn the technique of solving partial differential equations using the method of separation of variables

ELECTIVE COURSES
SEMESTER – VI (ELECTIVE)
MTS6B14(E01) : GRAPH THEORY

- To Understand and apply the fundamental concepts in graph theory • apply graph theory based tools in solving practical problems
- To Improve the proof writing skills.
- To analyse properties of graphs
- To understand trees and their properties
- To distinguish between Eulerian and Hamiltonian graphs
- To analyse planar graphs

SEMESTER – V (OPEN COURSE)
MTS5D01 : APPLIED CALCULUS

- Identify the independent and dependent variables of a function and compute its domain and range.
- Evaluate functions given by formulas at given points
- Plot the graphs of straight lines andconics
- Compute limits
- Check continuity
- Compute derivatives and write down the equation of the tangent line
- To determine whether the function is increasing or decreasing using derivatives
- Compute velocity and acceleration
- Compute marginal cost/revenue/profit of production
- Compute differential and use it to approximate the error occurred
- Perform implicit differentiation
- Compute convexity, concavity and points of inflection
- Sketch curves
- Determine extreme values
- Determine the level of elasticity and use it for predicting the behaviour of revenue/cost/profit
- Combine the techniques of model building with optimization technique
- Use exponential/logarithmic function to compute compound interest, radioactive decay etc
- To compute the area under a curve, average value of a function using integration
- Integration using substitution
- To estimate the future and present value of an income flow
- To compute the survival and renewal functions
- To compute antiderivative
- To determine population density
- To find the area and volume of surface of revolution

COMPLEMENTARY COURSES

SEMESTER – I
MTS1C01 : MATHEMATICS – 1

- To understand the fundamental ideas of limit, continuity, and differentiability
- Increasing and decreasing functions, local maxima, minima, concavity, and inflection points
- How to apply these ideas in drawing the graphs of functions
- To find the solution of maximum-minimum problems using the idea of derivatives
- The mean value theorem and L'hospital rule
- Riemann sums

- Fundamental theorem of calculus and proof
- To solve the area problem, the problem of finding the arc length of a plane curve, and volume of solids
- average values and the mean value theorem for integrals

SEMESTER – II
MTS2C02 : MATHEMATICS – 2

- To represent points in polar coordinates and convert from one system to another
- To do the graphing in polar coordinates
- To find the derivatives and anti derivatives of hyperbolic and inverse hyperbolic functions
- To find the arc length and surface area of revolution using definite integrals
- To find the improper integrals
- To find the limit of sequences
- To find the integral using the trapezoidal rule and Simpson's rule
- To find the convergence and divergence of series
- To solve a system of linear equations using matrix theorem
- To find the rank and inverse of a matrix using elementary row transformations
- To find the eigen values and the corresponding eigen vectors of a matrix
- To check whether a matrix is diagonalizable or not

SEMESTER – III
MTS3C03 : MATHEMATICS – 3

- Work on the idea of limit, continuity, and derivative of vector-valued functions
- Use partial derivatives to find the tangent plane and normal line to a point on a surface
- Understand the properties and applications of the gradient of a function
- Apply double integral and triple integral to find the mass of a lamina, center of mass, etc.
- Evaluate curl and divergence of a vector field
- Understand line integral, surface integral, and triple integral
- Learn the three important theorems: green's theorem, gauss's theorem, and Stokes's theorem and their applications
- Learn about harmonic functions and their relation with analytic functions
- Understand the definition and evaluation of complex integral
- Learn the fundamental results on contour integration such as Cauchy-Goursat theorem
- Understand Cauchy's integral formula and apply it to derive Liouville's theorem and the fundamental theorem of algebra

SEMESTER – IV
MTS4C04 : MATHEMATICS – 4

- To learn the major classifications of differential equations.
- To learn the conditions for the existence of solution of first and second order initial value problems.
- To learn how to formulate a mathematical model of a physical process.
- To learn to solve the first order differential equations that are of linear, separable, exact, and Bernoulli's forms.
- They learn about the numerical method of solving a differential equation using euler's method.
- To become familiar with the theory and method of solving second order linear homogeneous and non-homogeneous equations with constant coefficients.
- To learn the method of reduction of order to find a second solution of linear second order equation by reducing to linear first order equation.

- To learn the method of solution of Cauchy Euler equations.
- To learn about linear models and boundary value problems.
- To acquire the knowledge of solving a differential equation using the Laplace method, which is useful to deal with problems in engineering.
- To are familiarized with the Fourier series.
- To learn the technique of solving partial differential equations using the method of separation of variables.