Department of Mathematics

Programme Specific Outcomes for TDC Mathematics Honours (B.Sc Mathematics Honours Course) :

After completion of TDC Mathematics Honours, the students are expected to achieve the following programme specific outcomes (PSOs) :

PSO1	To develop a conceptual understanding of mathematics at undergraduate level.
PSO2	To develop problem solving skills in various areas of pure and applied mathematics.
PSO3	To gain practical knowledge of the uses of various mathematical softwares used to analyse and illustrate mathematical concepts and problems.
PSO4	To enhance mathematical skills through the study of Skill Enhancement Courses.
PSO5	To achieve a good background in mathematics for progression to higher education and research.
PSO6	To use mathematical knowledge in preparing oneself for various competitive examinations and job prospects.

Course Outcomes (COs) for TDC Mathematics Honours :

Semester I

Paper - Calculus (MTMHCC-101T)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Differentiation of hyperbolic functions, higher order derivatives, Leibnitz rule and its applications.

CO2	Indeterminate forms and L'Hospital's rule.
CO3	Asymptotes, concavity and inflection points.
CO4	Tracing of standard curves in cartesian and polar coordinates.
CO5	Reduction formulae and applications to some standard integrals.
CO6	Cartesian and Parametric equations of plane curves, rectification of plane curves; areas of surfaces of revolution.
CO7	Scalar and vector triple products of vectors, vector equations of lines, planes and spheres.
CO8	Introduction to vector functions, limits, continuity and differentiation of vector functions.

Paper - Calculus (Practical) (MTMHCC-101P)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Plotting of graphs of linear, exponential, logarithmic and trigonometric functions.
CO2	Plotting the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
CO3	Sketching parametric curves like Trochoid, cycloid, epicycloids, hypocycloid.
CO4	Obtaining surface of revolution of curves
CO5	Tracing of conics in cartesian coordinates/ polar coordinates.
CO6	Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

Paper - Higher Algebra (MTMHCC-102)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Polar representation of complex numbers, De Moivre's theorem for rational indices.

CO2	Trigonometric, exponential and logarithmic functions of complex arguments, Gregory's series
CO3	Reflexive, Symmetric, Transitive, Equivalence; Equivalence classes and partitions.
CO4	Functions, Composition of functions, Bijections, Invertible functions, One to one correspondence and cardinality of a set.
CO5	Well-ordering property of positive integers, Principles of Mathematical Induction, Division algorithm, Divisibility of integers, Euclidean algorithm.
CO6	Fundamental Theorem of Arithmetic, Congruence relation between integers, properties of congruences.
CO7	Descartes' rule of signs, relation between roots and coefficients of polynomial equations, symmetric functions of roots
CO8	Reciprocal and binomial equations, Cardan's method of solving a cubic equation.
CO9	Elementary transformation of matrices, echelon and canonical forms, rank of a matrix.
C10	Systems of linear equations, their solutions by Gaussian elimination method.

Semester II

Paper - Real Analysis (MTMHCC-201)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Algebraic and order properties of the set of real numbers, idea of countable sets and uncountable sets.
CO2	Bounded and unbounded sets, supremum, infimum, completeness property of R, Archimedean property, density of rational and irrational numbers in R.
CO3	Limit points of a set, isolated points, derived sets, open and closed sets, closure of a set, illustrations of Bolzano-Weierstrass theorem for sets.
CO4	Sequences, bounded sequence, convergent sequence, limit of a sequence.
CO5	Limit theorems, monotone sequences, monotone convergence theorem.
CO6	Subsequences, divergence criteria, monotone subsequence theorem.
CO7	Bolzano Weierstrass theorem for sequences, Cauchy sequence, Cauchy's convergence criterion.
CO8	Infinite series, convergence and divergence of infinite series, Cauchy criterion.
CO9	Comparison test, ratio test, Cauchy's nth root test, integral test, alternating series, Leibniz test, absolute and conditional convergence.

Paper - Calculus (MTMHCC-202T)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Differential equation and its formulation, general, particular, explicit, implicit and singular solutions of a differential equation.
CO2	Wronskian and its properties.

CO3	Exact differential equations and integrating factors, separable equations, linear equation and Bernoulli equations.
CO4	Compartmental model, exponential decay model, lake pollution model.
CO5	Drug assimilation into the blood, exponential growth of population, limited growth of population, limited growth with harvesting.
CO6	Simultaneous differential equations.
CO7	Total differential equations.
CO8	Solutions of linear equations of higher order with constant coefficients, general solution of homogeneous equation of second order, linear homogeneous and non-homogeneous equations.
CO9	Principle of superposition for linear homogeneous equation, method of variation of parameters.

Paper - Higher Algebra (MTMHCC-202P)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Plotting solutions of second and third order differential equations.
CO2	Plotting of growth, decay, lake pollution, single cold pill, course of cold pills, limited growth of population, battle model.
CO3	To illustrate the convergence and divergence of sequences by plotting.
CO4	To illustrate the convergence and divergence of infinite series by plotting.

Semester III

Paper - Theory of Real Functions (MTMHCC-301)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Limits of functions, sequential criterion for limits, divergence criteria.
CO2	Limit theorems, one sided limits, infinite limits and limits at infinity.
CO3	Continuous functions, sequential criterion for continuity and discontinuity, algebra of continuous functions, continuous functions on an interval.
CO4	Intermediate value theorem, location of roots theorem, preservation of intervals theorem.
CO5	Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions, relative extrema, interior extremum theorem.
CO6	Rolle's theorem, mean value theorem, intermediate value property of derivatives, Darboux's theorem.
CO7	Uniform continuity, non-uniform continuity criteria via sequences, algebra of uniformly continuous functions.
CO8	Uniform continuity theorems, sufficient condition for uniform continuity using derivative, Lipchitz's continuity.
CO9	Applications of mean value theorems to inequalities and approximation of polynomials.
CO10	Taylor's theorem with Lagrange's form of remainder, Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema.
CO11	Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions.

Paper - Group Theory (MTMHCC-302)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Symmetries of a square. Dihedral groups.
CO2	Groups and their elementary properties.
CO3	Subgroups, centralizer, normalizer.
CO4	Center of a group, product of two subgroups.
CO5	Cyclic groups, classification of subgroups of cyclic groups.
CO6	Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group.
CO7	Cosets, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.
CO8	External direct product of a finite number of groups, normal subgroups, factor groups.
CO9	Group homomorphisms, properties of homomorphisms, Cayley's theorem.
CO10	Isomorphisms of groups. First, second and third isomorphism theorems.

Paper - PDE and systems of ODE (MTMHCC-303T)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Partial differential equations – basic concepts and definitions, mathematical problems, first order equations, classification, construction and geometrical interpretation.
CO2	Some exact solutions of lower order non-linear PDE by method of inspection.
CO3	Canonical forms of first-order linear equations, method of separation of variables for solving first order partial differential equations, Langrange's equation and its solutions.
CO4	Classification of second order linear equations as hyperbolic, parabolic or elliptic, reduction of second order linear equations to canonical forms.

CO5	Solution of linear PDE with constant coefficients upto order two.
CO6	Initio-boundary value problems, semi-infinite string with a fixed end, semi-infinite string with a free end, equations with non-homogeneous boundary conditions.
CO7	One dimensional homogeneous wave and heat conduction equation, solving by separation of variables.
CO8	Systems of linear differential equations, types of linear systems, differential operators, an operator method for solving linear systems with constant coefficients, basic theory of linear systems in normal form.
CO9	Homogeneous linear systems with constant coefficients: two equations in two unknown functions.

Paper - PDE and systems of ODE (Practical) (MTMHCC-303P)

CO1	To solve the Cauchy problem for first order PDE.
CO2	To find the characteristics for the first order PDE.
CO3	To plot integral surfaces of a given first order PDE with initial data.
CO4	Solution of wave equation.

Paper - Logic and Sets (MTMHSEC-301(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Propositions, truth table, negation, conjunction and disjunction.Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators.
CO2	Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.
CO3	Sets, subsets, Set operations and the laws of set theory and Venn diagrams.Examples of finite and infinite sets, Finite sets and counting principle. Empty set, properties of empty set. Standard set operations.

CO4	Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.
CO5	Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations

Semester IV

Paper - Numerical Methods (MTMHCC-401)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Algorithms, convergence, error analysis: relative, absolute, round off, truncation.
CO2	Definition and properties of finite difference operators.
CO3	Newton's forward, backward formulae, Lagrange's formula error bounds.
CO4	General quadrature formula - Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.
CO5	Numerical solution of ordinary differential equations : Euler's method.
CO6	Transcendental and polynomial equations : bisection method, regula-falsi method, secant method, Newton-Raphson method, iteration method, rates of convergence of these methods.
CO7	System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss-Jacobi method, Gauss- Seidel method.
CO8	Convergence analysis of the above methods.

Paper - Numerical Methods (Practical) (MTMHCC-401P)

CO1	To compute finite sums using a loop structure.
CO2	To solve algebraic and transcendental equations using various numerical methods studied in theory paper.
CO3	To write programs for interpolation using various methods studied in theory paper.
CO4	To write programs for numerical integration using various methods studied in theory paper.

Paper - Riemann Integration and Series of Functions (MTMHCC-402)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability.
CO2	Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions.
CO3	Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.
CO4	Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.
CO5	Improper integrals and their convergence.
CO6	Beta and Gamma functions.
CO7	Pointwise and uniform convergence of sequence of functions, Cauchy criterion for uniform convergence and Mn-test
CO8	Pointwise and uniform convergence of series of functions, Cauchy criterion for uniform convergence and Weierstrass M-Test.
CO9	Limit superior and Limit inferior, power series, radius of convergence, Cauchy Hadamard theorem.

Paper - Ring Theory (MTMHCC-403)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Rings, properties of rings, subrings, nilpotent and idempotent elements.
CO2	Integral domains, division rings, fields, characteristic of a ring.
CO3	Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.
CO4	Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III and applications.

CO5	Polynomial rings over commutative rings, division algorithm and consequences.
CO6	Euclidean domains, principal ideal domains.
CO7	Factorization of polynomials, irreducibility tests, Eisenstein criterion.
CO8	Unique factorization in Z[x], prime and irreducible elements.

Paper - Special Functions (MTMHSEC-401(II))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Legendre's equation, Legendre's Polynomials, generating function, Laplace's definite integral for $P_n(x)$.
CO2	Orthogonal properties and recurrence formulae for $P_n(x)$, Rodrigues formula.
CO3	Bessel's equation of order 0, 1 and n, Bessel's functions and Recurrence formula.
CO4	Laplace transform, the inverse Laplace transform.
CO5	Application of Laplace transform to differential equations.
CO6	Fourier series and Fourier integrals, Fourier transform(infinite), Relation between Laplace and Fourier transforms problems related to Fourier integral.

Semester V

Paper - Topology (MTMHCC-501)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Metric spaces, open, closed sets and their properties.
CO2	Limit point of a set, diameter, interior, exterior, closure and boundary of a set.
CO3	Sequences in metric spaces, complete metric spaces
CO4	Continuity of functions in metric spaces.
CO5	Topological spaces, comparison of topologies, open, closed sets and their properties.
CO6	Union and intersection of topologies, metrizable spaces, Hausdorff spaces
CO7	Limit point, neighbourhood of a point, interior, exterior, closure and boundary of a set.
CO8	Sequences in topological spaces and their convergence
CO9	Continuity of functions in topological spaces, non-uniqueness of limit in topological spaces.
CO10	

Paper - Multivariate Calculus (MTMHCC-502)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Functions of several variables, limit and continuity of functions of two variables, repeated limits,
CO2	Partial differentiation, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.
CO3	Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems.
CO4	Definition of vector field, divergence and curl.
CO5	Double integration over rectangular region, double integration

	over non-rectangular region, Double integrals in polar coordinate.
CO6	Triple integrals, Triple integral over a parallelepiped and solid regions, volume by triple integrals, cylindrical and spherical coordinates.
CO7	Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals.
CO8	Fundamental theorem for line integrals, conservative vector fields, independence of path.
CO9	Green's theorem, surface integrals, integrals over parametrically defined surfaces, Stoke's theorem, the divergence theorem

Paper - Mechanics (MTMHDSE-501(II))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Coplanar forces and their resultant, equilibrium of three coplanar forces.
CO2	Friction, laws of friction, angle of friction, cone of friction.
CO3	Radial and transverse components of velocity and acceleration of a particle moving along a plane curve, angular velocity and acceleration, tangential and normal components of acceleration,
CO4	Simple harmonic motion.
CO5	Motion under inverse square law, motion under other laws of forces.
CO6	Kepler's laws of planetary motion, motion in resisting medium under gravity.
CO7	Work, power, energy, impulse of a force, principle of conservation of linear momentum, impact, direct impact of two spheres, laws of K.E. due to direct impact of two smooth spheres, direct impact of a solid on a fixed smooth surface.
CO8	Moments and product of inertia, theorems of parallel and perpendicular axes, principal axes.
CO9	D'Alembert's principle.

Paper - Analytical Geometry (MTMHDSE-502(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Change of origin, invariants in orthogonal transformation, pair of straight lines, bisector of angles between pair of straight lines.
CO2	Orthogonal circles, radial axis, radical center of three circles, circles through intersection of two circles, circles through intersection of a circle and a straight line.
CO3	Condition of tangency of a straight line to a circle, parabola, ellipse and hyperbola, pair of tangents from an external point to a circle, parabola and ellipse.
CO4	Polar of a point with respect to a circle, parabola, ellipse and hyperbola, determination of the pole of a straight line with respect to a circle, parabola, ellipse and hyperbola. Polar equation of a conic in the form $l/r = 1 + e \cos \theta$.
CO6	Shortest distance and equation of shortest distance line, general equation of a sphere, sphere through origin and having intercepts on the axes, section of a sphere by a plane, great circle, sphere through a given circle, the curve of intersection of two spheres.
CO7	Tangent plane to a sphere at a given point on it, condition of tangency of a given plane to be a tangent plane to a sphere.
CO8	Cone with vertex at a given point and a given curve as base, equation of a right circular cone with vertex is at a point other than origin.
CO9	Cylinder, equation of a cylinder, equation of a right circular cylinder.

Semester - VI

Paper - Complex Analysis (MTMHCC-601)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Algebra of complex numbers, polar representation of complex numbers, geometrical interpretation of Arg $(z - \alpha)/(z - \beta)$, complex equations of straight lines, circles.
CO2	Limits, continuity of functions of complex variables, regions in the complex plane.
CO3	Derivatives, differentiation formulae, Cauchy-Riemann equations, sufficient conditions for differentiability,
CO4	Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function.
CO5	Definite integrals of functions, contours, contour integrals and its examples, upper bounds for moduli of contour integrals, Cauchy-Goursat theorem, Cauchy's integral formula.
CO6	Liouville's theorem and the fundamental theorem of algebra, convergence of sequences and series, Taylor series.
CO7	Laurent series and its examples, types of singularities, calculus of residues, Cauchy's residue theorem.

Paper - Linear Algebra (MTMHCC-602)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Vector spaces, subspaces, algebra of subspaces, quotient spaces.
CO2	Linear combination of vectors, linear span, linear dependence and independence, basis and dimension.
CO3	Linear transformations, null space, range, rank and nullity of a linear transformation,
CO4	Matrix representation of a linear transformation.
CO5	Algebra of linear transformations, isomorphisms, isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

CO6	Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.
CO7	Inner product spaces and norms, Cauchy-Schwarz inequality, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality.
CO8	The adjoint of a linear operator, least squares approximation, minimal solutions to systems of linear equations.

Paper - Linear Programming (MTMHDSE-601(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Formulation of LPP and its graphical solution
CO2	Convex sets and their properties; Slack and surplus variables, Standard form of an LPP.
CO3	Simplex method for solving LPP.
CO4	Artificial variables techniques : Big M method and two-phase method.
CO5	Duality, formulation of the dual problem, primal-dual relationships, theorems on duality;
CO6	Transportation problems : mathematical formulation and methods of determining initial basic feasible solutions. Unbalanced transportation problems.
CO6	Optimality tests for transportation problems and MODI method for obtaining optimal solution, degeneracy in transportation problems.
CO7	Assignment problems, Hungarian method of solution.
CO8	Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies,
CO9	Graphical solution procedure, linear programming solution of games.

Paper - Hydrodynamics (MTMHDSE-602(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Types of fluids(real and ideal fluids), description of fluid motion (Eulerian and Lagrangian methods), stream lines, path lines, velocity potential, irrotational motion.
CO2	Equation of continuity-Lagrangian and Eulerian forms and their equivalence, Cartesian, polar, and curvilinear forms of equation of continuity.
CO3	Stream functions, Rate of motion – Local and individual rates and their relation, acceleration of a fluid particle (vector form and its equivalence in cartesian and polar forms).
CO4	Equation of motion – Equation of motion of an inviscid fluid (Eulerian and Lamb's hydrodynamics forms) ,
CO5	The basic dynamical principles (the principle of linear momentum, angular momentum and energy definition only).
CO6	Pressure at a point in moving fluid of known velocity, Bernoulli's theorem.
CO7	Euler's momentum theorem, D'Alembert's paradox.

Department of Mathematics

Programme Specific Outcomes for TDC Mathematics GE/DSC (B.Sc Pass Course) :

After completion of TDC Mathematics GE/DSC, the students are expected to achieve the following programme specific outcomes (PSOs) :

PSO1	To develop a conceptual understanding of mathematics at undergraduate level.
PSO2	To develop problem solving skills in various areas of pure and applied mathematics.
PSO3	To enhance mathematical skills through the study of Skill Enhancement Courses.
PSO4	To achieve a good background in mathematics for progression to higher education.
PSO5	To use mathematical knowledge in preparing oneself for various competitive examinations and job prospects.

Course Outcomes for TDC Mathematics GE/DSC Course :

Semester I

Paper - Differential Calculus (MTMGE/DSC-101(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Limit of a function, algebra of limits.
CO2	Continuity, related theorems, types of discontinuities, differentiability of functions.
CO3	Successive differentiation, Leibnitz's theorem, Partial

	differentiation, Euler's theorem on homogeneous functions.
CO4	Tangents and normals, subtangents and subnormals, radius of curvature, tracing of cartesian and parametric curves.
CO5	Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series.
CO6	Maxima and Minima Indeterminate forms.

Semester II

Paper - Differential Equations (MTMGE/DSC-201(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations.
CO2	Methods for solving higher-order differential equations, basic theory of linear differential equations.
CO3	Solving a differential equation by reducing its order linear homogeneous equations with constant coefficients, linear non-homogeneous equations, the method of variation of parameters. Cauchy-Euler equation.
CO4	Simultaneous differential equations.
CO5	Total differential equations.
CO6	Order and degree of partial differential equations, concept of linear and non-linear partial differential equations, Formation of first order partial differential equations.

Semester III

Paper - Real Analysis (MTMGE/DSC-301(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Finite and infinite sets, countable and uncountable sets. Real line.

CO2	Bounded sets, suprema and infima, completeness property of R, Archimedean property of R.
CO3	Intervals, open and closed subsets of R, their properties, nested interval theorem, concept of cluster points and Bolzano-Weierstras theorem.
CO4	Real Sequence, bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence.
CO5	Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Absolute and conditional convergence.
CO6	Sequential criterion of limit and continuity and the equivalence of sequential criterion with epsilon delta definition, properties of continuous functions, related theorems on continuous functions.

Semester III

Paper - Classical Algebra and Trigonometry (MTMSEC-301(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Idempotent , nilpotent , involutory matrices, transpose of a matrix , conjugate of a matrix, symmetric and skew symmetric, Hermitian , skew Hermitian, orthogonal, unitary matrices.
CO2	Adjoint of a square matrix , Jacobi's Theorem ; inverse of a square matrix.
CO3	Elementary transformation on matrices, rank of a matrix, echelon form, normal form, elementary matrices.
CO4	Inverse of a matrix from elementary matrices; Solution of a system of linear equations by matrix inverse and by Gaussian elimination method.
CO5	Descartes' rule of signs, relation between roots and coefficients of polynomial equations, symmetric functions of roots, transformation of equations, reciprocal and binomial equations.

CO6	De-Moivre's theorem (for rational indices), Expansions of sin nθ, cos nθ, Expansions of sin θ, cos θ in ascending powers of θ, Functions of complex arguments.
CO7	Gregory's series; summation of trigonometric series; Hyperbolic functions.

Semester IV

Paper - Abstract Algebra (MTMGE/DSC-401(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Definition, examples and properties of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n, the group U(n) of units under multiplication modulo n, group of complex roots of unity, the general linear group GL(n, R).
CO2	Cyclic groups, subgroups and related theorems.
CO3	Cosets and their properties, Index of subgroup, Lagrange's theorem, order of an element of a group.
CO4	Normal subgroups: their definition, examples and characterizations, Quotient groups, group homomorphism: definition, example and related problems
CO5	Rings, Integral domains and Fields : Definitions, properties, examples and related theorems.

Semester IV

Paper - Vector Analysis (MTMSEC-401)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Scalar and vector triple products of vectors, Vector equations of lines, planes and spheres.
CO2	Vector functions, limits, continuity and differentiation of vector functions, related problems
CO3	Gradient, Divergence and Curl, their identities and related

	problems.
CO4	Integration of vector functions, line integrals, related problems.
CO5	Applications of vectors : Tangential and normal components of velocity and acceleration, conservation of momentum and energy, principle of work.

Semester V

Paper - Linear Algebra (MTMDSE-501(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspace.
CO2	Linear transformations, null space, range, rank and nullity of a linear transformation, matrix of a linear transformation.
CO3	Algebra of linear transformations, isomorphisms, isomorphism theorems, invertibility and isomorphisms.
CO4	Eigenvalues, eigenvectors and eigen space of a linear operator, invariant subspaces, Cayley-Hamilton theorem
CO5	Inner product spaces, norm generated by inner product, Cauchy-Scwartz's inequality, Bessel's inequality

Semester V

Paper - Integral Calculus (MTMSEC-501)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Integration as the reverse of differentiation, integration by substitution, integration of rational functions
CO2	Definite integrals and their properties, definite integral as the limit of a sum.
CO3	Reduction formulae, derivations and illustrations of reduction formulae of standard integrals.

CO4	Cartesian and Parametric equations of plane curves, rectification of plane curves.
CO5	Areas of surfaces of revolution and volumes of solids of revolution.

Semester VI

Paper - Linear Programming (MTMDSE-601(I))

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Formulation of LPP and its graphical solution
CO2	Convex sets and their properties; Slack and surplus variables, Standard form of an LPP.
CO3	Simplex method for solving LPP.
CO4	Artificial variables techniques : Big M method and two-phase method.
CO5	Duality, formulation of the dual problem, primal-dual relationships, theorems on duality;
CO6	Transportation problems : mathematical formulation and methods of determining initial basic feasible solutions. Unbalanced transportation problems.
CO6	Optimality tests for transportation problems and MODI method for obtaining optimal solution, degeneracy in transportation problems.
CO7	Assignment problems, Hungarian method of solution.
CO8	Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies,
CO9	Graphical solution procedure, linear programming solution of games.

Semester VI

Paper - Analytical Geometry (MTMSEC-601)

After completion of this course, the students are expected to achieve the following course outcomes :

CO1	Change of origin, rotation of axes, invariants in orthogonal transformation, pair of straight lines, bisector of angles between pair of straight lines.
CO2	Orthogonal circles, radial axis, radical centre of three circles, circles through intersection of two circles, circles through intersection of a circle and a straight line
	Condition of tangency of a straight line to a circle.
CO3	Properties of parabola, ellipse and hyperbola, equations of chords, tangents and normals, polar equation of a conic
CO4	Shortest distance and equation of shortest distance line, general equation of a sphere, sphere through origin and having intercepts on the axes.
CO5	Section of a sphere by a plane, great circle, sphere through a given circle, the curve of intersection of two spheres, tangent plane to a sphere at a given point on it.
CO6	Equations of Cones and cylinders.