PROGRAMME SPECIFIC OUTCOME OF MATHEMATICS (MAJOR)

After graduation the students will be able to learn-

PSO1: To infuse the classical ideas of algebraic and analytic structures. The students can have a deeper insight of the developments of the generalized notions of Trigonometry. The students will have an orientation towards the vectorial notations of multivariable calculi.

PSO2: Students will be able to use matrix methods for solving liners equations, have ideas on the basics of differential equations and also about the numerical methods of obtaining results where complexity of obtaining analytical solutions is sufficiently high.

PSO3: Students will be able to identify the analytical aspects of Mathematical concepts.

PSO4: The students will have a deeper understanding of Co-ordinate geometry and a broader insight towards the analytical aspects of Mathematics.

PSO5: Students will be able to formulate simple programmes for numerical evaluation of computational problems. By Computer Laboratory, they will be exposed to a hand on experience on various Mathematical Software.

PSO6: Students will be able to determine the Mathematical know how of linear programming problems of Operations Research and also to solve then using LPP techniques. Students will be exposed to be further analytical aspects of Mathematical concepts.

PSO7: Students will be able to identify the basics of Mathematical Logic and that of the counting principles. Students will be allowed to have insights to more generalized analytical aspects.

PSO8: Students will be able to use algebraic structures for explaining geometric concepts. Students will be exposed to the fundamentals of Numbers and their properties.

PSO9: Students will be introduced to the fundamental concepts of Fluid Mechanics and its various applications in Physical Sciences.

PSO10: Students will be introduced to the Mathematical background of Mechanics and the corresponding problem solving techniques.

PSO11: Students will be exposed to the Topological Structures and the generalization concepts arising out of Real Analysis.

PSO12: The students will be able to identify the relations between Mathematics and Theoretical Computer Science. Students will be introduced to the fundamentals of Graph Theory and different representations of a Graph for practical applications.

PSO13: Students will be able to identify the characteristics of Abstract Algebraic Structures and also can have ideas on the basics of partial differential equations.
PSO 14: Students will be introduced to the application of Mathematical principles to the problems of Space Dynamics and Relativity.

COURSE OUTCOME OF MATHEMATICS (MAJOR)

Course Code MM-101:
After completion of the course, the students will understand the following:-

CO1: It introduced the basic knowledge of real sequences.
CO2: About the infinite series and its convergence.
C**O3:** Introduction of polynomial equations.
CO4: De Moivre's theorem and important deductions from De Moivre's theorem.
CO5: Trigonometrical and exponential functions of complex arguments.
CO6: Gregory's series and evaluation of pi .
CO7: Summation of trigonometric series and hyperbolic functions.
CO8: Ordinary and partial derivative of vectors and its related terms.

Course Code; MM-201:
After completion of the course, the students will understand the following:

CO1: Elementary operations on a matrix and rank of a matrix.
CO2: Solution of homogeneous & non homogeneous linear equations, Characteristic polynomial, characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem.
CO3: Solution of homogeneous & non homogeneous linear equations, Characteristic polynomial, characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem.
CO4: Linear differential equation of higher order with constant coefficients, linear homogeneous equations.
CO5: Linear equation of second order with variable coefficients: Removal of first order derivative, Change of independent variables, Method of variation of parameters.
CO6: Solution of algebraic and transcendental equation: Bisection method, Regula-falsi method, Iteration method, Newton-Raphson method and its geometrical interpretation. Solution of system of equations: Gauss elimination method, Gauss Seidal Method, Gauss Jordan method.
CO7: Diagonal and horizontal difference tables, finite difference operators, Newton's forward, backward and general interpolation formulae, Lagrange's

interpolation formula, Quadrature: Trapezoidal rule, Simpson's quadrature (1/3 and 3/8 rule).

COURSE CODE MM-301:
After completion of the course, the students will understand the following:

CO1: Successive differentiation, Leibnitz's theorem, Indeterminate forms, Sub tangent, sub normal, derivative of arc length (Cartesian and polar forms), values of $\sin\varphi, \cos\varphi$, angle between radius vector and tangent, polar sub tangent and polar subnormal, curvature and radius of curvature.
CO2: Function of one variable: Functions continuous on closed intervals, Differentiability, Darboux's theorem, Rolle's theorem, Lagrange mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series.
CO3: Partial derivatives, Euler's theorem on homogeneous function
CO4: Function of several variable : Explicit and implicit functions, continuity, partial derivatives, definition of Jacobian, partial derivatives of higher order, Young's and Schwarz'S theorems (without proof), change of variables, Taylor's theorem, extreme values.
CO5: Definite integrals by using properties only, Reduction formula of the integrands.
CO6: Rectification of plane curves, surface and volume of solids of revolution.
CO7: Definitions and existence of R-integrals (Reimann Integrals).
CO8: Primitive, fundamental theorem (1^{st} & 2^{nd}) of integral calculus, first mean value theorem and generalized first mean value theorem, related examples.
CO9: Improper integrals: Introduction and their convergence, Statements of Comparison test, Cauchy's test, Abel's test, Dirichlet's test and their applications**.**
CO10: Beta and Gamma functions and their relationship.

Course Code MM-302:
After completion of the course, the students will understand the following:

CO1: Transformation of coordinates: Translation of axes, Rotation of axes, Invariants, Removal of xy-term.
CO2: About the Pair of straight lines:
CO3: General Equation of second degree: Equation to the conic sections.
CO4: Equation of planes, straight lines.
CO5: Shortest distance between two lines, Skew lines.
CO6: Binary Composition, Definition and Examples of Group and its Elementary properties.

CO7: Normal subgroups, Quotient groups, Homomorphisms – Isomorphisms, permutations groups and its related theorems.

Course Code MM-401:
After completion of the course, the students will understand the following:

CO1: Introduction to C-Programming: Basic programming concept, programming approach to solving problem.
CO2: Operators and expressions in C-programming.
CO3: Input output operations: Reading and writing a character, formatted input and formatted output.
CO4: Decision Making and Branching, IF statement, IF … ELSE statement, nested IF, ELSE IF Ladder, WHILE statement, DO statement, FOR statement, Jumps in Loops.
CO5: About the Arrays in C-programming.
CO6: User defined functions: Elements of user defined functions, Definition of functions, return values and their types.
CO7: Computer Laboratory Practical- C-programming.
CO8: Matlab practical.

Course Code MM-402:
After completion of the course, the students will understand the following:

CO1: LP Model formulation & Graphical Method.
CO2: Theory of simplex algorithm and simplex method.
CO3: Duality Theory: Concept of duality, Types of primal dual problem.
CO4: Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties.
CO5: Fourier series: Preliminary & other theorems, main theorem, series for even function, odd functions, half range series, Interval other than [$-\pi, \pi$]
CO6: Integration over $\mathbf{R}^2$: Line integrals, double integrals.
CO7: Integration over $\mathbf{R}^3$: Surface and surface integral, Stoke's and Gauss's theorems and their applications.

Course Code MM-501:
After completion of the course, the students will understand the following:

CO1: The Statement Calculus: Introduction, Sentential Connectives ,Truth tables, Truth value, Validity, truth function, tautology and related theorems, arithmetic representation of sentential connectives.

CO2: Theory of Inference: Consequence, rule of inference and applications. Predicate calculus: symbolizing language.
CO3: Fundamental Principles of Counting: Binomial Theorem, Pascal and Vander Monde's identity, Multinational theorem, Ramsey number, Catalan numbers, Stirling and Bell number
CO4: About the principles of Inclusion-Exclusion.
CO5: Analytic Function: Limit, Continuity and differentiability, Analytic functions, Cauchy-Riemann equations. Necessary and sufficient condition for a function to be analytic, polar form of C.R. equation, Harmonic functions, Construction of analytic function.
CO6: Complex Integrals : Definite integral, Jordan arc, contour, line integrals, Cauchy's theorem, simply and multiply connected domains, Cauchys' integral formula, Derivatives of analytic function, Morera's theorem, Liouville's theorem.
CO7: Power series: Taylors's series, Laurent's series and their related problems.
CO8: Poles & Residues: Definition and statement of the related theorems of isolated singularity, removable singularity and poles, calculation of residues, Cauchy's residue theorem, Contour Integration (Integration round the unit circle, Integration of the type $\int_{-\infty}^{\infty} f(x)dx$ where no poles on the real axis)

Course Code MM-502:
After completion of the course, the students will understand the following:

CO1: System of linear equations, Definitions and examples of Vector space, vector subspace, basis and dimension of a Vector Space.
CO2: Definition of a line, Affine Space, Quotient Space, Linear transformation, Representation of Linear maps by Matrices, Kernel and image of a linear transformation, linear isomorphism, Geometric Ideas and some loose ends.
CO3: Peano's axiom, Well ordering property of positive integer, Division Algorithm, Theorems, G.C.D., Theorems, Euclidean Algorithm.
CO4: Prime numbers, unique factorization theorem (fundamental theorem of arithmetic), Euclid's heorem, greatest integer function[n].
CO5: Definition, Basic properties of congruence, complete residue system, reduced residue system. Fermat's little theorem, Euler's theorem, Wilson's theorem, Solution of Congruence, Solutions of the problems of type ax+by+c=0, Chines Reminder theorem, Solutions of simultaneous equations by using Chines Reminder theorem.
CO6: Arithmetic Function, Euler's function, Division function, Mobius function $\mu(n)$, the Mobius inversion formula, Properties of arithmetic functions.

Course Code MM-503:
After completion of the course, the students will understand the following:

CO1: Kinematics: Real and ideal fluid, velocity of a fluid at a point, Eulerian and Lagrangian method, stream lines and path lines, steady and unsteady flows, velocity potential, rotational and irrotational motions, local and particle rate of change, equation of continuity, examples, acceleration of a fluid at a point, General analysis of fluid motion.
CO2: Equation of Motion: Euler's equation of motion, Bernoullis equation, steady motion under conservative forces, impulsive motion, circulation, Kelvin's circulation theorem.
CO3: General theory of irrotational motion : Potential flow, deductions from Green's theorem, kinetic energy of a liquid, uniqueness theorems, Kelvin's minimum energy theorem, Mean value of velocity potential.
CO4: Fluid Pressure**:** Introduction, Fluid Pressure and related theorems, Density and specific gravity, Theorems on fluid pressure under gravity, Rate of variation of pressure, Differential equation of pressure, Condition of equilibrium, Equi-pressure surfaces and lines of force, Curves of equi-pressure and equi-density, Examples.
CO5: Resultant Pressure and Centre of Pressure: Resultant fluid pressure and related theorems, Centre of pressure, Determination of centre of pressure of parallelogram, triangle, circle under different conditions, Examples, Thrust on curved surfaces, Examples.
CO6: Equilibrium and Stability of Floating Bodies: Condition of equilibrium of floating bodies, Examples, Unstable and Neutral equilibrium, Determination of Meta centre, Examples.

Course Code MM-504:
After completion of the course, the students will understand the following:

CO1: Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, Pointsot's central axis, wrench, pitch, screw, Invariants, Equations of central axis.
CO2: Virtual work, Common catenary, Stability of equilibrium.
CO3: Motion in a straight line and plane, Radial and transverse velocities and acceleration, angular velocity and angular acceleration, tangential and normal acceleration, Simple Harmonic Motion.
CO4: Central forces, Motion under resistance.
CO5: Dynamics of Rigid Body: Moments of inertia, Theorems of parallel and perpendicular axes, Moment of inertia about a line, Moment and product of inertia

of a plane lamina, Momental ellipsoid and momental ellipse. D'Alembert's principle and general equations of motion, Motion of the centre of inertia and relative to the centre of inertia.

CO6: Laplace Transforms: Laplace Transforms of some elementary functions, Linearity property, First and second translational or shifting theorem. Change of scale property, Laplace transforms of derivatives Multiplication by powers of t, and related problems.

CO7: The inverse Laplace transforms: Definition, some inverse Laplace transforms properties of inverse Laplace transform, inverse Laplace transforms of derivatives, Multiplication by s, Convolution property, partial fraction method, Complex inversion formula.

CO8: Application to differential equations: Solution of ordinary differential equations with constant coefficients, Solution of ordinary differential equations with variable coefficients, solution of Simultaneous ordinary differential equations, Solution of partial differential equations.

Course Code MM-601:

After completion of the course, the students will understand the following:

CO1: Definition and examples of metric spaces, Open spheres and closed spheres, Neighborhoods, Open sets, Equivalent metrics, Interior points, Closed sets, Limit points and isolated points, Closure of a set, Boundary points, Distance between sets and diameter of a set, Subspace of metric space, Product metric spaces (definition only), Bases.

CO2: Convergent sequences, Cauchy sequences, complete & separable spaces, dense sets.

CO3: Continuous functions: Definition and characterizations, Extension theorem, Uniform continuity (definition only), Homomorphism.

CO4: Compact spaces and compact sets, Sequential compactness.

CO5: Probability: Basic terminology, Mathematical probability, Statistical probability, Axiomatic approach to probability. Some theorems on probability, Conditional probability, Multiplication theorem of probability, Independent events, Multiplication theorem of probability for independent events, Extension of multiplication theorem of probability, Baye's theorem.

CO6: Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation.

CO7: Correlation and regression: Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equation.

CO8: Theoretical Probability Distribution: Binomial, Poisson and Normal Distribution and their applications to simple problems.

CO9: Time series analysis: Different components of time series, analysis of trends (Least Square Method and Moving Average Method)

Course Code MM-602:
After completion of the course, the students will understand the following:

CO1: Recurrence Relations: Formulation as Recurrence Relations, Solutions of Recurrence Relations, Solutions of homogeneous and nonhomogeneous linear Recurrence Relations, Generating Functions.
CO2: Lattice: Definition and examples, Hasse diagram, Properties of Lattice, Lattice as an Algebraic systems, Sub lattice and lattice isomorphism, Special Classes : of lattice, Distributive lattice and Boolean algebras.
CO3: Boolean Algebra: Boolean algebra as lattice and an algebraic system, Properties of Boolean algebra, Sub-algebra and homomorphism of Boolean algebra, Boolean expressions, sum-of-products canonical form, values of Boolean expression & Boolean functions, representation by Karnaugh Maps, minimization of Boolean functions using Karnaugh Maps.
CO4: Logic Gates, Switching circuits & Logic circuits: Introduction, Gates and Boolean algebra, Applications, Special Sequences, Switching circuits, simplification of circuits, bridge circuits, logic circuits, multiple output logic circuit, minimization.
CO5: Graph Theory: Definition, Directed and undirected graphs, basic terminologies, finite and infinite graph, incidence and degree of vertex, isolated and pendent vertices, null graph, Handshaking theorem, types of graphs, sub graphs, graphs isomorphism, operations of graphs, connected graph, disconnected graphs and components.
CO6: Walk, path and circuits, Eulerian graphs, Hamiltonian graphs, Dirac's theorem, Ore's, theorem, Konigsberg's Bridge problem, Representation of graphs, matrix representation o f graph, adjacency matrix, Incidence matrix, Linked representation of graphs.

Course Code MM-603:
After completion of the course, the students will understand the following:

CO1: Automorphism of groups, Inner automorphism, external and internal direct products.
CO2: Definition and examples of Ring, Special kinds of rings, sub rings and ideals, sum and product of ideals.
CO3: Quotient Ring, Homomorphism of ring, Imbedding of rings, Maximal and Prime ideal,

CO4: Introduction, Origins of First order PDE, Cauchy Problem for First order equations, Linear equations of first order, Lagrange equation, Integral Surface passing through a given curve, surface orthogonal to a given system of surfaces.
CO5: Nonlinear PDE of first order, Cauchy Method of characteristics, Compatible systems of first order equation, Charpit's Method, special types of first order equations, solution satisfying given conditions, Jacobi's Method.

Course Code MM-604:
After completion of the course, the students will understand the following:

CO1: Spherical Trigonometry: Spherical triangles and its properties, the sine-cosine formulae, four parts formula.
CO2: Coordinate systems: Position on the earth surface, horizontal system, equatorial system, ecliptic system, elements of the orbit in space, rectangular coordinate system, orbital plane coordinate system, transformation of systems.
CO3: Gravitation, the one and two body problems, elliptic motion, attraction of irregular bodies, rotational distortion, coordinates the orbits in space.
CO4: Special Theory: The fundamental postulates, Lorentz transformation, equations, composition of velocities in terms of rapidity. Lorentz transformation as rotation, consequences of Lorentz transformation equation viz. Lorentz-Fitzgerald contraction, Time dilation, the clock paradox, space like and time like integrals.
CO5: Relativistic mechanics : The relativistic conception of mass increasing with velocity, transformation laws of mass, velocity, acceleration, density, momentum, energy and force.