Lesson Plane for Academic Year: 2018-2019

Sem-I(HONS)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
<u>Unit-1</u> : Calculus Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. Reduction formulae, derivations and illustrations of reduction formulae of the type $\sin^n xdx$,$\cos^n xdx$, $\tan^n xdx$, $\sec^n xdx$, $(\log x)^n dx$, $\sin^n x\sin mxdx$, $\sin^n x\cos^m xdx$. Parametric equations, parametriz- ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. <u>Unit-2</u> : Geometry Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics. Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.	SC	3	<u>Unit-1</u> : Calculus Reduction formulae, derivations and illustrations of reduction formulae of the type $\sin^n xdx$,$\cos^n xdx$, $\tan^n xdx$, $\sec^n xdx$, $(\log x)^n dx$, $\sin^n x\sin mxdx$, $\sin^n x\cos^m xdx$. Parametric equations, parametriz- ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. <u>Unit-2: Algebra</u> Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$. Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruencerelation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.
Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines.	NM	3	<u>Unit-1</u> : Calculus Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en-

<table>
<tr>
<td rowspan="3">
Equation of skew lines. Shortest distance between two skew lines.
Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.
<u>Unit-3</u> : Vector Analysis
Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued
functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.
<u>Algebra</u>
<u>Unit-1</u>
Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.
Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.
Linear difference equations with constant coefficients (up to 2nd order).
<u>Unit-2</u>
</td>
<td></td>
<td></td>
<td>
velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates,
tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.
<u>Unit-1: Algebra</u>
Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.
Linear difference equations with constant coefficients (up to 2nd order).
</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>
<u>Unit-2</u> : Geometry
Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics.
Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.
</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>
<u>Unit-1: Algebra</u>
Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.
Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation.

Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$.

Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruencerelation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.

<u>Unit-3</u>

Rank of a matrix, inverse of a matrix, characterizations of invertible matrices.

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.</td>
<td>KT</td>
<td>4</td>
<td><u>Unit-3: Algebra</u>

Rank of a matrix, inverse of a matrix, characterizations of invertible matrices.

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.

<u>Unit-3</u> : Vector Analysis

Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued

Functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td><u>Unit-2</u> : Geometry

Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.</td>
</tr>
</table>

Part II(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Module V</u> Group A (15marks) SC <u>Modern Algebra II</u> Cosets and Lagrange's theorem. Cyclic groups. Generator, Subgroups of cyclic groups. Necessary and sufficient condition for a finite group to be cyclic. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integraldomain, Every field is an integral domain, every finite integrals domain isa field. Definitions of Sub-ring and sub-field. Statement of Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Characteristic of ring and integral domain. Permutation : Cycle, transposition, Statement of the result that every permutation can be expressed as a product of disjoint cycles. Even and oddpermutations, Permutation Group. Symmetric group. Alternating Group. Order of an alternating group. Group B (35 marks) SS <u>Linear Programming and Game Theory</u> Definition of L.P.P. Formation of L.P.P. from daily life involving inequations. Graphical solution of L.P.P. Basic solutions and BasicFeasible Solution (BFS) with reference to L.P.P. Matrix formulation of L.P.P.Degenerate and Non-degenerate B.F.S.	SC	4	<u>Module V</u> Group A (15marks) <u>Modern Algebra II</u> Cosets and Lagrange's theorem. Cyclic groups. Generator, Subgroups of cyclic groups. Necessary and sufficient condition for a finite group to be cyclic. Rings and Fields: Properties of Rings directly following from the definition, Unitary and commutative rings. Divisors of zero, Integraldomain, Every field is an integral domain, every finite integrals domain isa field. Definitions of Sub-ring and sub-field. Statement of Necessary of sufficient condition for a subset of a ring (field) to be sub-ring (resp. subfield). Characteristic of ring and integral domain. Permutation : Cycle, transposition, Statement of the result that every permutation can be expressed as a product of disjoint cycles. Even and oddpermutations, Permutation Group. Symmetric group. Alternating Group. Order of an alternating group. <u>Module VII</u> Group A (30 marks) <u>Real-Valued Functions of Several Real Variables</u> Point sets in two and three dimensions: Concept only of neighbourhood of apoint, interior point, limit point, open set, closed set. [2] Concept of functions on IR^n.[1] Function of two and three variables : Limit and continuity. Partial derivatives. Sufficient condition for continuity. Relevant results regarding repeated limits and double limits.

Hyperplane, Convex set, Cone, extreme points, convex hull and convex polyhedron. Supporting and Separating hyperplane. The collection of all feasible solutions of an L.P.P. constitutes a convex set. The extreme pointsof the convex set of feasible solutions correspond to its B.F.S. andconversely. The objective function has its optimal value at an extreme point of the convex polyhedron generated by the set of feasible solutions.(the convex polyhedron may also be unbounded). In the absence of degeneracy, if the L.P.P. admits of an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to a B.F.S. Slack and surplus variables. Standard from of L.P.P. theory of simplex method. Feasibility and optimality conditions. The algorithm. Two phase method. Degeneracy in L.P.P. and its resolution. Duality theory : The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Relation between their optimal values. Complementary slackness, Duality and simplex method and their applications. Transportation and Assignment problems. Mathematical justification for optimality criterion. Hungarian method. Traveling Salesman problem. Concept of Game problem. Rectangular games. Pure strategy and Mixed strategy. Saddle point and its existence. Optimal strategy and value of thegame. Necessary and sufficient condition for a given strategy to be optimalin a game. Concept of Dominance. Fundamental Theorem of Rectangulargames. Algebraic method. Graphical method and Dominance method of solving Rectangular games. Inter-relation between the theory of Games and L.P.P.			Functions $IR^2 \rightarrow IR$: Differentiability and its sufficient condition, differential as a map, chain rule, Euler's theorem and its converse. Commutativity of the second order mixed partial derivatives : Theorems ofYoung and Schwarz. Jacobian of two and three variables, simple properties including function dependence. Concept of Implicit function : Statement and simple applicationof implicit function theorem for two variables Differentiation of Implicit function. Taylor's theorem for functions two variables. Lagrange's method of undetermined multipliers for function of two variables (problems only). Group B (20 marks) <u>Application of Calculus</u> Tangents and normals : Sub-tangent and sub-normals. Angle of intersection of curves. Pedal equation of a curve, pedal of a curve. Rectilinear asymptotes of a curve (Cartesian, parametric and polar form). Curvature-Radius of curvature, centre of curvature, chord of curvature, evolute of a curve. Envelopes of families of straight lines and curves (Cartesian and parametric equations only). Concavity, convexity, singular points, nodes, cusps, points of inflexion, simple problems on species of cusps of a curve (Cartesian curves only). Familiarity with the figure of following curves : Periodic curves with suitable scaling, Cycloid, Catenary, Lemniscate of Bernoulli, Astroid, Cardiode, Folium of Descartes, equiangularspiral.

<table>
<tr>
<td rowspan="2">
<u>Module VI</u>
<u>Group A (15 marks) NM</u>
<u>Analysis II</u>

Infinite Series of real numbers :
Convergence, Cauchy’s criterion of convergence.
Series of non-negative real numbers : Tests of convergence – Cauchy’scondensation test. Comparison test (ordinary form and upper limit andlower limit criteria), Kummer’s test. Statements and applications of : Abel – Pringsheim’s Test, Ratio Test , Root test, Raabe’s test, Bertrand’s test, Logarithmic test and Gauss’s test. Series of arbitrary terms : Absolute and conditional convergence
Alternating series : Leibnitz test (proof needed).
Non-absolute convergence : Abel’s and Dirichlet’s test (statements andapplicatins). Riemann’s rearrangement theorem (statement only) and rearrangement of absolutely convergent series (statement only).
Derivatives of real –valued functions of a real variable
Definition of derivability. Meaning of sign of derivative. Chain rule. Successive derivative: Leibnitz theorem. Theorems on derivatives : Darboux theorem, Rolle’s theorem, Mean value theorems of Lagrange and Cauchy – as an application of Rolle’stheorem. Taylor’s theorem on closed and bounded interval with Lagrange’s and Cauchy’s form of remainder deduced from Lagrange’sand Cauchy’s mean value theorem respectively. Maclaurin’s theoremas a consequence of Taylor’s theorem. Statement of Maclaurin’s

Theorem on infinite series expansion. Expansion of e^x, $\log(1 \square x)$, $(1 \square x)^m$, $\sin x$, $\cos x$ with their range of validity.
Statement of L’ Hospital’s rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the
</td>
<td></td>
<td></td>
<td>Area enclosed by a curve, determination of C.G., moments and products of inertia (Simple problems only).</td>
</tr>
<tr>
<td>NM</td>
<td>3</td>
<td>
<u>Module VI</u>
<u>Group A (15 marks)</u>
<u>Analysis II</u>

Infinite Series of real numbers :
Convergence, Cauchy’s criterion of convergence.
Series of non-negative real numbers : Tests of convergence – Cauchy’scondensation test. Comparison test (ordinary form and upper limit andlower limit criteria), Kummer’s test. Statements and applications of : Abel – Pringsheim’s Test, Ratio Test , Root test, Raabe’s test, Bertrand’s test, Logarithmic test and Gauss’s test. Series of arbitrary terms : Absolute and conditional convergence
Alternating series : Leibnitz test (proof needed).
Non-absolute convergence : Abel’s and Dirichlet’s test (statements andapplicatins). Riemann’s rearrangement theorem (statement only) and rearrangement of absolutely convergent series (statement only).
Derivatives of real –valued functions of a real variable :
Definition of derivability. Meaning of sign of derivative. Chain rule. Successive derivative: Leibnitz theorem. Theorems on derivatives : Darboux theorem, Rolle’s theorem, Mean value theorems of Lagrange and Cauchy – as an application of Rolle’stheorem. Taylor’s theorem on closed and bounded interval with Lagrange’s and Cauchy’s form of remainder deduced from Lagrange’sand Cauchy’s mean value theorem respectively. Maclaurin’s theoremas a consequence of Taylor’s theorem. Statement of Maclaurin’s.
</td>
</tr>
</table>

existence of a local maximum/minimum ofa function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. Group B (35 marks) SS <u>Differential Equation I</u> Significance of ordinary differential equation. Geometrical and physicalconsideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations.[Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevantresults only). First order linear equations : Integrating factor (Statement of relevant resultsonly). Equations reducible to first order linear equations. [2] Equations of first order but not of first degree. Clairaut's equation. Singularsolution.[3] Applications : Geometric applications, Orthogonal trajectories. [2] Higher order linear equations with constant co-efficients : Complementaryfunction, Particular Integral. Method of undetermined co-efficients,Symbolic operator D. Method of variation of parameters. Exact Equation. Euler's homogeneous equation and Reduction to an equation of constant co-efficients. Second order linear equations with variable co-efficients :			Theorem on infinite series expansion. Expansion of e^x, log(1□ x), (1□ x)^m, sin x, cos x with their range of validity. Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum ofa function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. Group B (35 marks) <u>Differential Equation I</u> Significance of ordinary differential equation. Geometrical and physicalconsideration. Formation of differential equation by elimination of arbitrary constant. Meaning of the solution of ordinary differential equation. Concept of linear and non-linear differential equations.[Equations of first order and first degree : Statement of existence theorem. Separable, Homogeneous and Exact equation. Condition of exactness, Integrating factor. Rules of finding integrating factor, (statement of relevant results only). First order linear equations : Integrating factor (Statement of relevant resultsonly). Equations reducible to first order linear equations. [2] Equations of first order but not of first degree. Clairaut's equation. Singularsolution.[3] Applications : Geometric applications,
	SS	3	Group B (35 marks)

Reduction of order when one solution of the homogeneous part is known. Complete solution. Method of variation of parameters. Reduction to Normal form. Change of independent variable. Operational Factors. Simple eigenvalue problems. Simultaneous linear differential equations. Total differential equation :Condition of integrability. Partial differential equation (PDE) : Introduction. Formation of P.D.E., Solution of PDE by Lagrange's method of solution and by Charpit's method. <u>Module VII SC</u> Group A (30 marks) <u>Real-Valued Functions of Several Real Variables</u> Point sets in two and three dimensions: Concept only of neighbourhood of apoint, interior point, limit point, open set, closed set. [2] Concept of functions on IR^n.[1] Function of two and three variables : Limit and continuity. Partial derivatives. Sufficient condition for continuity. Relevant results regarding repeated limits and double limits. Functions $IR^2 \rightarrow IR$: Differentiability and its sufficient condition, differential as a map, chain rule, Euler's theorem and its converse. Commutativity of the second order mixed partial derivatives : Theorems ofYoung and Schwarz. Jacobian of two and three variables, simple properties including function dependence. Concept of Implicit function : Statement and simple applicationof implicit function theorem for two variables Differentiation of Implicit function.			<u>Linear Programming and Game Theory</u> Definition of L.P.P. Formation of L.P.P. from daily life involving inequations. Graphical solution of L.P.P. Basic solutions and BasicFeasible Solution (BFS) with reference to L.P.P. Matrix formulation of L.P.P.Degenerate and Non-degenerate B.F.S. Hyperplane, Convex set, Cone, extreme points, convex hull and convex polyhedron. Supporting and Separating hyperplane. The collection of all feasible solutions of an L.P.P. constitutes a convex set. The extreme pointsof the convex set of feasible solutions correspond to its B.F.S. andconversely. The objective function has its optimal value at an extreme point of the convex polyhedron generated by the set of feasible solutions.(the convex polyhedron may also be unbounded). In the absence of degeneracy, if the L.P.P. admits of an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to a B.F.S. Slack and surplus variables. Standard from of L.P.P. theory of simplex method. Feasibility and optimality conditions. The algorithm. Two phase method. Degeneracy in L.P.P. and its resolution. Duality theory : The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Relation between their optimal values. Complementary slackness, Duality and simplex method and their applications. Transportation and Assignment problems. Mathematical justification for optimality criterion. Hungarian method. Traveling Salesman problem.

<table>
<tr>
<td rowspan="3">Taylor's theorem for functions two variables. Lagrange's method of undetermined multipliers for function of two variables (problems only).

Group B (20 marks)
<u>Application of Calculus</u>
Tangents and normals : Sub-tangent and sub-normals. Angle of intersection of curves. Pedal equation of a curve, pedal of a curve.
Rectilinear asymptotes of a curve (Cartesian, parametric and polar form).

Curvature-Radius of curvature, centre of curvature, chord of curvature, evolute of a curve.

Envelopes of families of straight lines and curves (Cartesian and parametric equations only).

Concavity, convexity, singular points, nodes, cusps, points of inflexion, simple problems on species of cusps of a curve (Cartesian curves only).

Familiarity with the figure of following curves : Periodic curves with suitable scaling, Cycloid, Catenary, Lemniscate of Bernoulli, Astroid, Cardiode, Folium of Descartes, equiangularspiral.

Area enclosed by a curve, determination of C.G., moments and products of inertia (Simple problems only).

Module VIII
Group A (15 marks)
<u>Analytical Geometry of 3 Dimensions II</u>
Sphere : General Equation. Circle, Sphere through the intersection of two spheres. Radical Plane, Tangent, Normal.
Cone : Right circular cone. General homogeneous second degree equation. Section of cone by a plane as a conic and as a pair of lines. Condition for three perpendicular generators. Reciprocal cone.</td>
<td></td>
<td></td>
<td>Concept of Game problem. Rectangular games. Pure strategy and Mixed strategy. Saddle point and its existence. Optimal strategy and value of thegame. Necessary and sufficient condition for a given strategy to be optimalin a game. Concept of Dominance. Fundamental Theorem of Rectangulargames. Algebraic method. Graphical method and Dominance method of solving Rectangular games. Inter-relation between the theory of Games and L.P.P.

Group B (35 marks)

<u>Differential Equation I</u>

Orthogonal trajectories. [2]

Higher order linear equations with constant co-efficients : Complementaryfunction, Particular Integral. Method of undetermined co-efficients, Symbolic operator D. Method of variation of parameters. Exact Equation. Euler's homogeneous equation and Reduction to an equation of constant co-efficients.
Second order linear equations with variable co-efficients : Reduction of order when one solution of the homogeneous part is known. Complete solution. Method of variation of parameters. Reduction to Normal form. Change of independent variable. Operational Factors.
Simple eigenvalue problems.
Simultaneous linear differential equations. Total differential equation :Condition of integrability.
Partial differential equation (PDE) : Introduction. Formation of P.D.E., Solution of PDE by Lagrange's method of solution and by Charpit's method.</td>
</tr>
<tr>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>2</td>
<td>Module VIII
Group A (15 marks)
<u>Analytical Geometry of 3 Dimensions II</u></td>
</tr>
</table>

Cylinder : Generators parallel to either of the axes, general form of equation. Right-circular cylinder. Ellipsoid, Hyperboloid, Paraboloid : Canonical equations only. Tangent planes, Normals, Enveloping cone. Surface of Revolution (about axes of reference only). Ruled surface. Generating lines of hyperboloid of one sheet and hyperbolic paraboloid. [10] Transformation of rectangular axes by translation, rotation and their combinations. [2] Knowledge of Cylindrical, Polar and Spherical polar co-ordinates, their relations (Nodeduction required). GroupB(10marks) <u>Analytical Statics I</u> Friction : Law of Friction, Angle of friction, Cone of friction, To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces. Astatic Equilibrium, Astatic Centre, Positions of equilibrium of a particle lying on a smooth plane curve under action of given force. Action at a joint in a frame work.			Sphere : General Equation. Circle, Sphere through the intersection of two spheres. Radical Plane, Tangent, Normal. Cone : Right circular cone. General homogeneous second degree equation. Section of cone by a plane as a conic and as a pair of lines. Condition for three perpendicular generators. Reciprocal cone. Cylinder : Generators parallel to either of the axes, general form of equation. Right-circular cylinder. Ellipsoid, Hyperboloid, Paraboloid : Canonical equations only. Tangent planes, Normals, Enveloping cone. Surface of Revolution (about axes of reference only). Ruled surface. Generating lines of hyperboloid of one sheet and hyperbolic paraboloid. [10] Transformation of rectangular axes by translation, rotation and their combinations. [2] Knowledge of Cylindrical, Polar and Spherical polar co-ordinates, their relations (Nodeduction required). GroupB(10marks) <u>Analytical Statics I</u> Friction : Law of Friction, Angle of friction, Cone of friction, To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces. Astatic Equilibrium, Astatic Centre, Positions of equilibrium of a particle lying on a smooth plane curve

Group C (25 marks) <u>Analytical Dynamics of A Particle</u> Recapitulations of Newton's laws. Applications of Newton's laws to elementary problems of simple harmonic motion, inverse square law and composition of two simple harmonic motions. Centre of mass. Basic kinematic quantities : momentum, angular momentum and kinetic energy. Principle of energy and momentum. Work and poser. Simple examples on their applications. Impact of elastic bodies. Direct and oblique impact of elastic spheres. Losses of kinetic energy. Angle of deflection. Tangent and normal accelerations. Circular motion. Radial and cross-radial accelerations. Damped harmonic oscillator. Motion under gravity with resistance proportional to some integral power of velocity. Terminal velocity. Simple cases of a constrained motion of a particle. Motion of a particle in a plane under different laws of resistance. Motion of a projectile in a resisting medium in which the resistance varies as the velocity. Trajectories in a resisting medium where resistance varies as some integral power of the velocity.			under action of given force. Action at a joint in a frame work. Group C (25 marks) <u>Analytical Dynamics of A Particle</u> Recapitulations of Newton's laws. Applications of Newton's laws to elementary problems of simple harmonic motion, inverse square law and composition of two simple harmonic motions. Centre of mass. Basic kinematic quantities : momentum, angular momentum and kinetic energy. Principle of energy and momentum. Work and poser. Simple examples on their applications. Impact of elastic bodies. Direct and oblique impact of elastic spheres. Losses of kinetic energy. Angle of deflection. Tangent and normal accelerations. Circular motion. Radial and cross-radial accelerations. Damped harmonic oscillator. Motion under gravity with resistance proportional to some integral power of velocity. Terminal velocity. Simple cases of a constrained motion of a particle. Motion of a particle in a plane under different laws of resistance. Motion of a projectile in a resisting medium in which the resistance varies as the velocity. Trajectories in a resisting medium where resistance varies as some integral power of the velocity.
	TS	0	

Part III(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

Module IX Analysis III (50 marks) Compactness in IR : Open cover of a set. Compact set in IR, a set is compact iff it is closed and bounded. Function of bounded variation (BV) : Definition and examples. Monotone function is of BV. If *f* is on BV on [a,b] then *f* is bounded on [a,b]. Examples of functions of BV which are not continuous and continuous functions not of BV. Definition of variation function. Necessary and sufficient condition for a function *f* to be of BV on [a,b] is that *f* can be written as the difference of two monotonic increasing functions on[a,b]. Definition of rectifiable curve. A plane curve γ = (*f*,*g*) is rectifiable if *f* and *g* both are of bounded variation (statement only). Length of a curve (simple problems only). Riemann integration : Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum U (P,f) and lower Darboux sum L(P,f) and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann intergrability. Continuous functions are Riemann integrable. Definition of a set of measure zero (or negligible set or zero set) as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of sets of measure zero : any subset of a set of measure zero, countable set, countable union of sets of measure zero. Concept of oscillation of a function at a point. A function is continuous at *x* if its oscillation at *x* is zero. A bounded function on a closed and bounded interval is Riemann integrable if the set of points of discontinuity is a set of measure zero (Lebesgue's theorem on Riemann integrable function). Problems on Riemann integrability of functions with sets of points of discontinuity having measure zero.	SC	3	**Module IX** **Analysis III (50 marks)** Compactness in IR : Open cover of a set. Compact set in IR, a set is compact iff it is closed and bounded. Function of bounded variation (BV) : Definition and examples. Monotone function is of BV. If *f* is on BV on [a,b] then *f* is bounded on [a,b]. Examples of functions of BV which are not continuous and continuous functions not of BV. Definition of variation function. Necessary and sufficient condition for a function *f* to be of BV on [a,b] is that *f* can be written as the difference of two monotonic increasing functions on[a,b]. Definition of rectifiable curve. A plane curve γ = (*f*,*g*) is rectifiable if *f* and *g* both are of bounded variation (statement only). Length of a curve (simple problems only). Riemann integration : Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum U (P,f) and lower Darboux sum L(P,f) and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann intergrability. Continuous functions are Riemann integrable. Definition of a set of measure zero (or negligible set or zero set) as a set covered by countable number of open intervals sum of whose lengths is

Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Properties of Riemann integrable functions arising from the above results. Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Fundamental theorem of integral calculus. First mean value theorem of integral calculus. Statement of second mean value theorems of integrals calculus (both Bonnet's and Weierstrass' form). Sequence and Series of functions of a real variable : Sequence of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only). Weierstrass's M-test. Limit function : Boundedness, Repeated limits, Continuity, Integrability and differentiability of the limit function of sequence of functions in case of uniform convergence. Series of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only), Tests of uniform convergence – Weierstrass' M-test. Statement of Abel's and Dirichlet's test and their applications. Passage to the limit term by term. Sum function : boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Abel's limit theorems. Uniqueness of power series having sum function. Module X Group A (20 marks) <u>Linear Algebra II & Modern Algebra III</u> Section – I : Linear Algebra II (10 marks)			arbitrary small. Examples of sets of measure zero : any subset of a set of measure zero, countable set, countable union of sets of measure zero. Concept of oscillation of a function at a point. A function is continuous at x if its oscillation at x is zero. A bounded function on a closed and bounded interval is Riemann integrable if the set of points of discontinuity is a set of measure zero (Lebesgue's theorem on Riemann integrable function). Problems on Riemann integrability of functions with sets of points of discontinuity having measure zero. Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Properties of Riemann integrable functions arising from the above results. Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Fundamental theorem of integral calculus. First mean value theorem of integral calculus. Statement of second mean value theorems of integrals calculus (both Bonnet's and Weierstrass' form). Sequence and Series of functions of a real variable : Sequence of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only). Weierstrass's M-test. Limit function : Boundedness, Repeated limits, Continuity, Integrability and differentiability of the limit function of sequence of functions in case of uniform convergence.

Linear Transformation (L.T.) on Vector Spaces : Definition of L.T., Null space, range space of an L.T., Rank and Nullity, Sylvester's Law of Nullity. [Rank (T) + Nullity (T) = dim (V)]. Determination of rank (T), Nullity (T) of linear transformation T : $IR^n \rightarrow IR^m$. Inverse of Linear Transformation. Non-singular Linear Transformation. Linear Transformation and Matrices : Matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces. Correspondence between Linear Transformations and Matrices. Linear Transformation is non-singular if its representative matrix be non-singular. Rank of L.T. = Rank of the corresponding matrix. [5] Section – II : Modern Algebra III (10 marks) Normal sub-groups of a Group : Definition and examples. Intersection, union of normal sub-groups. Prefect of a normal sub-group and a sub-group. Quotient Group of a Group by a normal sub-group. [5] Homomorphism and Isomorphism of Groups. Kernel of a Homomorphism. First Isomorphism Theorem. Properties deducible from definition of morphism. An infinite cyclic group is isomorphic to (Z,+) and a finite cyclic group of order *n* is isomorphic to the group of residue classes modulo *n*. Group B (25 marks) <u>Tensor Calculus</u> A tensor as a generalized concept of a vector in an Euclidean space E^3. To generalize the idea in an n-dimensional space. Definition of E^n.			Series of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only), Tests of uniform convergence – Weierstrass' M-test. Statement of Abel's and Dirichlet's test and their applications. Passage to the limit term by term. Sum function : boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Abel's limit theorems. Uniqueness of power series having sum function. Module XIII Group A (20marks) <u>Analysis IV</u> Improper Integral : Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. [2] Tests of convergence : Comparison and μ-test. Absolute and non-absolute convergence and interrelations. Abel's and Dirichlet's test for convergence of the integral of a product (statement only). Convergence and working knowledge of Beta and Gamma function and their interrelation

<table>
<tr>
<td rowspan="2">Transformation of co-ordinates in E^n (n = 2, 3 as example). Summation convention.

Contravariant and covariant vectors. Invariants. Contravariant, covariant and mixed tensors. The Kronecker delta. Algebra of tensors Symmetric and skew-symmetric tensors. Addition and scalar multiplication. Contraction. Outer and Inner products of tensors. Quotient law. Reciprocal Tensor. Riemannian space. Line element and metric tensor. Reciprocal metric tensor. Raising and lowering of indices with the help of metric tensor. Associated tensor. Magnitude of a vector. Inclination of two vectors. Orthogonal vectors. Christoffel symbols and their laws of transformations. Covariant differentiation of vectors and tensors. [15]

Group C (15marks) <u>Differential Equations II</u>

Laplace Transformation and its application in ordinary differential equations : Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Laplace Transform of derivatives. Laplace transform of integrals. Convolution theorem (Statement only). Application to the solution of ordinary differential equations of second order with constant coefficients.

Series solution at an ordinary point : Power Series solution of ordinary differential equations. Simple problems only.

Module XI Group A (10 marks)
<u>Vector Calculus II</u>
Line integrals as integrals of vectors, circulation, irrotational vector, work done, conservative force, , potential orientation. Statements and</td>
<td></td>
<td></td>
<td>$(\Gamma(n)\Gamma(1-n) = \frac{\pi}{\sin n\pi}, 0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\pi/2} sin^n x\, dx$, $\int_0^{\pi/2} cos^n x\, dx$ $\int_0^{\pi/2} tan^n x\, dx$ when they exist (using Beta and Gamma function)
Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier co-efficients for periodic functions defined on $[-\pi, \pi]$. Statement of Dirichlet's conditions convergence. Statement of theorem of sum of Fourier series. [5]

Multiple integral : Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Change of order of integration. Triple integral. Transformation of double and triple integrals (Problem only). Determination of volume and surface area by multiple integrals (Problem only).</td>
</tr>
<tr>
<td>NM</td>
<td>4</td>
<td>Module X Group A (20 marks)
<u>Linear Algebra II</u>

Section – I : Linear Algebra II (10 marks)

Linear Transformation (L.T.) on Vector Spaces : Definition of L.T., Null space, range space of an L.T., Rank and Nullity, Sylvester's Law of Nullity. [Rank (T) + Nullity (T) = dim (V)]. Determination of rank (T), Nullity (T) of linear</td>
</tr>
</table>

verification of Green's theorem, Stokes' theorem and Divergence theorem. [8] Group (20marks) <u>Analytical Statics II</u> Centre of Gravity: General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration. [3] Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work. Stable and unstable equilibrium. Coordinates of a body and of a system of bodies. Field of forces. Conservative field. Potential energy of a system. The energy test of stability. Condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones. [6] Forces in the three dimensions. Moment of a force about a line. Axis of a couple. Resultant of any two couples acting on a body. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Resultant force is an invariant of the system but the resultant couple is not an invariant. Conditions of equilibrium of a system of forces acting on a body.			transformation $T : IR^n \rightarrow IR^m$. Inverse of Linear Transformation. Non-singular Linear Transformation. Linear Transformation and Matrices : Matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces. Correspondence between Linear Transformations and Matrices. Linear Transformation is non-singular if its representative matrix be non-singular. Rank of L.T. = Rank of the corresponding matrix. [5] Group B (25 marks) <u>Tensor Calculus</u> A tensor as a generalized concept of a vector in an Euclidean space E^3. To generalize the idea in an n-dimensional space. Definition of E^n. Transformation of co-ordinates in E^n (n = 2, 3 as example). Summation convention. Contravariant and covariant vectors. Invariants. Contravariant, covariant and mixed tensors. The Kronecker delta. Algebra of tensors Symmetric and skew-symmetric tensors. Addition and scalar multiplication. Contraction. Outer and Inner products of tensors. Quotient law. Reciprocal Tensor. Riemannian space. Line element and metric tensor. Reciprocal metric tensor. Raising and lowering of indices with the help of metric tensor. Associated tensor. Magnitude of a vector. Inclination of two vectors. Orthogonal vectors. Christoffel symbols and their laws of transformations. Covariant differentiation of vectors and tensors. Group B (15marks) <u>Metric Space</u> Definition and examples of metric spaces. Open ball. Open set. Closed set defined as complement of open set. Interior point and interior of a set.

<table>
<tr>
<td rowspan="2">Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual work. Poisnot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of forces. [12]

Group C (20marks) <u>Analytical Dynamics of A ParticleII</u>

Central forces and central orbits. Typical features of central orbits. Stability of nearly circular orbits.

Planetary motion and Kepler's laws. Time of describing an arc of the orbit. Orbital energy. Relationship between period and semi-major axis. Motion of an artificial satellite.

Motion of a smooth cure under resistance. Motion of a rough curve under gravity e.g., circle, parabola, ellipse, cycloid etc.

Varying mass problems. Examples of falling raindrops and projected rockets.

Linear dynamical systems, preliminary notions: solutions, phase portraits, fixed or critical points. Plane autonomous systems. Concept of Poincare phase plane. Simple examples of damped oscillator and a simple pendulum. The two-variable case of a linear plane autonomous system. Characteristic polynomial. Focal, nodal and saddle points.
Module XII

Group A (25 marks) <u>Hydrostatics</u></td>
<td></td>
<td></td>
<td>Limit point, derived set and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary of a set. Diameter of a set and bounded set. Distance between a point and a set. [7]

Subspace of a metric space. Convergent sequence. Cauchy sequence. Every Cauchy sequence is bounded. Every convergent sequence is Cauchy, not the converse. Completeness : definition and examples. Cantor intersection theorem. IR is a complete metric space. Q is not complete. [4]

Group C(15 marks)

<u>Complex Analysis</u>

Extended complex plane. Stereographic projection.
Complex function : Limit , continuity and differentiability of complex functions. Cauchy-Riemann equations. Sufficient condition for differentiability of a complex function. Analytic functions. Harmonic functions. Conjugate harmonic functions. Relation between analytic function and harmonic function.</td>
</tr>
<tr>
<td>SS</td>
<td>5</td>
<td>Module XV Group A (25 marks)
<u>Numerical Analysis</u>

What is Numerical Analysis ?
Errors in Numerical computation : Gross error,</td>
</tr>
</table>

Definition of Fluid. Perfect Fluid, Pressure. To prove that the pressure at a point in fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids. To prove

- **(i)** In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane.
- **(ii)** In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths.
- **(iii)** In a fluid at rest under gravity horizontal planes re surfaces of equal density.
- **(iv)** When two fluids of different densities at rest under gravity do not mix, their surface of separation is a horizontal plane.

Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid on plane surface.

Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area. Position of the centre of pressure. Centre of pressure of a triangular area whose angular points are at different depths. Centre of pressure of a circular area. Position of the centre of pressure referred to co- ordinate axes through the centroid of the area. Centre of pressure of an elliptical area when its major axis is vertical or along the line of greatest slope. Effect of additional depth on centre of pressure.

Equilibrium of fluids in given fields of force : Definition of field of force, line of force. Pressure derivative in terms of force. Surface of equi-pressure. To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are *X, Y, Z* along the co-ordinate axes. To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the lines of force, (ii) when the force system is conservative, the surfaces of equal pressure are equi-potential surfaces and are also surfaces of equal density. To find the differential equations of the surfaces of equal pressure and density.

Round off error, Truncation error. Approximate numbers. Significant figures. Absolute, relative and percentage error.

Operators : Δ, □ , E, μ, δ (Definitions and simple relations among them).

Interpolation : Problems of interpolation, Weierstrass' approximation theorem only statement). Polynomial interpolation. Equispaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. error terms. General interpolation formulae : Deduction of Lagrange's interpolation formula. Divided difference. Newton's General Interpolation formula (only statement). Inverse interpolation.

Interpolation formulae using the values of both *f(x)* and its derivative *f(x)* : Idea of Hermite interpolation formula (only the basic concepts).

Numerical Differentiation based on Newton's forward & backward and Lagrange's formulae.

Numerical Integration : Integration of Newton's interpolation formula. Newton-Cote's formula. Basic Trapezoidal and Simpson's ⅓rd. formulae. Their composite forms. Weddle's rule (only statement). Statement of the error terms associated with these formulae. Degree of precision (only definition).

Numerical solution of non-linear equations : Location of a real root by tabular method. Bisection method. Secant/Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method.

Numerical solution of a system of linear equations : Gauss elimination method. Iterative method – Gauss-Seidal method. Matrix inversion

Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid contained in a vessel, revolves uniformly about a vertical axis. The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy. General propositions about small rotational displacements. To derive the condition for stability. Pressure of gases. The atmosphere. Relation between pressure, density and temperature. Pressure in an isothermal atmosphere. Atmosphere in convective equilibrium. Group B (25marks) <u>Rigid Dynamics</u> Momental ellipsoid, Equimomental system. Principal axis. D'Alembert's principle. D'Alembert's equations of motion. Principles of moments. Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy. Equation of motion of a rigid body about a fixed axis. Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation. Minimum time of oscillation. Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of rigid body moving in two dimensions. Necessary and sufficient			by Gauss elimination method (only problems – up to 3×3 order). Eigenvalue Problems : Power method for numerically extreme eigenvalues. Numerical solution or Ordinary Differential Equation : Basic ideas, nature of the problem. Picard, Euler and Runge-Kutta (4th order) methods (emphasis on the problems only). Group B (25 marks) <u>Computer Programming</u> Fundamentals of Computer Science and Computer Programming : Computer fundamentals : Historical evolution, computer generations, functional description, operating system, hardware & software. Positional number system : binary, octal, decimal,hexadecimalsystem. Binary arithmetic. Storing of data in a computer : BIT, BYTE, Word. Coding of data – ASCII, EBCDIC, etc. Algorithm and Glow Chart : Important features, Ideas about the complexities of algorithm. Application in simple problems. Programming languages : General concepts, Machine language, Assembly Language, High Level Languages, Compiler and Interpreter. Object and Source Program. Ideas about some major HLL.

condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane.
Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces. To show that (i) of there is a definite straight line such that the sum of the moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces.

Module XIII

Group A (20marks) Analysis IV

Improper Integral :

Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. [2]
Tests of convergence : Comparison and μ-test. Absolute and non-absolute convergence and interrelations. Abel's and Dirichlet's test for convergence of the integral of a product(statement only).
Convergence and working knowledge of Beta and Gamma function and their interrelation ((n)□(1□ n) □ $\frac{\pi}{\sin n\pi}$, 0 □ n □ 1, , to be assumed).

Computation of the integrals $\int_0^{\pi/2} sin^n x\, dx$, $\int_0^{\pi/2} cos^n x\, dx$ $\int_0^{\pi/2} tan^n x\, dx$ when they exist (using Beta and Gamma function)
Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier co-efficients for periodic functions defined on [□□ ,□]. Statement of Dirichlet's conditions
convergence. Statement of theorem of sum of Fourier

Students are required to opt for any one of the following two programming languages :

(iii) Programming with FORTRAM 77/90.

Or

(iv) Introduction to ANSI C.

Programming with FORTRAN 77/90 :

Introduction, Keywords, Constants and Variables – integer, real, complex, logical, character, double precision, subscripted. Fortran expressions. I/O statements-formatted and unformatted. Program execution control-logical if, if- then-else, etc. Arrays-Dimension statement. Repetitive computations – Do. Nested Do, etc. Sub-programs : Function sub program and Subroutine sub program.
Application to simple problems : Evaluation of functional values, solution of quadratic equations, approximate sum of convergent infinite series, sorting of real numbers, numerical integration, numerical solution of non-linear equations, numerical solution of ordinary differential equations, etc.

Introduction to ANSI C :

Character set in ANSI C. Key words : if, while, do, for, int, char, float etc.
Data type : character, integer, floating point, etc.
Variables, Operators : =,
= =, !!<, >, etc. (arithmetic, assignment, relational, logical, increment, etc.). Expresions : e.g. (a = = b) !! (b = = c), Statements : e.g. if (a>b) small = a; else small = b. Standard

series. [5] Multiple integral : Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Change of order of integration. Triple integral. Transformation of double and triple integrals (Problem only). Determination of volume and surface area by multiple integrals (Problem only). Group B (15marks) <u>Metric Space</u> Definition and examples of metric spaces. Open ball. Open set. Closed set defined as complement of open set. Interior point and interior of a set. Limit point, derived set and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary of a set. Diameter of a set and bounded set. Distance between a point and a set. [7] Subspace of a metric space. Convergent sequence. Cauchy sequence. Every Cauchy sequence is bounded. Every convergent sequence is Cauchy, not the converse. Completeness : definition and examples. Cantor intersection theorem. IR is a complete metric space. Q is not complete. [4] Group C(15 marks) <u>Complex Analysis</u> Extended complex plane. Stereographic projection. Complex function : Limit , continuity and differentiability of complex functions. Cauchy-Riemann equations. Sufficient condition for differentiability of a complex function. Analytic functions. Harmonic functions. Conjugate harmonic functions. Relation between analytic function and harmonic function.			input/output. Use of while, if…. Else, for, do…while, switch, continue, etc. Arrays, strings. Function definition. Running simple C Programs. Header File. [30] Boolean Algebra : Huntington Postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Statement of principle of duality. Disjunctive normal and Conjunctive normal forms of Boolean Expressions. Design of simple switching circuits. Module XVI <u>Practical</u> (Problem:30, Sessional Work:10, Viva:10) Using Calculator INTERPOLATION : Newton’s forward & Backward Interpolation. Stirling & Bessel’s Interpolation. Lagrange’s Interpolation & Newton’s Divided Difference Interpolation. Inverse Interpolation. Differentiation based on Newton’s Forward & Backward Interpolation Formulae. Numerical Integration : Trapezoidal Rule, Simpson’s ⅓ Rule and Weddle’s Formula.

Module XIV Group A (30 marks) <u>Probability</u> Mathematical Theory of Probability : Random experiments. Simple and compound events. Event space. Classical and frequency definitions of probability and their drawbacks. Axioms of Probability. Statistical regularity. Multiplication rule of probabilities. Bayes' theorem. Independent events. Independent random experiments. Independent trials. Bernouli trials and binomial law. Poisson trials. Random variables. Probability distribution. distribution function. Discrete and continuous distributions. Binomial, Poisson, Gamma, Uniform and Normal distribution. Poisson Process (only definition). Transformation of random variables. Two dimensional probability distributions. Discrete and continuous distributions in two dimensions. Uniform distribution and two dimensional normal distribution. Conditional distributions. transformation of random variables in two dimensions. Mathematical expectation. Mean, variance, moments, central moments. Measures of location, dispersion, skewness and kurtosis. Median, mode, quartiles. Moment- generating function. Characteristic function. Two-dimensional expectation. Covariance, Correlation co-efficient, Joint characteristic function. Multiplication rule for expectations. Conditional expectation. Regression curves, least square regression lines and parabolas. Chi-square and *t*-distributions and their important properties (Statements only). Tchebycheff's inequality. Convergence in probability. Statements of : Bernoulli's limit theorem. Law of large numbers. Poissons's approximation to binomial distribution and normal approximation to binomial distribution. Concepts of asymptotically normal distribution. Statement of central limit theorem in the case of equal components and of limit theorem for characteristic functions			Solution of Equations : Bisection Method, Regula Falsi, Fixed Point Iteration. Newton-Raphson formula (including modified form for repeated roots and complex roots). Solution of System of Linear Equations : Gauss' Elimination Method with partial pivoting, Gauss-Seidel/Jordon Iterative Method, Matrix Inversion. Dominant Eigenpair of a (4×4) real symmetric matrix and lease eigen value of a (3×3) real symmetric matrix by Power Method. Numerical Solution of first order ordinary Differential Equation (given the initial condition) by : Picard' Method, Euler Method, Heun's Method, Modified Euler's Method, 4^{th} order Runge-Kutta Method. Problems of Curve Fitting : To fit curves of the form y=a+bx, $y=a+bx+cx^2$, exponential curve of the form $y=ab^x$, geometric curve $y=ax^b$ by Least Square Method. ON COMPUTER : The following problems should be done on computer using either FORTRAN or C language : (v) To find a real root of an equation by Newton-Raphson Method. (vi) Dominant eigenpair by Power Method. (vii) Numerical Integration by Simpson's ⅓ Rule. To solve numerically Initial Value Problem by Euler's and RK_4 Method.

(Stress should be more on the distribution function theory than on combinatorial problems. Difficult combinatorial problems should be avoided). Group B (20 marks) <u>Statistics</u> Random sample. Concept of sampling and various types of sampling. Sample and population. Collection, tabulation and graphical representation. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased and consistent estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal populations. Bivariate samples. Scatter diagram. Sample correlation co-efficient. Least square regression lines and parabolas. Estimation of parameters. Method of maximum likelihood. Applications to binomial, Poisson and normal population. Confidence intervals. Interval estimation for parameters of normal population. Statistical hypothesis. Simple and composite hypothesis. Best critical region of a test. Neyman-Pearson theorem (Statement only) and its application to normal population. Likelihood ratio testing and its application to normal population. Simple applications of hypothesis testing. Module XV Group A (25 marks) <u>Numerical Analysis</u> What is Numerical Analysis ? Errors in Numerical computation : Gross error, Round off error,	MFM	2	Group (20marks) <u>Analytical Statics II</u> Centre of Gravity: General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration. [3] Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work. Stable and unstable equilibrium. Coordinates of a body and of a system of bodies. Field of forces. Conservative field. Potential energy of a system. The energy test of stability. Condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones. [6] Forces in the three dimensions. Moment of a force about a line. Axis of a couple. Resultant of any two couples acting on a body. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Resultant force is an invariant of the system but the resultant couple is not an invariant. Conditions of equilibrium of a system of forces

Truncation error. Approximate numbers. Significant figures. Absolute, relative and percentage error.

Operators : Δ, □ , E, μ, δ (Definitions and simple relations among them).

Interpolation : Problems of interpolation, Weierstrass' approximation theorem only statement). Polynomial interpolation. Equispaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. error terms. General interpolation formulae : Deduction of Lagrange's interpolation formula. Divided difference. Newton's General Interpolation formula (only statement). Inverse interpolation.

Interpolation formulae using the values of both *f(x)* and its derivative *f(x)* : Idea of Hermite interpolation formula (only the basic concepts).

Numerical Differentiation based on Newton's forward & backward and Lagrange's formulae.

Numerical Integration : Integration of Newton's interpolation formula. Newton-Cote's formula. Basic Trapezoidal and Simpson's ⅓rd. formulae. Their composite forms. Weddle's rule (only statement). Statement of the error terms associated with these formulae. Degree of precision (only definition).

Numerical solution of non-linear equations : Location of a real root by tabular method. Bisection method. Secant/Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method.

Numerical solution of a system of linear equations : Gauss elimination method. Iterative method – Gauss-Seidal method. Matrix inversion by Gauss elimination method (only problems – up to 3×3 order).

Eigenvalue Problems : Power method for numerically extreme eigenvalues.

Numerical solution or Ordinary Differential Equation : Basic ideas, nature of the problem. Picard, Euler and Runge-Kutta (4^{th} order) methods (emphasis on the problems only).

acting on a body. Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual work. Poisnot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of forces.

[12]

Group C (20marks) <u>Analytical</u>

<u>Dynamics of A ParticleII</u>

Central forces and central orbits. Typical features of central orbits. Stability of nearly circular orbits.

Planetary motion and Kepler's laws. Time of describing an arc of the orbit. Orbital energy. Relationship between period and semi-major axis. Motion of an artificial satellite.

Motion of a smooth cure under resistance. Motion of a rough curve under gravity e.g., circle, parabola, ellipse, cycloid etc.

Varying mass problems. Examples of falling raindrops and projected rockets.

Linear dynamical systems, preliminary notions: solutions, phase portraits, fixed or critical points.

Group B (25 marks) <u>Computer Programming</u> Fundamentals of Computer Science and Computer Programming : Computer fundamentals : Historical evolution, computer generations, functional description, operating system, hardware & software. Positional number system : binary, octal, decimal,hexadecimalsystem. Binary arithmetic. Storing of data in a computer : BIT, BYTE, Word. Coding of data – ASCII, EBCDIC, etc. Algorithm and Glow Chart : Important features, Ideas about the complexities of algorithm. Application in simple problems. Programming languages : General concepts, Machine language, Assembly Language, High Level Languages, Compiler and Interpreter. Object and Source Program. Ideas about some major HLL. Students are required to opt for any one of the following two programming languages : (i) Programming with FORTRAM 77/90. Or (ii) Introduction to ANSI C. Programming with FORTRAN 77/90 : Introduction, Keywords, Constants and Variables – integer, real, complex, logical, character, double precision, subscripted. Fortran expressions. I/O statements-formatted and unformatted. Program execution control-logical if, if- then-else, etc. Arrays-Dimension statement. Repetitive computations – Do. Nested Do, etc. Sub-programs : Function sub program and Subroutine sub program. Application to simple problems : Evaluation of functional values,			Plane autonomous systems. Concept of Poincare phase plane. Simple examples of damped oscillator and a simple pendulum. The two-variable case of a linear plane autonomous system. Characteristic polynomial. Focal, nodal and saddle points. Group B (25marks) <u>Rigid Dynamics</u> Momental ellipsoid, Equimomental system. Principal axis. D'Alembert's principle. D'Alembert's equations of motion. Principles of moments. Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy. Equation of motion of a rigid body about a fixed axis. Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation. Minimum time of oscillation. Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of rigid body moving in two dimensions. Necessary and sufficient condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane. Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces. To show that (i) of there is a definite straight line such that the sum of the

<table>
<tr>
<td rowspan="2">solution of quadratic equations, approximate sum of convergent infinite series, sorting of real numbers, numerical integration, numerical solution of non-linear equations, numerical solution of ordinary differential equations, etc.
Introduction to ANSI C :

Character set in ANSI C. Key words : if, while, do, for, int, char, float etc. Data type : character, integer, floating point, etc. Variables, Operators : =, = =, !!<, >, etc. (arithmetic, assignment, relational, logical, increment, etc.). Expresions : e.g. (a = = b) !! (b = = c), Statements : e.g. if (a>b) small = a; else small = b. Standard input/output. Use of while, if…. Else, for, do…while, switch, continue, etc. Arrays, strings. Function definition. Running simple C Programs. Header File. [30]

Boolean Algebra : Huntington Postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Statement of principle of duality. Disjunctive normal and Conjunctive normal forms of Boolean Expressions. Design of simple switching circuits.
Module XVI

<u>Practical</u>
(Problem:30, Sessional Work:10, Viva:10)

Using Calculator

INTERPOLATION :
Newton's forward & Backward
Interpolation. Stirling & Bessel's
Interpolation.
Lagrange's Interpolation & Newton's Divided Difference
Interpolation. Inverse Interpolation.
Differentiation based on Newton's Forward & Backward
Interpolation Formulae.</td>
<td></td>
<td></td>
<td>moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces.</td>
</tr>
<tr>
<td>KT</td>
<td>4</td>
<td>Module XII

Group A (25 marks)

<u>Hydrostatics</u>

Definition of Fluid. Perfect Fluid, Pressure. To prove that the pressure at a point in fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids. To prove

(i) In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane.
(ii) In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths.
(iii) In a fluid at rest under gravity horizontal planes re surfaces of equal density.
(iv) When two fluids of</td>
</tr>
</table>

Numerical Integration : Trapezoidal Rule, Simpson's ⅓ Rule and Weddle's Formula. Solution of Equations : Bisection Method, Regula Falsi, Fixed Point Iteration. Newton-Raphson formula (including modified form for repeated roots and complex roots). Solution of System of Linear Equations : Gauss' Elimination Method with partial pivoting, Gauss-Seidel/Jordon Iterative Method, Matrix Inversion. Dominant Eigenpair of a (4×4) real symmetric matrix and lease eigen value of a (3×3) real symmetric matrix by Power Method. Numerical Solution of first order ordinary Differential Equation (given the initial condition) by : Picard' Method, Euler Method, Heun's Method, Modified Euler's Method, 4^{th} order Runge-Kutta Method. Problems of Curve Fitting : To fit curves of the form y=a+bx, $y=a+bx+cx^2$, exponential curve of the form $y=ab^x$, geometric curve $y=ax^b$ by Least Square Method. ON COMPUTER : The following problems should be done on computer using either FORTRAN or C language : (i) To find a real root of an equation by Newton-Raphson Method. (ii) Dominant eigenpair by Power Method. (iii) Numerical Integration by Simpson's ⅓ Rule. (iv) To solve numerically Initial Value Problem by Euler's and RK_4 Method.			different densities at rest under gravity do not mix, their surface of separation is a horizontal plane. Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid on plane surface. Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area. Position of the centre of pressure. Centre of pressure of a triangular area whose angular points are at different depths. Centre of pressure of a circular area. Position of the centre of pressure referred to co- ordinate axes through the centroid of the area. Centre of pressure of an elliptical area when its major axis is vertical or along the line of greatest slope. Effect of additional depth on centre of pressure. Equilibrium of fluids in given fields of force : Definition of field of force, line of force. Pressure derivative in terms of force. Surface of equi-pressure. To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are *X, Y, Z* along the co-ordinate axes. To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the lines of force, (ii) when the force system is conservative, the surfaces of equal pressure are equi-potential surfaces and are also surfaces of equal density. To find the differential equations of the surfaces of equal pressure and density. Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a

			mass of homogeneous liquid contained in a vessel, revolves uniformly about a vertical axis. The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy. General propositions about small rotational displacements. To derive the condition for stability. Pressure of gases. The atmosphere. Relation between pressure, density and temperature. Pressure in an isothermal atmosphere. Atmosphere in convective equilibrium. Module XIV Group A (30 marks) Probability Mathematical Theory of Probability : Random experiments. Simple and compound events. Event space. Classical and frequency definitions of probability and their drawbacks. Axioms of Probability. Statistical regularity. Multiplication rule of probabilities. Bayes' theorem. Independent events. Independent random experiments. Independent trials. Bernouli trials and binomial law. Poisson trials. Random variables. Probability distribution. distribution function. Discrete and continuous distributions. Binomial, Poisson, Gamma, Uniform and Normal distribution. Poisson Process (only definition). Transformation of random variables. Two dimensional probability distributions. Discrete and continuous

			distributions in two dimensions. Uniform distribution and two dimensional normal distribution. Conditional distributions. transformation of random variables in two dimensions. Mathematical expectation. Mean, variance, moments, central moments. Measures of location, dispersion, skewness and kurtosis. Median, mode, quartiles. Moment- generating function. Characteristic function. Two-dimensional expectation. Covariance, Correlation co-efficient, Joint characteristic function. Multiplication rule for expectations. Conditional expectation. Regression curves, least square regression lines and parabolas. Chi-square and *t*-distributions and their important properties (Statements only). Tchebycheff's inequality. Convergence in probability. Statements of : Bernoulli's limit theorem. Law of large numbers. Poissons's approximation to binomial distribution and normal approximation to binomial distribution. Concepts of asymptotically normal distribution. Statement of central limit theorem in the case of equal components and of limit theorem for characteristic functions (Stress should be more on the distribution function theory than on combinatorial problems. Difficult combinatorial problems should be avoided).
	TS	2	Section – II : Modern Algebra III (10 marks) Normal sub-groups of a Group : Definition and examples. Intersection, union of normal sub-groups. Prefect of a normal sub-group and a sub-

			group. Quotient Group of a Group by a normal sub-group. [5] Homomorphism and Isomorphism of Groups. Kernel of a Homomorphism. First Isomorphism Theorem. Properties deducible from definition of morphism. An infinite cyclic group is isomorphic to (Z,+) and a finite cyclic group of order *n* is isomorphic to the group of residue classes modulo *n*. Group B (20 marks) <u>Statistics</u> Random sample. Concept of sampling and various types of sampling. Sample and population. Collection, tabulation and graphical representation. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased and consistent estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal populations. Bivariate samples. Scatter diagram. Sample correlation co-efficient. Least square regression lines and parabolas. Estimation of parameters. Method of maximum likelihood. Applications to binomial, Poisson and normal population. Confidence intervals. Interval estimation for parameters of normal population. Statistical hypothesis. Simple and composite hypothesis. Best critical region of a test. Neyman-Pearson theorem

			(Statement only) and its application to normal population. Likelihood ratio testing and its application to normal population. Simple applications of hypothesis testing.

SEM-I(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
<u>Unit-1</u> : Algebra-I (15 Marks) Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions. Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications. Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.	SC	0	
	NM	1	<u>Unit-2</u> : Differential Calculus-I (25 Marks) Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included). Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity. Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation. Successive derivative - Leibnitz's theorem and its application.

<table>
<tr>
<td rowspan="4">Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-2</u> : Differential Calculus-I (25 Marks)

Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity.

Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation.

Successive derivative - Leibnitz's theorem and its application.

Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).</td>
<td></td>
<td></td>
<td>Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).</td>
</tr>
<tr>
<td>SS</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td><u>Unit-1</u> : Algebra-I (15 Marks)

Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions.

Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications.

Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation$f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b.

(ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2"><u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.

<u>Unit-4</u> : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.

Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal.

Sphere and its tangent plane. Right circular cone.</td>
<td></td>
<td></td>
<td>Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td><u>Unit-4</u> : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.</td>
</tr>
</table>

			Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal. Sphere and its tangent plane. Right circular cone.

PART-II(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MODULE III Group A (25 marks) Modern Algebra Basic concept : Sets, Sub-sets, Equality of sets, Operations on sets : Union, intersection and complement. Verification of the laws of Algebra of sets and De Morgan's Laws. Cartesian product of two sets. Mappings, One-One and onto mappings. Composition of Mappings – concept only, Identity and Inverse mappings. Binary Operations in a set. Identity element. Inverse element. Introduction of Group Theory : Definition and examples taken from various branches (examples from number system, roots of unity, 2 x 2 real matrices, non-singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub-group – Statement of necessary and sufficient condition – its applications. Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field.	SC	2	MODULE III Group A (25 marks) Modern Algebra Basic concept : Sets, Sub-sets, Equality of sets, Operations on sets : Union, intersection and complement. Verification of the laws of Algebra of sets and De Morgan's Laws. Cartesian product of two sets. Mappings, One-One and onto mappings. Composition of Mappings – concept only, Identity and Inverse mappings. Binary Operations in a set. Identity element. Inverse element. Introduction of Group Theory : Definition and examples taken from various branches (examples from number system, roots of unity, 2 x 2 real matrices, non-singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub-group – Statement of necessary and sufficient condition – its applications. Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field.

<table>
<tr>
<td rowspan="2">Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite set of vectors, Sup-space. Concepts of generators and basis of a finite-dimensional vector space. Problems on formation of basis of a vector space (No proof required).
Real Quadratic Form involving not more than three variables – Problems only.
Characteristic equation of a square matrix of order not more than three – determination of Eigen Values and Eigen Vectors – Problems only. Statement and illustration of Cayley-Hamilton Theorem.

Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u>

Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines.
Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes.
Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines.
Sphere and its tangent plane.
Right circular cone.

<u>MODULE IV</u>

Group A (25 marks)
<u>Differential Calculus</u>

Statement of Rolle’s theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin’s Theorems with Lagrange’s and Cauchy’s</td>
<td></td>
<td></td>
<td>Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite set of vectors, Sup-space. Concepts of generators and basis of a finite-dimensional vector space. Problems on formation of basis of a vector space (No proof required).
Real Quadratic Form involving not more than three variables – Problems only.
Characteristic equation of a square matrix of order not more than three – determination of Eigen Values and Eigen Vectors – Problems only. Statement and illustration of Cayley-Hamilton Theorem.</td>
</tr>
<tr>
<td>NM</td>
<td>1</td>
<td><u>MODULE IV</u>

Group A (25 marks)
<u>Differential Calculus</u>

Statement of Rolle’s theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin’s Theorems with Lagrange’s and Cauchy’s form of remainders. Taylor’s and Maclaurin’s Infinite series for functions like
e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary]
Indeterminate Forms : L’Hospital’s Rule : Statement and problems only.
Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz’s Theorem on commutative property of mixed derivatives. Euler’s theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange’s Method of undetermined multiplier – Problems only. Implicit function in</td>
</tr>
</table>

<table>
<tr>
<td rowspan="4">form of remainders. Taylor's and Maclaurin's Infinite series for functions like
e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary]
Indeterminate Forms : L'Hospital's Rule : Statement and problems only.
Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative.

Group-B (15-Marks)

<u>Integral Calculus</u>

Reduction formulae of $\int sin^n x cos^m x\, dx$, $\int \frac{sin^n x}{cos^m x}\, dx$, $\int tan^n\, dx$ and associated problems (m and n are non-negative integers).
Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only.
Use of Beta and Gamma functions (convergence and important relations being assumed).
Working knowledge of Double integral.
Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.</td>
<td></td>
<td></td>
<td>case of function of two variables (existence assumed) and derivative.

Group-B (15-Marks)

<u>Integral Calculus</u>

Reduction formulae of $\int sin^n x cos^m x\, dx$, $\int \frac{sin^n x}{cos^m x}\, dx$, $\int tan^n\, dx$ and associated problems (m and n are non-negative integers).
Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only.
Use of Beta and Gamma functions (convergence and important relations being assumed).
Working knowledge of Double integral.
Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.</td>
</tr>
<tr>
<td>SS</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>2</td>
<td>Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u>

Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines.
Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes.
Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines.
Sphere and its tangent plane.
Right circular cone.</td>
</tr>
</table>

Group C (10 marks) <u>Differential Equations</u> Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.			Group C (10 marks) <u>Differential Equations</u> Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.
	TS	0	

PART-III(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
	SC	0	
<u>MODULE V</u> Group A (20 marks) <u>Numerical Methods</u> Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage. Operators - □ , □ and E (Definitions and some relations among them). Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton's Forward Interpolation Formula. Remainder term (expression only). Newton's Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange's	NM	2	(50 marks) <u>Computer Science & Programming</u> Boolean algebra – Basic Postulates and Definition. Tow-element Boolean algebra. Boolean function. Truth table. Standard form of Boolean function – DNF and CNF. Minterms and maxterms. Principle of Duality. Some laws and theorem of Boolean algebra. Simplification of Boolean expressions – Algebraic method and Karnaugh Map method. Application of Boolean algebra – Switching Circuits, Circuit having some specified properties, Logical Gates – AND, NOT, OR, NAND, NOR etc. Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy – Different

Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments. Number Integration : Trapezoidal and Simpson's ⅓rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems. (Note : emphasis should be given on problems) Group B (30 marks) <u>Linear Programming</u> Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions. <u>MODULE VI</u> (Any <u>one</u> of the following groups)			Components of a Computer System. Operating System, Hardware and Software. Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer – BIT, BYTE, WORD, etc. Coding of a data – ASCII , etc. Programming Language : Machine Language, Assembly language and High level language. Compiler and Interpreter. Object Programme and Source Programme. Ideas about some HLL – e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc. Algorithms and Flow Charts – their utilities and important features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/99 : Introduction, Data Type – Keywords, Constants and Variables – Integer, Real, Complex, Logical, Character, Subscripted Variables, Fortran Expressions. I/O Statements – formatted and unformatted. Programme execution control – Logical if, if-then-else, etc. Arrays, dimension statement. Repetitive Computation – Do, Bested Do etc. Sub Programs – (i) Function Sub Programme (ii) Subroutine Sub Programme <u>MODULE VIII</u> (Any <u>one</u> of the following groups) <u>Group A</u> <u>A Course of Calculus</u> Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the

<u>Group A</u> <u>Analytical</u> <u>Dynamics</u> Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. Central orbit. Kepler's laws of motion. Motion under inverse square law. OR <u>Group B</u> <u>Probability and Statistics</u> Elements of Probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equality like and Exhaustive, Classical definition of Probability, theorems of			limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems. Fourier series on (-π, π) : Periodic function. Determination of Fourier co- efficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Third and Fourth order ordinary differential equation with constant co- efficients. Euler's Homogeneous Equation. Second order differential equation : (a) Method of variation of parameters. (b) Method of undetermined co-efficients. (c) Simple eigenvalue problem. Simultaneous linear differential equation with constant co-efficients. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant eo-efficients. Partial Differential Equation (PDE) : Introduction, Formation of PDE, Solutions of PDE, Lagrange's method of solution.
	SS	0	
	MFM	2	<u>MODULE V</u>

Total Probability, Conditional Probability and Statistical Independence. Bayes' theorem. Problems. Shortcomings of the classical definition. Axiomatic approach – Problems. Random Variable and its Expectation. Theorems on mathematical expectation. Joint distribution of two random variables. Theoretical Probability Distribution – Discrete and Continuous (p.m.f. pd.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes, Primary data and secondary data. Population and sample. Census and Sample Survey. Tabulation – Chart and Diagram, graph, Bar diagram, Pie diagram etc. Frequency Distribution – Un-grouped and grouped cumulative frequency distribution. Histogram, Frequency curve, Measure of Central Tendencies – Average : AM, GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions – Range, Quartile Deviation, Mean Deviation, Variance/S.D., Moments, Skewness and Kurtosis. Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples. Statistic and Parameter, Sampling Distribution – standard error of a statistic (e.g. sample mean, sample proportion). Four fundamental distributions derived from the normal : (i) Standard Normal Distribution, (ii) Chi-square distribution, (iii) Student's distribution, (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation – Point estimation and Interval estimation. Confidence Inter/Confidence Limit. Statistical Hypothesis – Bull Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and Type II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Correlation co-efficient – Definition and properties. Regression lines. Time Series : Definition. Why to analyze Time series data ? Components. Measurement of Trend – (i) Moving Average			Group A (20 marks) <u>Numerical Methods</u> Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage. Operators - □ , □ and E (Definitions and some relations among them). Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton's Forward Interpolation Formula. Remainder term (expression only). Newton's Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange's Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments. Number Integration : Trapezoidal and Simpson's ⅓rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems. (Note : emphasis should be given on problems) Group B (30 marks) <u>Linear Programming</u> Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of

Method, (ii) Curve Fittings (linear and quadratic curve). (Ideas of other curves, e.g. exponential curve etc.). Ideas about the measurement of other components.

Index Number : Meaning of Index Number. Construction of Price Index Number. Consumer Price Index Number. Calculation of Purchasing Power of Rupee.

MODULE VII

(50 marks)

Computer Science & Programming

Boolean algebra – Basic Postulates and Definition. Tow-element Boolean algebra. Boolean function. Truth table. Standard form of Boolean function – DNF and CNF. Minterms and maxterms. Principle of Duality. Some laws and theorem of Boolean algebra. Simplification of Boolean expressions – Algebraic method and Karnaugh Map method. Application of Boolean algebra

– Switching Circuits, Circuit having some specified properties, Logical Gates

– AND, NOT, OR, NAND, NOR etc.

Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy – Different Components of a Computer System. Operating System, Hardware and Software.

Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer – BIT, BYTE, WORD, etc. Coding of a data – ASCII , etc.

Programming Language : Machine Language, Assembly language and High level language. Compiler and Interpreter. Object Programme and Source Programme. Ideas about some HLL – e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc.

Algorithms and Flow Charts – their utilities and important

KT	0
TS	0

a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality.

Transportation and Assignment problem and their optimal solutions.

MODULE VI

(Any one of the following groups)

Group A Analytical Dynamics

Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.

Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle

moving in a straight line, (ii) moving in a plane.

Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.

Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

Central orbit. Kepler's laws of motion. Motion under inverse square law.

features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/99 : Introduction, Data Type – Keywords, Constants and Variables – Integer, Real, Complex, Logical, Character, Subscripted Variables, Fortran Expressions.

I/O Statements – formatted and unformatted. Programme execution control – Logical if, if-then-else, etc. Arrays, dimension statement. Repetitive Computation – Do, Bested Do etc.

Sub Programs – (i) Function Sub Programme
(ii) Subroutine Sub Programme

MODULE VIII

(Any one of the following groups)

Group A

A Course of Calculus

Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series.

Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems.

Fourier series on (-π, π) : Periodic function. Determination of Fourier co- efficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Third and Fourth order ordinary differential equation with constant co- efficients. Euler's Homogeneous Equation. Second order differential equation : (a) Method of variation of parameters. (b) Method of undetermined co-efficients. (c) Simple eigenvalue problem. Simultaneous linear differential equation with constant co-efficients. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant eo-efficients. Partial Differential Equation (PDE) : Introduction, Formation of PDE, Solutions of PDE, Lagrange's method of solution. OR Group B Discrete Mathematics Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbitrary base. Prime integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid's Theorem. Linear Diophantine Equations. (Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer			

operations with integers – Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid’s Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation – when such an equation has solution, some applications). Congruences : Congruence relation on integers, Basic properties of this relation. Linear Congruences, Chinese Remainder Theorem. System of Linear Congruences. (Definition of Congruence – to show it is an equivalence relation, to prove the following : a □ b (mod m) implies (i) (a+c) □ (b+c) (mod m) (ii) ac □ bc (mod m) (iii) a^n □ b^n (mod m), for any polynomial f(x) with integral coefficients f(a) □ f(b) (mod m) etc. Linear Congruence, to show how to solve these congruences, Chinese remainder theorem – Statement and proof and some applications. System of linear congruences, when solution exists – some applications). Application of Congruences : Divisibility tests. Computer file, Storage and Hashing functions. Round-Robin Tournaments. Check-digit in an ISBN, in Universal Product Code, in major Credit Cards. Error detecting capability. (Using Congruence, develop divisibility tests for integers base on their expansions with respect to different bases, if d divides (b-1) then n = $(a_k a_{k-1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. A university wishes to store a file for each of its students in its computer. Systematic methods of arranging files have been developed based on Hashing functions h(k) □ k (mod m). Discuss different properties of this congruence and also problems based on this congruence. Check digits for different identification numbers – International standard book number, universal product code etc. Theorem regarding error detecting capability). Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat’s little theorem. Euler’s Theorem. Wilson’s theorem. Some simple applications.			

(Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat’s little theorem. Euler’s theorem. Wilson’s theorem – Statement, proof and some applications). Recurrence Relations and Generating functions : Recurrence Relations. The method of Iteration. Linear difference equations with constant coefficients. Counting with generating functions. Boolean Algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			

Lesson Plane for Academic Year: 2019-2020

EVEN SEM

Sem-II(HONS)

Syllabus	Name of Teacher	No. of Classes	Distribution of Syllabus
Unit-1 • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R. • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R. **Unit-2** • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.	SC	2	**Unit-1** • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.
	NM	3	**Unit-1** • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R.

• Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $\lvert l\rvert < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems. Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence. Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence. **Unit-1** • Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta- tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.			**Unit-2** • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits. • Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $\lvert l\rvert < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems.
	SS	3	**Unit-1** • Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta- tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.
	MFM	2	**Unit-2** • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's

Unit-2 • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem. **Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems			Little theorem.
	KT	4	**Unit-2** Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup$\{x_n, x_{n+1}, \ldots,\}$ and lim inf x_n = sup inf$\{x_n, x_{n+1}, \ldots,\}$ h Equivalence between these definitions is assumedi . A bounded sequence $\{x_n\}$ is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence. Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.
	TS	2	**Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems

SEM IV(Hons)

<table>
<tr><th>Syllabus</th><th>Name of Teachers</th><th>No . of Classes</th><th>Distribution of Syllabus</th></tr>
<tr><td rowspan="2"><u>Riemann Integration & Series of Functions</u>

<u>Unit-1</u> : Riemann integration

• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem.
Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability.

• Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann
integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions.

• Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results.

• Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0.

• Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

Unit-2 :

Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper</td><td>SC</td><td>3</td><td>• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem.
Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability.

• Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann
integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions.

• Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results.

• Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0.

• Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.</td></tr>
<tr><td>NM</td><td>3</td><td>Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and</td></tr>
</table>

integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product. Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma$ (1- n) □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed). Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function) Unit-3 : Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. • Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.			Dirichlet's test for convergence on the integral of a product.
	SS	2	Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma$ (1- n) □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed). Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function) Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.
	MFM	1	Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.
	KT	3	Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. •
	TS	5	Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties.

			Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

Part III(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

Module IX <u>Analysis III (50 marks)</u> Compactness in IR : Open cover of a set. Compact set in IR, a set is compact iff it is closed and bounded. Function of bounded variation (BV) : Definition and examples. Monotone function is of BV. If *f* is on BV on [a,b] then *f* is bounded on [a,b]. Examples of functions of BV which are not continuous and continuous functions not of BV. Definition of variation function. Necessary and sufficient condition for a function *f* to be of BV on [a,b] is that *f* can be written as the difference of two monotonic increasing functions on[a,b]. Definition of rectifiable curve. A plane curve $\gamma = (f,g)$ is rectifiable if *f* and *g* both are of bounded variation (statement only). Length of a curve (simple problems only). Riemann integration : Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum U (P,f) and lower Darboux sum L(P,f) and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann intergrability. Continuous functions are Riemann integrable. Definition of a set of measure zero (or negligible set or zero set) as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of sets of measure zero : any subset of a set of measure zero, countable set, countable union of sets of measure zero. Concept of oscillation of a function at a point. A function is continuous at *x* if its oscillation at *x* is zero. A bounded function on a closed and bounded interval is Riemann integrable if the set of points of discontinuity is a set of measure zero (Lebesgue's theorem on Riemann integrable function). Problems on Riemann integrability	SC	3	**Module IX** **<u>Analysis III (50 marks)</u>** Compactness in IR : Open cover of a set. Compact set in IR, a set is compact iff it is closed and bo unded. Function of bounded variation (BV) : Definition and examples. Monotone function is of BV. If *f* is on BV on [a,b] then *f* is bounded on [a,b]. Examples of functions of BV which are not continuous and continuous functions not of BV. Definition of variation function. Necessary and sufficient condition for a function *f* to be of BV on [a,b] is that *f* can be written as the difference of two monotonic increasing functions on[a,b]. Definition of rectifiable curve. A plane curve $\gamma = (f,g)$ is rectifiable if *f* and *g* both are of bounded variation (statement only). Length of a curve (simple problems only). Riemann integration : Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum U (P,f) and lower Darboux sum L(P,f) and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann intergrability. Continuous functions are Riemann integrable. Definition of a set of measure zero (or negligible set or zero set) as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of sets of measure zero : any subset of a set of measure zero, countable set, countable union of sets of measure zero. Concept of oscillation of a function at a point. A function is continuous at *x* if its oscillation at *x* is zero. A bounded function on a closed

of functions with sets of points of discontinuity having measure zero. Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Properties of Riemann integrable functions arising from the above results. Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Fundamental theorem of integral calculus. First mean value theorem of integral calculus. Statement of second mean value theorems of integrals calculus (both Bonnet's and Weierstrass' form). Sequence and Series of functions of a real variable : Sequence of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only). Weierstrass's M-test. Limit function : Boundedness, Repeated limits, Continuity, Integrability and differentiability of the limit function of sequence of functions in case of uniform convergence. Series of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only), Tests of uniform convergence – Weierstrass' M-test. Statement of Abel's and Dirichlet's test and their applications. Passage to the limit term by term. Sum function : boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Abel's limit theorems. Uniqueness of power series having sum function.			and bounded interval is Riemann integrable if the set of points of discontinuity is a set of measure zero (Lebesgue's theorem on Riemann integrable function). Problems on Riemann integrability of functions with sets of points of discontinuity having measure zero. Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Properties of Riemann integrable functions arising from the above results. Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Fundamental theorem of integral calculus. First mean value theorem of integral calculus. Statement of second mean value theorems of integrals calculus (both Bonnet's and Weierstrass' form). Sequence and Series of functions of a real variable : Sequence of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only). Weierstrass's M- test. Limit function : Boundedness, Repeated limits, Continuity, Integrability and differentiability of the limit function of sequence of functions in case of uniform convergence. Series of functions defined on a set : Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Dini's theorem on uniform convergence (statement only), Tests of uniform convergence – Weierstrass' M-test. Statement of Abel's and Dirichlet's test and their applications. Passage to the limit term by term. Sum function : boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of

Module X Group A (20 marks)

Linear Algebra II & Modern Algebra III

Section – I : Linear Algebra II (10 marks)

Linear Transformation (L.T.) on Vector Spaces : Definition of L.T., Null space, range space of an L.T., Rank and Nullity, Sylvester's Law of Nullity. [Rank (T) + Nullity (T) = dim (V)]. Determination of rank (T), Nullity (T) of linear transformation $T : IR^n \to IR^m$. Inverse of Linear Transformation. Non-singular Linear Transformation.

Linear Transformation and Matrices : Matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces. Correspondence between Linear Transformations and Matrices. Linear Transformation is non-singular if its representative matrix be non-singular. Rank of L.T. = Rank of the corresponding matrix. [5]

Section – II : Modern Algebra III (10 marks)

Normal sub-groups of a Group : Definition and examples. Intersection, union of normal sub-groups. Prefect of a normal sub-group and a sub- group. Quotient Group of a Group by a normal sub-group. [5]

Homomorphism and Isomorphism of Groups. Kernel of a Homomorphism. First Isomorphism Theorem. Properties deducible from definition of morphism. An infinite cyclic group is isomorphic to (Z,+) and a finite cyclic group of order *n* is isomorphic to the group of

power series. Properties of sum function. Abel's limit theorems. Uniqueness of power series having sum function.

Module XIII

Group A (20marks) Analysis IV

Improper Integral :

Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. [2]

Tests of convergence : Comparison and μ-test. Absolute and non-absolute convergence and interrelations. Abel's and Dirichlet's test for convergence of the integralof a product (statement only).

Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\Gamma(1-n) = \frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} cos^n x\,dx$ $\int_0^{\frac{\pi}{2}} tan^n x\,dx$ when they exist (using Beta and Gamma function)

Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier co-efficients for periodic functions defined on $[-\pi, \pi]$. Statement of Dirichlet's conditions convergence. Statement of theorem of sum of Fourier series. [5]

Multiple integral : Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Change of order of integration. Triple integral. Transformation of double and triple integrals (Problem only). Determination of volume and surface area by multiple integrals (Problem only).

<table>
<tr>
<td rowspan="2">residue classes modulo n.

Group B (25 marks) <u>Tensor Calculus</u>

A tensor as a generalized concept of a vector in an Euclidean space E^3. To generalize the idea in an n-dimensional space. Definition of E^n. Transformation of co-ordinates in E^n (n = 2, 3 as example). Summation convention.

Contravariant and covariant vectors. Invariants. Contravariant, covariant and mixed tensors. The Kronecker delta. Algebra of tensors Symmetric and skew-symmetric tensors. Addition and scalar multiplication. Contraction. Outer and Inner products of tensors. Quotient law. Reciprocal Tensor. Riemannian space. Line element and metric tensor. Reciprocal metric tensor. Raising and lowering of indices with the help of metric tensor. Associated tensor. Magnitude of a vector. Inclination of two vectors. Orthogonal vectors. Christoffel symbols and their laws of transformations. Covariant differentiation of vectors and tensors. [15]

Group C (15marks) <u>Differential Equations II</u>

Laplace Transformation and its application in ordinary differential equations : Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Laplace Transform of derivatives. Laplace transform of integrals. Convolution theorem (Statement only). Application to the solution of ordinary differential equations of second order with constant coefficients.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NM</td>
<td>4</td>
<td>Module X Group A (20 marks)
<u>Linear Algebra II</u>

Section – I : Linear Algebra II (10 marks)

Linear Transformation (L.T.) on Vector Spaces : Definition of L.T., Null space, range space of an L.T., Rank and Nullity, Sylvester's Law of Nullity. [Rank (T) + Nullity (T) = dim (V)]. Determination of rank (T), Nullity (T) of linear transformation T : $IR^n \rightarrow IR^m$. Inverse of Linear Transformation. Non-singular Linear Transformation.
Linear Transformation and Matrices : Matrix of a linear transformation relative to ordered bases of finite-dimensional vector spaces. Correspondence between Linear Transformations and Matrices. Linear Transformation is non-singular if its representative matrix be non-singular. Rank of L.T. = Rank of the corresponding matrix. [5]
Group B (25 marks) <u>Tensor Calculus</u>

A tensor as a generalized concept of a vector in an Euclidean space E^3. To generalize the idea in an n-dimensional space. Definition of E^n. Transformation of co-ordinates in E^n (n = 2, 3 as example). Summation convention.
Contravariant and covariant vectors. Invariants. Contravariant, covariant and mixed tensors. The Kronecker delta. Algebra of tensors Symmetric and skew-symmetric tensors. Addition and scalar multiplication. Contraction. Outer and Inner products of tensors. Quotient law. Reciprocal Tensor. Riemannian space. Line element and metric tensor. Reciprocal metric tensor. Raising and lowering of indices with the help of metric tensor. Associated tensor. Magnitude of a vector. Inclination of two vectors. Orthogonal vectors.</td>
</tr>
</table>

Series solution at an ordinary point : Power Series solution of ordinary differential equations. Simple problems only. Module XI Group A (10 marks) <u>Vector Calculus II</u> Line integrals as integrals of vectors, circulation, irrotational vector, work done, conservative force, , potential orientation. Statements and verification of Green's theorem, Stokes' theorem and Divergence theorem. [8] Group (20marks) <u>Analytical Statics II</u> Centre of Gravity: General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration. [3] Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work. Stable and unstable equilibrium. Coordinates of a body and of a system of bodies. Field of forces. Conservative field. Potential energy of a system. The energy test of stability. Condition of			Christoffel symbols and their laws of transformations. Covariant differentiation of vectors and tensors. Group B (15marks) <u>Metric Space</u> Definition and examples of metric spaces. Open ball. Open set. Closed set defined as complement of open set. Interior point and interior of a set. Limit point, derived set and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary of a set. Diameter of a set and bounded set. Distance between a point and a set. [7] Subspace of a metric space. Convergent sequence. Cauchy sequence. Every Cauchy sequence is bounded. Every convergent sequence is Cauchy, not the converse. Completeness : definition and examples. Cantor intersection theorem. IR is a complete metric space. Q is not complete. [4] Group C(15 marks) <u>Complex Analysis</u> Extended complex plane. Stereographic projection. Complex function : Limit , continuity and differentiability of complex functions. Cauchy-Riemann equations. Sufficient condition for differentiability of a complex function. Analytic functions. Harmonic functions. Conjugate harmonic functions. Relation between analytic function and harmonic function.
	SS	5	Module XV Group A (25 marks) <u>Numerical Analysis</u> What is Numerical Analysis ?

stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones. [6] Forces in the three dimensions. Moment of a force about a line. Axis of a couple. Resultant of any two couples acting on a body. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Resultant force is an invariant of the system but the resultant couple is not an invariant. Conditions of equilibrium of a system of forces acting on a body. Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual work. Poisnot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of forces. [12] Group C (20marks) <u>Analytical Dynamics of A</u> <u>ParticleII</u> Central forces and central orbits. Typical features of central orbits. Stability of nearly circular orbits. Planetary motion and Kepler's laws. Time of describing an arc of the orbit. Orbital energy. Relationship between period and semi-major axis. Motion of an artificial satellite. Motion of a smooth cure under resistance. Motion of a rough curve under gravity e.g., circle, parabola, ellipse, cycloid etc.			Errors in Numerical computation : Gross error, Round off error, Truncation error. Approximate numbers. Significant figures. Absolute, relative and percentage error. Operators : Δ, □ , E, μ, δ (Definitions and simple relations among them). Interpolation : Problems of interpolation, Weierstrass' approximation theorem only statement). Polynomial interpolation. Equispaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. error terms. General interpolation formulae : Deduction of Lagrange's interpolation formula. Divided difference. Newton's General Interpolation formula (only statement). Inverse interpolation. Interpolation formulae using the values of both *f(x)* and its derivative *f(x)* : Idea of Hermite interpolation formula (only the basic concepts). Numerical Differentiation based on Newton's forward & backward and Lagrange's formulae. Numerical Integration : Integration of Newton's interpolation formula. Newton-Cote's formula. Basic Trapezoidal and Simpson's ⅓rd. formulae. Their composite forms. Weddle's rule (only statement). Statement of the error terms associated with these formulae. Degree of precision (only definition). Numerical solution of non-linear equations : Location of a real root by tabular method. Bisection method. Secant/Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method. Numerical solution of a system of linear equations : Gauss elimination method. Iterative method – Gauss-Seidal method. Matrix inversion by Gauss elimination method (only problems – up to 3×3 order). Eigenvalue Problems : Power method for numerically extreme eigenvalues. Numerical solution or Ordinary Differential Equation : Basic

Varying mass problems. Examples of falling raindrops and projected rockets. Linear dynamical systems, preliminary notions: solutions, phase portraits, fixed or critical points. Plane autonomous systems. Concept of Poincare phase plane. Simple examples of damped oscillator and a simple pendulum. The two-variable case of a linear plane autonomous system. Characteristic polynomial. Focal, nodal and saddle points. Module XII Group A (25 marks) <u>Hydrostatics</u> Definition of Fluid. Perfect Fluid, Pressure. To prove that the pressure at a point in fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids. To prove **(i)** In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane. **(ii)** In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths. **(iii)** In a fluid at rest under gravity horizontal planes re surfaces of equal density. **(iv)** When two fluids of different densities at rest under gravity do not mix, their surface of separation is a horizontal plane. Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid on plane surface. Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area. Position of the centre of			ideas, nature of the problem. Picard, Euler and Runge-Kutta (4^{th} order) methods (emphasis on the problems only). Group B (25 marks) <u>Computer Programming</u> Fundamentals of Computer Science and Computer Programming : Computer fundamentals : Historical evolution, computer generations, functional description, operating system, hardware & software. Positional number system : binary, octal, decimal,hexadecimalsystem. Binary arithmetic. Storing of data in a computer : BIT, BYTE, Word. Coding of data – ASCII, EBCDIC, etc. Algorithm and Glow Chart : Important features, Ideas about the complexities of algorithm. Application in simple problems. Programming languages : General concepts, Machine language, Assembly Language, High Level Languages, Compiler and Interpreter. Object and Source Program. Ideas about some major HLL. Students are required to opt for any one of the following two programming languages : (iii) Programming with FORTRAM 77/90. Or (iv) Introduction to ANSI C. Programming with FORTRAN 77/90 : Introduction, Keywords, Constants and Variables – integer,

pressure. Centre of pressure of a triangular area whose angular points are at different depths. Centre of pressure of a circular area. Position of the centre of pressure referred to co- ordinate axes through the centroid of the area. Centre of pressure of an elliptical area when its major axis is vertical or along the line of greatest slope. Effect of additional depth on centre of pressure.

Equilibrium of fluids in given fields of force : Definition of field of force, line of force. Pressure derivative in terms of force. Surface of equi-pressure. To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are *X, Y, Z* along the co-ordinate axes. To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the lines of force, (ii) when the force system is conservative, the surfaces of equal pressure are equi-potential surfaces and are also surfaces of equal density. To find the differential equations of the surfaces of equal pressure and density.

Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid contained in a vessel, revolves uniformly about a vertical axis.

The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy. General propositions about small rotational displacements. To derive the condition for stability.

Pressure of gases. The atmosphere. Relation between pressure, density and temperature. Pressure in an isothermal atmosphere. Atmosphere in convective equilibrium.

real, complex, logical, character, double precision, subscripted. Fortran expressions. I/O statements-formatted and unformatted. Program execution control-logical if, if-then-else, etc. Arrays-Dimension statement. Repetitive computations – Do. Nested Do, etc. Sub-programs : Function sub program and Subroutine sub program.

Application to simple problems : Evaluation of functional values, solution of quadratic equations, approximate sum of convergent infinite series, sorting of real numbers, numerical integration, numerical solution of non-linear equations, numerical solution of ordinary differential equations, etc.

Introduction to ANSI C :

Character set in ANSI C. Key words : if, while, do, for, int, char, float etc.

Data type : character, integer, floating point, etc. Variables, Operators : =,
= =, !!<, >, etc. (arithmetic, assignment, relational, logical, increment, etc.). Expresions : e.g. (a = = b) !! (b = = c), Statements : e.g. if (a>b) small = a; else small = b. Standard input/output. Use of while, if…. Else, for, do…while, switch, continue, etc. Arrays, strings. Function definition. Running simple C Programs. Header File. [30]

Boolean Algebra : Huntington Postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Statement of principle of duality. Disjunctive normal and Conjunctive normal forms of Boolean Expressions. Design of simple switching circuits.

Module XVI

Practical

(Problem:30, Sessional Work:10, Viva:10)

Using Calculator

Group B (25marks) <u>Rigid Dynamics</u> Momental ellipsoid, Equimomental system. Principal axis. D'Alembert's principle. D'Alembert's equations of motion. Principles of moments. Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy. Equation of motion of a rigid body about a fixed axis. Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation. Minimum time of oscillation. Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of rigid body moving in two dimensions. Necessary and sufficient condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane. Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces. To show that (i) of there is a definite straight line such that the sum of the moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces. Module XIII Group A (20marks) <u>Analysis IV</u> Improper Integral :			INTERPOLATION : Newton's forward & Backward Interpolation. Stirling & Bessel's Interpolation. Lagrange's Interpolation & Newton's Divided Difference Interpolation. Inverse Interpolation. Differentiation based on Newton's Forward & Backward Interpolation Formulae. Numerical Integration : Trapezoidal Rule, Simpson's ⅓ Rule and Weddle's Formula. Solution of Equations : Bisection Method, Regula Falsi, Fixed Point Iteration. Newton-Raphson formula (including modified form for repeated roots and complex roots). Solution of System of Linear Equations : Gauss' Elimination Method with partial pivoting, Gauss-Seidel/Jordon Iterative Method, Matrix Inversion. Dominant Eigenpair of a (4×4) real symmetric matrix and lease eigen value of a (3×3) real symmetric matrix by Power Method. Numerical Solution of first order ordinary Differential Equation (given the initial condition) by : Picard' Method, Euler Method, Heun's Method, Modified Euler's Method, 4^{th} order Runge-Kutta Method. Problems of Curve Fitting : To fit curves of the form $y=a+bx$, $y=a+bx+cx^2$, exponential curve of the form $y=ab^x$, geometric curve $y=ax^b$ by Least Square Method. ON COMPUTER : The following problems should be done on computer using either FORTRAN or C language : (v) To find a real root of an equation by Newton-Raphson Method. (vi) Dominant eigenpair by Power Method. (vii) Numerical Integration by Simpson's ⅓ Rule.

<table>
<tr>
<td rowspan="2">Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. [2]
Tests of convergence : Comparison and μ-test. Absolute and non-absolute convergence and interrelations. Abel's and Dirichlet's test for convergence of the integralof a product (statement only).
Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\Gamma(1-n)=\frac{\pi}{\sin n\pi}, 0<n<1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} cos^n x\, dx$ $\int_0^{\frac{\pi}{2}} tan^n x\, dx$ when they exist (using Beta and Gamma function)
Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier co-efficients for periodic functions defined on $[-\pi,\pi]$. Statement of Dirichlet's conditions
convergence. Statement of theorem of sum of Fourier series. [5]

Multiple integral : Concept of upper sum, lower sum, upper integral, lower-integral and double integral (no rigorous treatment is needed). Statement of existence theorem for continuous functions. Change of order of integration. Triple integral. Transformation of double and triple integrals (Problem only). Determination of volume and surface area by multiple integrals (Problem only).

Group B (15marks) <u>Metric Space</u>
Definition and examples of metric spaces. Open ball. Open set. Closed set defined as complement of open set. Interior point and interior of a set. Limit point, derived set and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary of a set. Diameter of a set and bounded set. Distance between a point and a set. [7]</td>
<td></td>
<td></td>
<td>To solve numerically Initial Value Problem by Euler's and RK_4 Method.</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>Group (20marks)

<u>Analytical Statics II</u>

Centre of Gravity: General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration. [3]

Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work.
Stable and unstable equilibrium. Coordinates of a body and of a system of bodies. Field of forces. Conservative field. Potential energy of a system. The energy test of stability. Condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones. [6]

Forces in the three dimensions. Moment of a force about a line. Axis of a couple. Resultant of any two couples acting on a body. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Resultant force is an invariant of the system but the resultant couple is not an invariant.
Conditions of equilibrium of a system of forces acting on a body. Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual</td>
</tr>
</table>

Subspace of a metric space. Convergent sequence. Cauchy sequence. Every Cauchy sequence is bounded. Every convergent sequence is Cauchy, not the converse. Completeness : definition and examples. Cantor intersection theorem. IR is a complete metric space. Q is not complete. [4] Group C(15 marks) <u>Complex Analysis</u> Extended complex plane. Stereographic projection. Complex function : Limit , continuity and differentiability of complex functions. Cauchy-Riemann equations. Sufficient condition for differentiability of a complex function. Analytic functions. Harmonic functions. Conjugate harmonic functions. Relation between analytic function and harmonic function. Module XIV Group A (30 marks) <u>Probability</u> Mathematical Theory of Probability : Random experiments. Simple and compound events. Event space. Classical and frequency definitions of probability and their drawbacks. Axioms of Probability. Statistical regularity. Multiplication rule of probabilities. Bayes' theorem. Independent events. Independent random experiments. Independent trials. Bernouli trials and binomial law. Poisson trials. Random variables. Probability distribution. distribution function. Discrete and continuous distributions. Binomial, Poisson, Gamma, Uniform and Normal distribution. Poisson Process (only definition). Transformation of random variables. Two dimensional probability			work. Poisnot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of forces. [12] Group C (20marks) <u>Analytical Dynamics of</u> <u>A ParticleII</u> Central forces and central orbits. Typical features of central orbits. Stability of nearly circular orbits. Planetary motion and Kepler's laws. Time of describing an arc of the orbit. Orbital energy. Relationship between period and semi-major axis. Motion of an artificial satellite. Motion of a smooth cure under resistance. Motion of a rough curve under gravity e.g., circle, parabola, ellipse, cycloid etc. Varying mass problems. Examples of falling raindrops and projected rockets. Linear dynamical systems, preliminary notions: solutions, phase portraits, fixed or critical points. Plane autonomous systems. Concept of Poincare phase plane. Simple examples of damped oscillator and a simple pendulum. The two-variable case of a linear plane autonomous system. Characteristic polynomial. Focal, nodal and saddle points.

distributions. Discrete and continuous distributions in two dimensions. Uniform distribution and two dimensional normal distribution. Conditional distributions. transformation of random variables in two dimensions. Mathematical expectation. Mean, variance, moments, central moments. Measures of location, dispersion, skewness and kurtosis. Median, mode, quartiles. Moment- generating function. Characteristic function. Two-dimensional expectation. Covariance, Correlation co-efficient, Joint characteristic function. Multiplication rule for expectations. Conditional expectation. Regression curves, least square regression lines and parabolas. Chi-square and *t*-distributions and their important properties (Statements only). Tchebycheff's inequality. Convergence in probability. Statements of : Bernoulli's limit theorem. Law of large numbers. Poissons's approximation to binomial distribution and normal approximation to binomial distribution. Concepts of asymptotically normal distribution. Statement of central limit theorem in the case of equal components and of limit theorem for characteristic functions (Stress should be more on the distribution function theory than on combinatorial problems. Difficult combinatorial problems should be avoided). Group B (20 marks) <u>Statistics</u> Random sample. Concept of sampling and various types of sampling. Sample and population. Collection, tabulation and graphical representation. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased and consistent			Group B (25marks) <u>Rigid Dynamics</u> Momental ellipsoid, Equimomental system. Principal axis. D'Alembert's principle. D'Alembert's equations of motion. Principles of moments. Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy. Equation of motion of a rigid body about a fixed axis. Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation. Minimum time of oscillation. Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of rigid body moving in two dimensions. Necessary and sufficient condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane. Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces. To show that (i) of there is a definite straight line such that the sum of the moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces.

estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal populations. Bivariate samples. Scatter diagram. Sample correlation co-efficient. Least square regression lines and parabolas. Estimation of parameters. Method of maximum likelihood. Applications to binomial, Poisson and normal population. Confidence intervals. Interval estimation for parameters of normal population. Statistical hypothesis. Simple and composite hypothesis. Best critical region of a test. Neyman-Pearson theorem (Statement only) and its application to normal population. Likelihood ratio testing and its application to normal population. Simple applications of hypothesis testing. Module XV Group A (25 marks) <u>Numerical Analysis</u> What is Numerical Analysis ? Errors in Numerical computation : Gross error, Round off error, Truncation error. Approximate numbers. Significant figures. Absolute, relative and percentage error. Operators : Δ, □ , E, μ, δ (Definitions and simple relations among them). Interpolation : Problems of interpolation, Weierstrass' approximation theorem only statement). Polynomial interpolation. Equispaced arguments. Difference table. Deduction of Newton's forward and backward interpolation formulae. Statements of Stirling's and Bessel's interpolation formulae. error terms. General interpolation formulae : Deduction of Lagrange's interpolation formula. Divided difference. Newton's General Interpolation formula (only statement). Inverse interpolation. Interpolation formulae using the values of both *f(x)* and its derivative *f(x)* : Idea of Hermite interpolation formula (only the	KT	4	Module XII Group A (25 marks) <u>Hydrostatics</u> Definition of Fluid. Perfect Fluid, Pressure. To prove that the pressure at a point in fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids. To prove **(i)** In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane. **(ii)** In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths. **(iii)** In a fluid at rest under gravity horizontal planes re surfaces of equal density. **(iv)** When two fluids of different densities at rest under gravity do not mix, their surface of separation is a horizontal plane. Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid on plane surface. Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area. Position of the centre of pressure. Centre of pressure of a triangular area whose angular points are at different depths. Centre of pressure of a circular area. Position of the centre of pressure referred to co-ordinate axes through the centroid of the area. Centre of

basic concepts).

Numerical Differentiation based on Newton's forward & backward and Lagrange's formulae.

Numerical Integration : Integration of Newton's interpolation formula. Newton-Cote's formula. Basic Trapezoidal and Simpson's ⅓rd. formulae. Their composite forms. Weddle's rule (only statement). Statement of the error terms associated with these formulae. Degree of precision (only definition).

Numerical solution of non-linear equations : Location of a real root by tabular method. Bisection method. Secant/Regula-Falsi and Newton-Raphson methods, their geometrical significance. Fixed point iteration method.

Numerical solution of a system of linear equations : Gauss elimination method. Iterative method – Gauss-Seidal method. Matrix inversion by Gauss elimination method (only problems – up to 3×3 order).

Eigenvalue Problems : Power method for numerically extreme eigenvalues.

Numerical solution or Ordinary Differential Equation : Basic ideas, nature of the problem. Picard, Euler and Runge-Kutta (4^{th} order) methods (emphasis on the problems only).

Group B (25 marks) Computer Programming

Fundamentals of Computer Science and Computer Programming :

Computer fundamentals : Historical evolution, computer generations, functional description, operating system, hardware & software.

Positional number system : binary, octal, decimal,hexadecimalsystem. Binary arithmetic. Storing of data in a computer : BIT, BYTE, Word. Coding of data – ASCII, EBCDIC, etc.

Algorithm and Glow Chart : Important features, Ideas about

pressure of an elliptical area when its major axis is vertical or along the line of greatest slope. Effect of additional depth on centre of pressure.

Equilibrium of fluids in given fields of force : Definition of field of force, line of force. Pressure derivative in terms of force. Surface of equi-pressure. To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are *X, Y, Z* along the co-ordinate axes. To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the lines of force, (ii) when the force system is conservative, the surfaces of equal pressure are equi-potential surfaces and are also surfaces of equal density. To find the differential equations of the surfaces of equal pressure and density.

Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid contained in a vessel, revolves uniformly about a vertical axis.

The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy. General propositions about small rotational displacements. To derive the condition for stability.

Pressure of gases. The atmosphere. Relation between pressure, density and temperature. Pressure in an isothermal atmosphere. Atmosphere in convective equilibrium.

Module XIV

Group A (30 marks)

Probability

Mathematical Theory of Probability :

Random experiments. Simple and compound events. Event

the complexities of algorithm. Application in simple problems. Programming languages : General concepts, Machine language, Assembly Language, High Level Languages, Compiler and Interpreter. Object and Source Program. Ideas about some major HLL. Students are required to opt for any one of the following two programming languages : (i) Programming with FORTRAM 77/90. Or (ii) Introduction to ANSI C. Programming with FORTRAN 77/90 : Introduction, Keywords, Constants and Variables – integer, real, complex, logical, character, double precision, subscripted. Fortran expressions. I/O statements-formatted and unformatted. Program execution control-logical if, if- then-else, etc. Arrays-Dimension statement. Repetitive computations – Do. Nested Do, etc. Sub-programs : Function sub program and Subroutine sub program. Application to simple problems : Evaluation of functional values, solution of quadratic equations, approximate sum of convergent infinite series, sorting of real numbers, numerical integration, numerical solution of non-linear equations, numerical solution of ordinary differential equations, etc. Introduction to ANSI C : Character set in ANSI C. Key words : if, while, do, for, int, char, float etc. Data type : character, integer, floating point, etc. Variables, Operators : =, = =, !!<, >, etc. (arithmetic, assignment, relational, logical, increment, etc.). Expresions : e.g. (a = = b) !! (b = = c), Statements : e.g. if (a>b) small = a; else small = b. Standard			space. Classical and frequency definitions of probability and their drawbacks. Axioms of Probability. Statistical regularity. Multiplication rule of probabilities. Bayes' theorem. Independent events. Independent random experiments. Independent trials. Bernouli trials and binomial law. Poisson trials. Random variables. Probability distribution. distribution function. Discrete and continuous distributions. Binomial, Poisson, Gamma, Uniform and Normal distribution. Poisson Process (only definition). Transformation of random variables. Two dimensional probability distributions. Discrete and continuous distributions in two dimensions. Uniform distribution and two dimensional normal distribution. Conditional distributions. transformation of random variables in two dimensions. Mathematical expectation. Mean, variance, moments, central moments. Measures of location, dispersion, skewness and kurtosis. Median, mode, quartiles. Moment- generating function. Characteristic function. Two-dimensional expectation. Covariance, Correlation co-efficient, Joint characteristic function. Multiplication rule for expectations. Conditional expectation. Regression curves, least square regression lines and parabolas. Chi-square and *t*-distributions and their important properties (Statements only). Tchebycheff's inequality. Convergence in probability. Statements of : Bernoulli's limit theorem. Law of large numbers. Poissons's approximation to binomial distribution and normal approximation to binomial distribution. Concepts of asymptotically normal distribution. Statement of central limit theorem in the case of equal components and of limit theorem for characteristic functions (Stress should be more on the distribution function theory than on combinatorial problems. Difficult combinatorial problems should be avoided).
	TS	2	Section – II : Modern Algebra III (10 marks)

input/output. Use of while, if…. Else, for, do…while, switch, continue, etc. Arrays, strings. Function definition. Running simple C Programs. Header File. [30]

Boolean Algebra : Huntington Postulates for Boolean Algebra. Algebra of sets and Switching Algebra as examples of Boolean Algebra. Statement of principle of duality. Disjunctive normal and Conjunctive normal forms of Boolean Expressions. Design of simple switching circuits.

Module XVI

Practical

(Problem:30, Sessional Work:10, Viva:10)

Using Calculator

INTERPOLATION :

Newton's forward & Backward Interpolation. Stirling & Bessel's Interpolation.

Lagrange's Interpolation & Newton's Divided Difference Interpolation. Inverse Interpolation.

Differentiation based on Newton's Forward & Backward Interpolation Formulae.

Numerical Integration : Trapezoidal Rule, Simpson's ⅓ Rule and Weddle's Formula.

Solution of Equations : Bisection Method, Regula Falsi, Fixed Point Iteration. Newton-Raphson formula (including modified form for repeated roots and complex roots).

Solution of System of Linear Equations : Gauss' Elimination Method with partial pivoting, Gauss-Seidel/Jordon Iterative Method, Matrix Inversion.

Dominant Eigenpair of a (4×4) real symmetric matrix and lease eigen value of a (3×3) real symmetric matrix by Power Method.

Numerical Solution of first order ordinary Differential Equation (given the initial condition) by :

Normal sub-groups of a Group : Definition and examples. Intersection, union of normal sub-groups. Prefect of a normal sub-group and a sub- group. Quotient Group of a Group by a normal sub-group. [5]

Homomorphism and Isomorphism of Groups. Kernel of a Homomorphism. First Isomorphism Theorem. Properties deducible from definition of morphism. An infinite cyclic group is isomorphic to (Z,+) and a finite cyclic group of order *n* is isomorphic to the group of residue classes modulo *n*.

Group B (20 marks)

Statistics

Random sample. Concept of sampling and various types of sampling. Sample and population. Collection, tabulation and graphical representation. Grouping of data. Sample characteristic and their computation. Sampling distribution of a statistic. Estimates of a population characteristic or parameter. Unbiased and consistent estimates. Sample characteristics as estimates of the corresponding population characteristics. Sampling distributions of the sample mean and variance. Exact sampling distributions for the normal populations.

Bivariate samples. Scatter diagram. Sample correlation co-efficient. Least square regression lines and parabolas. Estimation of parameters. Method of maximum likelihood. Applications to binomial, Poisson and normal population. Confidence intervals. Interval estimation for parameters of normal population. Statistical hypothesis. Simple and composite hypothesis. Best critical region of a test. Neyman-Pearson theorem (Statement only) and its application to normal population. Likelihood ratio testing and its application to normal population. Simple applications of hypothesis testing.

Picard' Method, Euler Method, Heun's Method, Modified Euler's Method, 4^{th} order Runge-Kutta Method. Problems of Curve Fitting : To fit curves of the form y=a+bx, $y=a+bx+cx^2$, exponential curve of the form $y=ab^x$, geometric curve $y=ax^b$ by Least Square Method. ON COMPUTER : The following problems should be done on computer using either FORTRAN or C language : (i) To find a real root of an equation by Newton-Raphson Method. (ii) Dominant eigenpair by Power Method. (iii) Numerical Integration by Simpson's ⅓ Rule. (iv) To solve numerically Initial Value Problem by Euler's and RK_4 Method.			

SEM-I(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Syllabus
Unit-1 : Calculus • Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin mx dx$, $\int \sin^n x \cos^m x dx$. Parametric equations, parametriz- ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. **Unit-2 : Geometry** • Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics. • Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes. • Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance	SC	2	• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. • Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$. • Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.
	NM	3	• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en-

<table>
<tr>
<td rowspan="3">of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.

• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.

<u>Unit-3</u> : Vector Analysis

• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

<u>Unit-1</u>

• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.

• Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).

• Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.

• Linear difference equations with constant coefficients (up to 2nd order).</td>
<td></td>
<td></td>
<td>velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.</td>
</tr>
<tr>
<td>SS</td>
<td>3</td>
<td>• Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics.

• Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.

• Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3"><u>Unit-2</u>
• Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation.
• Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \rightarrow Y$ and $B \subseteq Y$.
• Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid’s theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.
<u>Unit-3</u>
• Rank of a matrix, inverse of a matrix, characterizations of invertible matrices.
• Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.</td>
<td></td>
<td></td>
<td>• Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm’s theorem, cubic equation (solution by Cardan’s method) and biquadratic equation (solution by Ferrari’s method).</td>
</tr>
<tr>
<td>KT</td>
<td>4</td>
<td>• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued
• Rank of a matrix, inverse of a matrix, characterizations of invertible matrices.
• Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.</td>
</tr>
<tr>
<td>TS</td>
<td>2</td>
<td>• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.
• Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.
• Linear difference equations with constant coefficients (up to 2nd order).</td>
</tr>
</table>

SEM-I(GEN)

Syllabus	Name of Teache r	No. of Classe s	Distribution of Syllabus

<table>
<tr>
<td rowspan="2">

<u>Unit-1</u> : Algebra-I (15 Marks)

Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions.

Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications.

Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation$f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b.

(ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.

Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-2</u> : Differential Calculus-I (25 Marks)

Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of

</td>
<td>NM</td>
<td>1</td>
<td>

<u>Unit-2</u> : Differential Calculus-I (25 Marks)

Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity.

Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation.

Successive derivative - Leibnitz's theorem and its application.

Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).

</td>
</tr>
<tr>
<td>SS</td>
<td>0</td>
<td></td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">existence of inverse function of a strictly monotone function and its continuity.

Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation.

Successive derivative - Leibnitz's theorem and its application.

Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).

<u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.

<u>Unit-4</u> : Coordinate Geometry (25 Marks)</td>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td><u>Unit-1</u> : Algebra-I (15 Marks)

Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions.

Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications.

Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b.
(ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.

Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.</td>
</tr>
</table>

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants. General equation of second degree in x and y : Reduction to canonical forms. Classification of conic. Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic. Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola. Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal. Sphere and its tangent plane. Right circular cone.			Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.
	TS	1	**<u>Unit-4</u> : Coordinate Geometry (25 Marks)** Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants. General equation of second degree in x and y : Reduction to canonical forms. Classification of conic. Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic. Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola. Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal. Sphere and its tangent plane. Right circular cone.

SEM-III(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus

<u>Unit-1</u> : Limit & Continuity of functions

- Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important
- Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $|x|$, $\sin x$, $\cos x$, $\tan x$, $\log x$, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.
- Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main- tenance of same sign. Continuous function on $[a, b]$ is bounded and attains its bounds. Intermediate value theorem.
- Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous.
- Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval I will be uniformly continuous on I. A sufficient condition under which a continuous function on an unbounded open interval I will be uniformly continuous on I(statement only). Lipschitz condition and uniform continuity.

SC	2	2	[40 classes] • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $|x|$, $\sin x$, $\cos x$, $\tan x$, $\log x$, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.
NM	3		• Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main- tenance of same sign. Continuous function on $[a, b]$ is bounded and attains its bounds. Intermediate value theorem. • Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous.
SS	3		• Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local

<table>
<tr>
<td rowspan="4"><u>Unit-2</u> : Differentiability of functions

• Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule.

• Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, $\log(1 + x)$, $(1 + x)^m$, $\sin x$, $\cos x$ with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities.

• Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of
the principle of maximum/minimum in geometrical problems.

Ring theory

• Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated
by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third iso- morphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring.</td>
<td></td>
<td></td>
<td>extremum using first order derivative. Application of
the principle of maximum/minimum in geometrical problems</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>• Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace.

• Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms.
Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix,</td>
</tr>
<tr>
<td>KT</td>
<td>4</td>
<td>• Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule.

• Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, $\log(1+x)$, $(1+x)^m$, $\sin x$, $\cos x$ with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities.</td>
</tr>
<tr>
<td>TS</td>
<td>2</td>
<td>• Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated
by a subset of a ring, factor rings, operations on ideals,</td>
</tr>
</table>

Unit-2 : Linear algebra • Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace. • Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix,			prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third isomorphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring.

SEM-III(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Integral Calculus (20 Marks) Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions	SC	0	
	NM	1	**Integral Calculus (20 Marks)** Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple

(convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only. **<u>Unit-2</u> : Numerical Methods (30 Marks)** Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age. • Operators - Δ, O and E (Definitions and some relations among them). Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments. • Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems) **Linear Programming (30 Marks)**			problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.
	SS	2	**Linear Programming (30 Marks)** Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.

<table>
<tr>
<td rowspan="3">
Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.
The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.
Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.
</td>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>
Numerical Methods (30 Marks)
Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age.
Operators - Δ, O and E (Definitions and some relations among them).
Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.
</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>
Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration.
Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)
</td>
</tr>
</table>

PART-II(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
<u>MODULE III</u> Group A (25 marks) <u>Modern Algebra</u> Basic concept : Sets, Sub-sets, Equality of sets, Operations on sets : Union, intersection and complement. Verification of the laws of Algebra of sets and De Morgan's Laws. Cartesian product of two sets. Mappings, One-One and onto mappings. Composition of Mappings – concept only, Identity and Inverse mappings. Binary Operations in a set. Identity element. Inverse element. Introduction of Group Theory : Definition and examples taken from various branches (examples from number system, roots of unity, 2 x 2 real matrices, non-singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub-group – Statement of necessary and sufficient condition – its applications. Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite set of vectors, Sup-space. Concepts of generators and basis of a finite-dimensional vector space. Problems on formation of basis of a vector space (No proof required). Real Quadratic Form involving not more than three variables – Problems only.	SC	2	<u>MODULE III</u> Group A (25 marks) <u>Modern Algebra</u> Basic concept : Sets, Sub-sets, Equality of sets, Operations on sets : Union, intersection and complement. Verification of the laws of Algebra of sets and De Morgan's Laws. Cartesian product of two sets. Mappings, One-One and onto mappings. Composition of Mappings – concept only, Identity and Inverse mappings. Binary Operations in a set. Identity element. Inverse element. Introduction of Group Theory : Definition and examples taken from various branches (examples from number system, roots of unity, 2 x 2 real matrices, non-singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub-group – Statement of necessary and sufficient condition – its applications. Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependence and independence of a finite set of vectors, Sup-space. Concepts of generators and basis of a finite-dimensional vector space. Problems on formation of basis of a vector space (No proof required). Real Quadratic Form involving not more than three variables – Problems only.

Characteristic equation of a square matrix of order not more than three – determination of Eigen Values and Eigen Vectors – Problems only. Statement and illustration of Cayley-Hamilton Theorem.			Characteristic equation of a square matrix of order not more than three – determination of Eigen Values and Eigen Vectors – Problems only. Statement and illustration of Cayley-Hamilton Theorem.
Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u> Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines. Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes. Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines. Sphere and its tangent plane. Right circular cone. <u>MODULE IV</u> Group A (25 marks) <u>Differential Calculus</u> Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders. Taylor's and Maclaurin's Infinite series for functions like e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary] Indeterminate Forms : L'Hospital's Rule : Statement and problems only. Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for	NM	1	<u>MODULE IV</u> Group A (25 marks) <u>Differential Calculus</u> Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders. Taylor's and Maclaurin's Infinite series for functions like e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary] Indeterminate Forms : L'Hospital's Rule : Statement and problems only. Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative. Group-B (15-Marks) <u>Integral Calculus</u> Reduction formulae of

<table>
<tr>
<td rowspan="2">functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative.

Group-B (15-Marks)

<u>Integral Calculus</u>

Reduction formulae of
$\int sin^n x cos^m x \, dx$, $\int \frac{sin^n x}{cos^m x} \, dx$, $\int tan^n \, dx$ and associated problems (m and n are non-negative integers).
Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only.
Use of Beta and Gamma functions (convergence and important relations being assumed).
Working knowledge of Double integral.
Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.
Group C (10 marks)

<u>Differential Equations</u>

Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.</td>
<td></td>
<td></td>
<td>$\int sin^n x cos^m x \, dx$, $\int \frac{sin^n x}{cos^m x} \, dx$, $\int tan^n \, dx$ and associated problems (m and n are non-negative integers).
Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only.
Use of Beta and Gamma functions (convergence and important relations being assumed).
Working knowledge of Double integral.
Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.</td>
</tr>
<tr>
<td>KT</td>
<td>2</td>
<td>Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u>

Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines.
Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes.
Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines.
Sphere and its tangent plane.
Right circular cone.
Group C (10 marks)

<u>Differential Equations</u>

Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.</td>
</tr>
</table>

PART-III(GEN)

<table>
<tr><th>Syllabus</th><th>Name of Teacher</th><th>No. of Classes</th><th>Distribution of Sybbabus</th></tr>
<tr><td rowspan="2">MODULE V
Group A (20 marks)

Numerical Methods

Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage.
Operators - □ , □ and E (Definitions and some relations among them).
Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton’s Forward Interpolation Formula. Remainder term (expression only). Newton’s Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange’s Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments.
Number Integration : Trapezoidal and Simpson’s ⅓rd formula (statement only). Problems on Numerical Integration.
Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems.
(Note : emphasis should be given on problems)
Group B (30 marks)

Linear Programming</td><td>SC</td><td>0</td><td></td></tr>
<tr><td>NM</td><td>2</td><td>MODULE V
Group A (20 marks)

Numerical Methods

Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage.
Operators - □ , □ and E (Definitions and some relations among them).
Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton’s Forward Interpolation Formula. Remainder term (expression only). Newton’s Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange’s Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments.
Number Integration : Trapezoidal and Simpson’s ⅓rd formula (statement only). Problems on Numerical Integration.
Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems.
(Note : emphasis should be given on problems)
Group B (30 marks)

Linear Programming</td></tr>
</table>

Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.			Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.
MODULE VI (Any one of the following groups) Group A Analytical Dynamics Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped	KT	1	Group B Discrete Mathematics Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbitrary base. Prime integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid's Theorem. Linear Diophantine Equations. (Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers – Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all

oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.

Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

Central orbit. Kepler's laws of motion. Motion under inverse square law.

OR

Group B Probability and Statistics

Elements of Probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equality like and Exhaustive, Classical definition of Probability, theorems of Total Probability, Conditional Probability and Statistical Independence. Bayes' theorem. Problems. Shortcomings of the classical definition. Axiomatic approach – Problems. Random Variable and its Expectation. Theorems on mathematical expectation. Joint distribution of two random variables.

Theoretical Probability Distribution – Discrete and Continuous (p.m.f. pd.d.f.) Binomial, Poisson and Normal distributions and their properties.

Elements of Statistical Methods. Variables, Attributes, Primary data and secondary data. Population and sample. Census and Sample Survey. Tabulation – Chart and Diagram, graph, Bar diagram, Pie diagram etc. Frequency Distribution – Un-grouped and grouped cumulative frequency distribution. Histogram, Frequency curve, Measure of Central Tendencies – Average : AM, GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions – Range, Quartile Deviation, Mean Deviation, Variance/S.D., Moments, Skewness and Kurtosis.

Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples. Statistic and

prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation – when such an equation has solution, some applications).

Congruences : Congruence relation on integers, Basic properties of this relation. Linear Congruences, Chinese Remainder Theorem. System of Linear Congruences. (Definition of Congruence – to show it is an equivalence relation, to prove the following : $a \equiv b \pmod{m}$ implies (i) $(a+c) \equiv (b+c) \pmod{m}$ (ii) $ac \equiv bc \pmod{m}$ (iii) $a^n \equiv b^n \pmod{m}$, for any polynomial f(x) with integral coefficients $f(a) \equiv f(b) \pmod{m}$ etc. Linear Congruence, to show how to solve these congruences, Chinese remainder theorem – Statement and proof and some applications. System of linear congruences, when solution exists – some applications).

Application of Congruences : Divisibility tests. Computer file, Storage and Hashing functions. Round-Robin Tournaments. Check-digit in an ISBN, in Universal Product Code, in major Credit Cards. Error detecting capability. (Using Congruence, develop divisibility tests for integers base on their expansions with respect to different bases, if d divides (b-1) then $n = (a_k a_{k-1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. A university wishes to store a file for each of its students in its computer. Systematic methods of Round-Robin tournaments. A university wishes to store a file for each of its students in its computer. Systematic methods of arranging files have been developed based on Hashing functions $h(k) \equiv k \pmod{m}$. Discuss different properties of this congruence and also problems based on this congruence. Check digits for different identification numbers – International standard book number, universal product code etc. Theorem regarding error detecting capability).

Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's Theorem. Wilson's theorem. Some simple applications.

<table>
<tr>
<td rowspan="2">Parameter, Sampling Distribution – standard error of a statistic (e.g. sample mean, sample proportion). Four fundamental distributions derived from the normal : (i) Standard Normal Distribution, (ii) Chi-square distribution, (iii) Student's distribution, (iv) Snedecor's F-distribution.

Estimation and Test of Significance. Statistical Inference. Theory of estimation – Point estimation and Interval estimation. Confidence Inter/Confidence Limit. Statistical Hypothesis – Bull Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and Type II error. Problems.
Bivariate Frequency Distribution. Scatter Diagram, Correlation co-efficient – Definition and properties. Regression lines.
Time Series : Definition. Why to analyze Time series data ? Components. Measurement of Trend – (i) Moving Average Method, (ii) Curve Fittings (linear and quadratic curve). (Ideas of other curves, e.g. exponential curve etc.). Ideas about the measurement of other components.
Index Number : Meaning of Index Number. Construction of Price Index Number. Consumer Price Index Number. Calculation of Purchasing Power of Rupee.

<u>MODULE VII</u>

(50 marks)

<u>Computer Science & Programming</u>

Boolean algebra – Basic Postulates and Definition. Tow-element Boolean algebra. Boolean function. Truth table. Standard form of Boolean function – DNF and CNF. Minterms and maxterms. Principle of Duality. Some laws and theorem of Boolean algebra. Simplification of Boolean expressions – Algebraic method and Karnaugh Map method. Application of Boolean algebra
– Switching Circuits, Circuit having some specified properties, Logical Gates
– AND, NOT, OR, NAND, NOR etc.</td>
<td></td>
<td></td>
<td>(Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem – Statement, proof and some applications).
Recurrence Relations and Generating functions : Recurrence Relations. The method of Iteration. Linear difference equations with constant coefficients. Counting with generating functions.
Boolean Algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td><u>MODULE VII</u>

(50 marks)

<u>Computer Science & Programming</u>

Boolean algebra – Basic Postulates and Definition. Tow-element Boolean algebra. Boolean function. Truth table. Standard form of Boolean function – DNF and CNF. Minterms and maxterms. Principle of Duality. Some laws and theorem of Boolean algebra. Simplification of Boolean expressions – Algebraic method and Karnaugh Map method. Application of Boolean algebra
– Switching Circuits, Circuit having some specified properties, Logical Gates
– AND, NOT, OR, NAND, NOR etc.
Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy – Different Components of a Computer System. Operating System, Hardware and Software.
Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer – BIT, BYTE, WORD, etc. Coding of a data – ASCII , etc.
Programming Language : Machine Language, Assembly</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy – Different Components of a Computer System. Operating System, Hardware and Software.
Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer – BIT, BYTE, WORD, etc. Coding of a data – ASCII , etc.
Programming Language : Machine Language, Assembly language and High level language. Compiler and Interpreter. Object Programme and Source Programme. Ideas about some HLL – e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc.
Algorithms and Flow Charts – their utilities and important features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/99 : Introduction, Data Type – Keywords, Constants and Variables – Integer, Real, Complex, Logical, Character, Subscripted Variables, Fortran Expressions.
I/O Statements – formatted and unformatted. Programme execution control – Logical if, if-then-else, etc. Arrays, dimension statement. Repetitive Computation – Do, Bested Do etc.
Sub Programs – (i) Function Sub Programme
(ii) Subroutine Sub Programme

MODULE VIII
(Any one of the following groups)

Group A

A Course of Calculus

Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple</td>
<td></td>
<td></td>
<td>language and High level language. Compiler and Interpreter. Object Programme and Source Programme. Ideas about some HLL – e.g. BASIC, FORTRAN, C, C++, COBOL, PASCAL, etc.
Algorithms and Flow Charts – their utilities and important features, Ideas about the complexities of an algorithm. Application in simple problems. FORTRAN 77/99 : Introduction, Data Type – Keywords, Constants and Variables – Integer, Real, Complex, Logical, Character, Subscripted Variables, Fortran Expressions.
I/O Statements – formatted and unformatted. Programme execution control – Logical if, if-then-else, etc. Arrays, dimension statement. Repetitive Computation – Do, Bested Do etc.
Sub Programs – (i) Function Sub Programme
(ii) Subroutine Sub Programme</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>MODULE VI
(Any one of the following groups)
Group A Analytical

Dynamics

Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.
Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle
moving in a straight line, (ii) moving in a plane.
Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped</td>
</tr>
</table>

applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series.

Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems.

Fourier series on (-π, π) : Periodic function. Determination of Fourier co- efficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.

Third and Fourth order ordinary differential equation with constant co- efficients. Euler's Homogeneous Equation.

Second order differential equation : (a) Method of variation of parameters. (b) Method of undetermined co-efficients. (c) Simple eigenvalue problem.

Simultaneous linear differential equation with constant co-efficients.

Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant eo-efficients.

Partial Differential Equation (PDE) : Introduction, Formation of PDE, Solutions of PDE, Lagrange's method of solution.

OR

Group B

oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.

Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

Central orbit. Kepler's laws of motion. Motion under inverse square law.

OR

Group B Probability and Statistics

Elements of Probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equality like and Exhaustive, Classical definition of Probability, theorems of Total Probability, Conditional Probability and Statistical Independence. Bayes' theorem. Problems. Shortcomings of the classical definition. Axiomatic approach – Problems. Random Variable and its Expectation. Theorems on mathematical expectation. Joint distribution of two random variables.

Theoretical Probability Distribution – Discrete and Continuous (p.m.f. pd.d.f.) Binomial, Poisson and Normal distributions and their properties.

Elements of Statistical Methods. Variables, Attributes, Primary data and secondary data. Population and sample. Census and Sample Survey. Tabulation – Chart and Diagram, graph, Bar diagram, Pie diagram etc. Frequency Distribution – Un-grouped and grouped cumulative frequency distribution. Histogram, Frequency curve, Measure of Central Tendencies – Average : AM, GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions – Range, Quartile Deviation, Mean Deviation, Variance/S.D., Moments, Skewness and Kurtosis.

Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples. Statistic and Parameter, Sampling Distribution – standard error of a

<table>
<tr>
<td rowspan="2"><u>Discrete Mathematics</u>
Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbitrary base. Prime integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Euclid’s Theorem. Linear Diophantine Equations. (Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Representation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers – Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid’s Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation – when such an equation has solution, some applications).
Congruences : Congruence relation on integers, Basic properties of this relation. Linear Congruences, Chinese Remainder Theorem. System of Linear Congruences. (Definition of Congruence – to show it is an equivalence relation, to prove the following : a □ b (mod m) implies (i) (a+c) □ (b+c) (mod m) (ii) ac □ bc (mod m) (iii) a^n □ b^n (mod m), for any polynomial f(x) with integral coefficients f(a) □ f(b) (mod m) etc. Linear Congruence, to show how to solve these congruences, Chinese remainder theorem – Statement and proof and some applications. System of linear congruences, when solution exists – some applications).
Application of Congruences : Divisibility tests. Computer file, Storage and Hashing functions. Round-Robin Tournaments. Check-digit in an ISBN, in Universal Product Code, in major Credit Cards. Error detecting capability. (Using Congruence, develop divisibility tests for integers base on their expansions with respect to different bases, if d divides (b-1) then n = $(a_k a_{k-1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. A university wishes to store a file for</td>
<td></td>
<td></td>
<td>statistic (e.g. sample mean, sample proportion). Four fundamental distributions derived from the normal : (i) Standard Normal Distribution, (ii) Chi-square distribution, (iii) Student’s distribution, (iv) Snedecor’s F-distribution.
Estimation and Test of Significance. Statistical Inference. Theory of estimation – Point estimation and Interval estimation. Confidence Inter/Confidence Limit. Statistical Hypothesis – Bull Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and Type II error. Problems.
Bivariate Frequency Distribution. Scatter Diagram, Correlation co-efficient – Definition and properties. Regression lines.
Time Series : Definition. Why to analyze Time series data ? Components. Measurement of Trend – (i) Moving Average Method, (ii) Curve Fittings (linear and quadratic curve). (Ideas of other curves, e.g. exponential curve etc.). Ideas about the measurement of other components.
Index Number : Meaning of Index Number. Construction of Price Index Number. Consumer Price Index Number. Calculation of Purchasing Power of Rupee.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td><u>MODULE VIII</u>
(Any <u>one</u> of the following groups)

<u>Group A</u>

<u>A Course of Calculus</u>

Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness,</td>
</tr>
</table>

each of its students in its computer. Systematic methods of arranging files have been developed based on Hashing functions h(k) □ k (mod m). Discuss different properties of this congruence and also problems based on this congruence. Check digits for different identification numbers – International standard book number, universal product code etc. Theorem regarding error detecting capability). Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's Theorem. Wilson's theorem. Some simple applications. (Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem – Statement, proof and some applications). Recurrence Relations and Generating functions : Recurrence Relations. The method of Iteration. Linear difference equations with constant coefficients. Counting with generating functions. Boolean Algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems. Fourier series on (-π, π) : Periodic function. Determination of Fourier co- efficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Third and Fourth order ordinary differential equation with constant co- efficients. Euler's Homogeneous Equation. Second order differential equation : (a) Method of variation of parameters. (b) Method of undetermined co-efficients. (c) Simple eigenvalue problem. Simultaneous linear differential equation with constant co-efficients. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform and its Inverse. Application to the solution of ordinary differential equation of second order with constant eo-efficients. Partial Differential Equation (PDE) : Introduction, Formation of PDE, Solutions of PDE, Lagrange's method of solution.

Lesson Plane for Academic Year: 2020-2021

EVEN SEM

Sem-II(HONS)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R. • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R. **Unit-2** • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.	SC	2	**Unit-1** • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.
	NM	2	**Unit-1** • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R.

• Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $\|l\| < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems. Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence. Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence. **Unit-1** • Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta- tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.			**Unit-2** • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits. • Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $\|l\| < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems.
	SS	1	**Unit-1** • Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta- tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.
	MFM	1	**Unit-2** • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's

Unit-2 • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem. **Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems			Little theorem.
	KT	1	**Unit-2** Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup$\{x_n, x_{n+1}, . . . , \}$ and lim inf x_n = sup inf$\{x_n, x_{n+1}, . . . , \}$ h Equivalence between these definitions is assumedi . A bounded sequence $\{x_n\}$ is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence. Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.
	TS	1	**Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems

SEM II(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Differential Calculus-II (20 Marks) [15 classes] Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application. Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary. • Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.	SC	2	**<u>Unit-1</u> : Differential Calculus-II (20 Marks)** [15 classes] Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application. Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary. • Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems. Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.			Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems. Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.
Unit-2 : Differential Equation-II (15 Marks) [10 classes] Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method. **Unit-3 : Vector Algebra (15 Marks)** [10 classes] Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).	NM	2	**Unit-1 : Differential Calculus-II (20 Marks)** [15 classes] Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of *e*. Statement of Cauchy's general principle of convergence and its application. Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, $\sin x$, $\cos x$, $(1 + x)^n$, $\log(1 + x)$

Unit-4 : Discrete Mathematics (30 Marks)

[25 classes]

Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre-
sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation
â" when such an equation has solution, some applications.

Congruences : Congruence relation on integers, Basic properties of this relation.

Linear congruences,
Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â" to show it is an equivalence relation, to prove the following : *a*

i

h

with restrictions wherever necessary.

- Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Differential Equation-II (15 Marks)

[10 classes]

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-3 : Vector Algebra (15 Marks)

[10 classes]

Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).

b (mod m) implies (i) $(a + c)$ $(b + c)$ (mod m) (ii) ac bc (mod m) (iii) a^n b^n (≡ mod m), for any polynomial $f(x)$ with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications. Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides $(b$ 1$)$ then $n = (a_k a_{k\ 1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International standard book number, universal product code etc. Theorem regarding error detecting capability. Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement,			**<u>Unit-4</u> : Discrete Mathematics (30 Marks)** [25 classes] Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â“ Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation â“ when such an equation has solution, some applications. Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a

proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			b (mod m) implies (iv) $(a + c)$ $(b + c)$ (mod m) (v) ac bc (mod m) (vi) a^n b^n (mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications. Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides (b 1) then n = $(a_k a_{k-1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International standard book number, universal product code etc. Theorem regarding error detecting capability. Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement,

			proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.
	SS	1	Convergence and working knowledge of Beta and Gamma function and their interrelation (Γ(*n*) Γ (1- *n*) □ $\frac{\pi}{\sin n\pi}$, 0 < *n* < 1, , to be assumed). Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function) Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.
	MFM	1	<u>Unit-2</u> : Differential Equation-II (15 Marks) [10 classes] Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

	KT	2	**Unit-3 : Vector Algebra (15 Marks)** [10 classes] Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).
	TS	1	**Unit-4 : Discrete Mathematics (30 Marks)** [25 classes] Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear

i

			Diophantine equation â“ when such an equation has solution, some applications. Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a b (mod m) implies (vii) $(a + c)$ $(b + c)$ (mod m) (viii) ac bc (mod m) (ix) a^n b^n (mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications.

h

SEM IV(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

Riemann Integration & Series of Functions **Unit-1 : Riemann integration** • Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.	SC	3	• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.
Unit-2 : Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.	NM	2	Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.

<table>
<tr><td rowspan="6">Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\,\Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} cos^n x\,dx$ $\int_0^{\frac{\pi}{2}} tan^n x\,dx$ when they exist (using Beta and Gamma function)

Unit-3 :

Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. • Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td><td></td><td></td><td></td></tr>
<tr><td>SS</td><td>1</td><td>Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\,\Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} cos^n x\,dx$ $\int_0^{\frac{\pi}{2}} tan^n x\,dx$ when they exist (using Beta and Gamma function)

Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td></tr>
<tr><td>MFM</td><td>1</td><td>Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td></tr>
<tr><td>KT</td><td>1</td><td>Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. •</td></tr>
<tr><td>TS</td><td>2</td><td>Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem.

• Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties</td></tr>
</table>

			of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

SEM IV(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Algebra-II (20 Marks) Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis	SC	3	**<u>Unit-1</u> : Algebra-II (20 Marks)** Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis

<table>
<tr>
<td rowspan="3">of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).

• Real Quadratic Form involving not more than three variables (problems only).

Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.

Unit-2 : Computer Science & Programming (30 Marks)

Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software.

Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc.

Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc.

Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables,</td>
<td></td>
<td></td>
<td>of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).</td>
</tr>
<tr>
<td>NM</td>
<td>3</td>
<td>• Real Quadratic Form involving not more than three variables (problems only).

Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>Unit-2 : Computer Science & Programming (30 Marks)

Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software.

Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc.

Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc.

Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type–</td>
</tr>
</table>

<table>
<tr>
<td rowspan="4">Fortran Expressions.

Unit-3 : Probability & Statistics (30 Marks)

Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye’s Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.

Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.

Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis.

Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square</td>
<td></td>
<td></td>
<td>Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>Unit-3 : Probability & Statistics (30 Marks)

Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye’s Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.</td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td>Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.
Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis</td>
</tr>
<tr>
<td>TS</td>
<td>5</td>
<td>Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: standard Normal Distribution, (ii) Chi-square</td>
</tr>
</table>

distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.			(i) distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.

SEM VI(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Unit-1 : Metric space Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.	SC	3	**Unit-2 : Complex analysis** Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

<table>
<tr>
<td rowspan="2">Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.

• Continuous mappings, sequential criterion of continuity. Uniform continuity.

Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

• Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

<u>Unit-2</u> : Complex analysis

Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.</td>
<td></td>
<td></td>
<td>Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.</td>
</tr>
<tr>
<td>NM</td>
<td>1</td>
<td><u>Unit-1</u> : Metric space

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.

• Continuous mappings, sequential criterion of continuity. Uniform continuity.

Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

• Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.

<u>Unit-3</u>

• Numerical differentiation : Methods based on interpolations, methods based on finite differences.

Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule, composite Weddle's rule. Gaussian quadrature formula.
</td>
<td>SS</td>
<td>1</td>
<td>
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>
<u>Unit-5</u>

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.

Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).

Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method)
</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">Unit-4

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.
Numerical solution of system of nonlinear equations - Newton's method.

Unit-5

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.
Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).
Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts).
• The algebraic eigen value problem : Power method.

Unit-6

Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.</td>
<td></td>
<td></td>
<td>(operational counts).
• The algebraic eigen value problem : Power method.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>• Numerical differentiation : Methods based on interpolations, methods based on finite differences.
Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature formula.
Unit-4

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.
Numerical solution of system of nonlinear equations - Newton's method.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>Unit-6

Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.</td>
</tr>
</table>

SEM VI(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra. Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power	SC	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	NM	1	Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean

series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on PowerSeries. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), (1+x)^n. Simple problems. • Periodic Fourier series on ($-\pi, \pi$) : Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.			polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and minimization of switching circuits using Boolean algebra
	SS	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	MFM	1	• Periodic Fourier series on ($-\pi, \pi$) : Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.
	KT	1	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
	TS	1	Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients

ODD SEM

SEM I(H)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Calculus • Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin mx dx$, $\int \sin^n x \cos^m x dx$. Parametric equations, parametriz- ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. **Unit-2 : Geometry** • Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics. • Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the	SC	2	• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. • Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$. • Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.

<table>
<tr>
<td rowspan="4">
intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.

• Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.

• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.

<u>Unit-3</u> : Vector Analysis

• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

<u>Unit-1</u>

• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.

• Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and
</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NM</td>
<td>2</td>
<td>• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>• Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics.

• Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.

• Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.</td>
</tr>
</table>

biquadratic equation (solution by Ferrari's method). • Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality. • Linear difference equations with constant coefficients (up to 2nd order). **Unit-2** • Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. • Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \rightarrow Y$ and $B \subseteq Y$. • Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties. **Unit-3** • Rank of a matrix, inverse of a matrix, characterizations of invertible matrices. • Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.			• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable. • Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
	KT	2	• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued • Rank of a matrix, inverse of a matrix, characterizations of invertible matrices. • Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.
	TS	2	• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids. • Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.

			• Linear difference equations with constant coefficients (up to 2nd order).

SEM-I(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Syllabus
<u>Unit-1</u> : Algebra-I (15 Marks) Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions. Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications. Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.	SC	0	
	NM	1	<u>Unit-2</u> : Differential Calculus-I (25 Marks) Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included). Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity. Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation. Successive derivative - Leibnitz's theorem and its application.

<table>
<tr>
<td rowspan="4">Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-2</u> : Differential Calculus-I (25 Marks)

Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity.

Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation.

Successive derivative - Leibnitz's theorem and its application.

Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).</td>
<td></td>
<td></td>
<td>Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).</td>
</tr>
<tr><td>SS</td><td>0</td><td></td></tr>
<tr><td>MFM</td><td>0</td><td></td></tr>
<tr>
<td>KT</td>
<td>3</td>
<td><u>Unit-1</u> : Algebra-I (15 Marks)

Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions.

Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications.

Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation$f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b.
(ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">Unit-3 : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.

Unit-4 : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.

Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal.

Sphere and its tangent plane. Right circular cone.</td>
<td></td>
<td></td>
<td>Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

Unit-3 : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>Unit-4 : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.</td>
</tr>
</table>

			Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal. Sphere and its tangent plane. Right circular cone.

	NM	1	MODULE IV Group A (25 marks) Differential Calculus Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders. Taylor's and Maclaurin's Infinite series for functions like e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary] Indeterminate Forms : L'Hospital's Rule : Statement and problems only. Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative.

			Group-B (15-Marks) <u>Integral Calculus</u> Reduction formulae of $\int sin^n x cos^m x\, dx$, $\int \frac{sin^n x}{cos^m x}\, dx$, $\int tan^n\, dx$ and associated problems (m and n are non-negative integers). Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). Working knowledge of Double integral. Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.
	SS	0	
	MFM	0	
	KT	2	Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u> Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines. Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes. Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines. Sphere and its tangent plane. Right circular cone.

			Group C (10 marks) <u>Differential Equations</u> Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.
	TS	0	

	SS	0	
	MFM	2	<u>MODULE V</u> Group A (20 marks) <u>Numerical Methods</u> Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage. Operators - □ , □ and E (Definitions and some relations among them). Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton's Forward Interpolation Formula. Remainder term (expression only). Newton's Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange's Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments. Number Integration : Trapezoidal and Simpson's ⅓rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular

			method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems. (Note : emphasis should be given on problems) Group B (30 marks) <u>Linear Programming</u> Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions. <u>MODULE VI</u> (Any <u>one</u> of the following groups) <u>Group A</u> <u>Analytical Dynamics</u> Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation

			of energy and momentum. Motion under impulsive forces. Equations of motion of a particle moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. Central orbit. Kepler's laws of motion. Motion under inverse square law.
	KT	0	
	TS	0	

SEM-III(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Limit & Continuity of functions • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, sin x, cos x, tan x, log x, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions.	SC	2 2	[40 classes] • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, sin x, cos x, tan x, log x, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions.

Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point. • Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main- tenance of same sign. Continuous function on [*a, b*] is bounded and attains its bounds. Intermediate value theorem. • Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous. • Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval I will be uniformly continuous on I. A sufficient condition under which a continuous function on an unbounded open interval I will be uniformly continuous on I(statement only). Lipschitz condition and uniform continuity. **<u>Unit-2</u> : Differentiability of functions** • Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule. • Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, $\log(1 + x)$, $(1 + x)^m$, $\sin x$, $\cos x$ with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities.			Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.

• Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. **Ring theory** • Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third iso- morphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring. **<u>Unit-2</u> : Linear algebra** • Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace. • Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the			

inverse of a matrix,			

SEM-III(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Integral Calculus (20 Marks) Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only. **Unit-2 : Numerical Methods (30 Marks)** Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age. • Operators - Δ, ∇ and E (Definitions and some relations among them). Interpolation : The problem of interpolation Equispaced	SC	0	
	NM	1	**Integral Calculus (20 Marks)** Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.
	SS	2	**Linear Programming (30 Marks)** Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic

arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.

- Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration.

Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

Linear Programming (30 Marks)

Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty.

Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.

MFM	0	
KT	1	**Numerical Methods (30 Marks)**

Numerical Methods (30 Marks)

Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age.

- Operators - Δ, O and E (Definitions and some relations among them).

Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with

Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.			both equally and unequally spaced arguments.
	TS	1	• Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

SEM-V(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.	SC	2	**Unit-1** Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.

<table>
<tr>
<td rowspan="2"><u>Unit-2</u>

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

<u>Unit-3</u>

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

<u>Unit-4</u>

Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.

Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri-butions, Chi-square, t and F-distributions, sampling distribution of $\bar{X}$, s^2, $\frac{\sqrt{n}(\bar{X} - \mu)}{s}$

Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency,</td>
<td>NM</td>
<td>3</td>
<td><u>Unit-2</u>

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

<u>Unit-3</u>

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td><u>Unit-2</u> : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties.

Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature.

Dual spaces, dual basis, double dual, transpose of a linear</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">Minimum-Variance Unbiased Estimator (MVUE).

• Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.

<u>Unit-5</u>

Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, levelof significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values.

• Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only).

Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

<u>Unit-1</u> : Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.

<u>Unit-2</u> : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its</td>
<td></td>
<td></td>
<td>transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.</td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td><u>Unit-4</u>

Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.

Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri- butions, Chi-square, t and F-distributions, sampling distribution of X, s^2, $\sqrt{n}(X - \mu)$

Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of</td>
</tr>
</table>

basic properties. Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature. Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).			good estimators - unbiasedness, consistency,sufficiency, Minimum-Variance Unbiased Estimator (MVUE). • Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.
	TS	2	**<u>Unit-5</u>** Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The *p*-value (observed level of significance), Calculating *p*-values. • Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only). Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

SEM V(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and	SC	1	Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane.

<table>
<tr>
<td rowspan="5">normal components of velocity and acceleration of a particle moving along a plane curve.

Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.

Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.

Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

• Central orbit. Kepler's laws of motion. Motion under inverse square law.

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs

Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travellingsalesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

• Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.</td>
<td></td>
<td></td>
<td>Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.</td>
</tr>
<tr>
<td>NM</td>
<td>1</td>
<td>Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.</td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point.

• Central orbit. Kepler's laws of motion. Motion under inverse square law.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs

Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.</td>
</tr>
</table>

			• Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.
	TS	0	

Lesson Plane for Academic Year: 2021-2022

EVEN SEM

Sem-II(HONS)

<table>
<tr><th>Syllabus</th><th>Name of Teacher</th><th>No. of Classes</th><th>Distribution of Sybbabus</th></tr>
<tr><td rowspan="2"><u>Unit-1</u>
Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.
Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R.
<u>Unit-2</u>
Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.</td><td>SC</td><td>2</td><td><u>Unit-1</u>
Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.</td></tr>
<tr><td>NM</td><td>2</td><td><u>Unit-1</u>
Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R.</td></tr>
</table>

<table>
<tr>
<td rowspan="3">

- Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $|l| < 1$, $\{(1+\frac{1}{n})^n\}_n$, $\{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems.

  Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence.

  Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.

Unit-1

- Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta-
tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.

</td>
<td></td>
<td></td>
<td>

Unit-2

- Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.
- Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence $\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $|l| < 1$, $\{(1+\frac{1}{n})^n\}_n$, $\{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$, $\{a^{x_n}\}_n$(a>0). Cauchy's first and second limit theorems.

</td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>

Unit-1

- Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta-
tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.

</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>

Unit-2

- Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's

</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">

<u>Unit-2</u>

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange’s theorem and consequences including Fermat’s Little theorem.

<u>Unit-3</u>

Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley’s theorem, properties of isomorphisms. First,

Second and Third isomorphism theorems

</td>
<td></td>
<td></td>
<td>Little theorem.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>

<u>Unit-2</u>

Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy’s convergence criterion. Cauchy sequence.

Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy’s n-th root test, Kummer’s test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.

</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>

<u>Unit-3</u>

Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley’s theorem, properties of isomorphisms. First,

Second and Third isomorphism theorems

</td>
</tr>
</table>

SEM II(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Differential Calculus-II (20 Marks) [15 classes] Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application. Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary. • Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.	SC	2	**<u>Unit-1</u> : Differential Calculus-II (20 Marks)** [15 classes] Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application. Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications. Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary. • Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

<table>
<tr>
<td rowspan="2">Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Differential Equation-II (15 Marks)

[10 classes]

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-3 : Vector Algebra (15 Marks)

[10 classes]

Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).</td>
<td></td>
<td></td>
<td>Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.</td>
</tr>
<tr>
<td>NM</td>
<td>2</td>
<td>Unit-1 : Differential Calculus-II (20 Marks)

[15 classes]

Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application.

Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.

Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, $\sin x$, $\cos x$, $(1 + x)^n$, $\log(1 + x)$</td>
</tr>
</table>

Unit-4 : Discrete Mathematics (30 Marks)

[25 classes]

Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation â" when such an equation has solution, some applications.

Congruences : Congruence relation on integers, Basic properties of this relation.

Linear congruences,
Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â" to show it is an equivalence relation, to prove the following : *a*

i

h

with restrictions wherever necessary.

- Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Differential Equation-II (15 Marks)

[10 classes]

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-3 : Vector Algebra (15 Marks)

[10 classes]

Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).

b (mod m) implies
(i) $(a + c)$ $(b + c)$ (mod m)
(ii) ac bc (mod m)
(iii) a^n b^n (mod m), for any polynomial $f(x)$ with integral coefficients $f(a)$
$f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and
proof and some applications. System of linear congruences, when solution exists â“ some
i
applications.
Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers
based on their expansions with respect to different bases, if d divides $(b\ 1)$ then $n = (a_k a_{k\ 1} a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International
standard book number, universal product code etc.
i
Theorem regarding error detecting capability.
Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem.
Euler's theorem. Wilson's theorem - Statement,

h

Unit-4 : Discrete Mathematics (30 Marks)

[25 classes]

Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre-
sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â“ Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation
â“ when such an equation has solution, some applications.

Congruences : Congruence relation on integers, Basic properties of this relation.

Linear congruences,
Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a

i

h

proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			b (mod m) implies (iv) $(a + c)$ $(b + c)$ (mod m) (v) ac bc (mod m) (vi) a^n b^n (≡ mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications. Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides (b 1) then n = ($a_k a_{k-1} a_1 b$) is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International standard book number, universal product code etc. Theorem regarding error detecting capability. Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement,

			proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.
	SS	1	Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\,\Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed). Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\,dx$, $\int_0^{\frac{\pi}{2}} cos^n x\,dx$ $\int_0^{\frac{\pi}{2}} tan^n x\,dx$ when they exist (using Beta and Gamma function) Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.
	MFM	1	Unit-2 : Differential Equation-II (15 Marks) [10 classes] Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

	KT	2	**Unit-3 : Vector Algebra (15 Marks)** [10 classes] Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).
	TS	1	**Unit-4 : Discrete Mathematics (30 Marks)** [25 classes] Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear

i

			Diophantine equation â“ when such an equation has solution, some applications. Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a b (mod m) implies (vii) $(a + c)$ $(b + c)$ (mod m) (viii) ac bc (mod m) (ix) a^n b^n (≡ mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some i applications.

h

SEM IV(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

Riemann Integration & Series of Functions **Unit-1 : Riemann integration** • Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus. Unit-2 : Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.	SC	3	• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.
	NM	2	Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.

<table>
<tr>
<td rowspan="5">Convergence and working knowledge of Beta and Gamma function and their interrelation (Γ(n) Γ (1- n) □ $\frac{\pi}{\sin n\pi}$, 0 < n < 1, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Unit-3 :

Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. • Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>Convergence and working knowledge of Beta and Gamma function and their interrelation (Γ(n) Γ (1- n) □ $\frac{\pi}{\sin n\pi}$, 0 < n < 1, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. •</td>
</tr>
<tr>
<td>TS</td>
<td>2</td>
<td>Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem.

• Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties</td>
</tr>
</table>

			of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

SEM IV(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Algebra-II (20 Marks) Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis	SC	3	**<u>Unit-1</u> : Algebra-II (20 Marks)** Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis

of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required). • Real Quadratic Form involving not more than three variables (problems only). Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem. Unit-2 : Computer Science & Programming (30 Marks) Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc. Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc. Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables,			of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).
	NM	3	• Real Quadratic Form involving not more than three variables (problems only). Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.
	SS	2	Unit-2 : Computer Science & Programming (30 Marks) Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc. Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc. Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type–

Fortran Expressions. Unit-3 : Probability & Statistics (30 Marks)			Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.
Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables. Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.	MFM	1	Unit-3 : Probability & Statistics (30 Marks) Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.
Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis.	KT	3	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square	TS	5	Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: standard Normal Distribution, (ii) Chi-square

distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.			(i) distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.

SEM VI(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Unit-1 : Metric space Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.	SC	3	**Unit-2 : Complex analysis** Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

<table>
<tr>
<td rowspan="2">Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.

• Continuous mappings, sequential criterion of continuity. Uniform continuity.

Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

• Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

<u>Unit-2</u> : Complex analysis

Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.</td>
<td></td>
<td></td>
<td>Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.</td>
</tr>
<tr>
<td>NM</td>
<td>1</td>
<td><u>Unit-1</u> : Metric space

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.

• Continuous mappings, sequential criterion of continuity. Uniform continuity.

Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

• Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.
<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).
Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.
Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
<u>Unit-3</u>

• Numerical differentiation : Methods based on interpolations, methods based on finite differences.
Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature formula.
</td>
<td>SS</td>
<td>1</td>
<td>
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.
<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).
Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.
Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>
<u>Unit-5</u>

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.
Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).
Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method)
</td>
</tr>
</table>

Unit-4 Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method. Numerical solution of system of nonlinear equations - Newton's method. **Unit-5** System of linear algebraic equations : Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies. Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LUdecomposition method (Crout's LU decomposition method). Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts). • The algebraic eigen value problem : Power method. **Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.			(operational counts). • The algebraic eigen value problem : Power method.
	KT	1	• Numerical differentiation : Methods based on interpolations, methods based on finite differences. Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule, composite Weddle's rule. Gaussian quadrature formula. **Unit-4** Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method. Numerical solution of system of nonlinear equations - Newton's method.
	TS	1	**Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

SEM VI(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra. Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power	SC	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	NM	1	Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean

series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on PowerSeries. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems. • Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.			polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra
	SS	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	MFM	1	• Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.
	KT	1	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
	TS	1	Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients

ODD SEM

SEM I(H)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Calculus • Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \sec^n x dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin mx dx$, $\int \sin^n x \cos^m x dx$. Parametric equations, parametriz- ing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. **Unit-2 : Geometry** • Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics. • Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the	SC	2	• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, curvature, concavity and points of inflection, en- velopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. • Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. • Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \to Y$ and $B \subseteq Y$. • Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties.

<table>
<tr>
<td rowspan="4">intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.

• Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.

• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids.

<u>Unit-3</u> : Vector Analysis

• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

<u>Unit-1</u>

• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable.

• Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NM</td>
<td>2</td>
<td>• Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, curvature, concavity and points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>• Rotation of axes and second degree equations, classification of conics using the discriminant, tangent and normal, polar equations of conics.

• Equation of Plane : General form, Intercept and Normal forms. The sides of a plane. Signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Parallelism and perpendicularity of two planes.

• Straight lines in 3D: Equation (Symmetric & Parametric form). Direction ratio and direction cosines. Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Distance of a point from a line. Condition of coplanarity of two lines. Equation of skew lines. Shortest distance between two skew lines.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.</td>
</tr>
</table>

biquadratic equation (solution by Ferrari's method). • Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality. • Linear difference equations with constant coefficients (up to 2nd order). **Unit-2** • Relation : equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. • Mapping : injective, surjective, one to one correspondence, invertible mapping, composition of mappings, relation between composition of mappings and various set theoretic operations. Meaning and properties of $f^{-1}(B)$, for any mapping $f : X \rightarrow Y$ and $B \subseteq Y$. • Well-ordering property of positive integers, Principles of Mathematical induction, division algorithm, di- visibility and Euclidean algorithm. Prime numbers and their properties, Euclid's theorem. Congruence relation between integers. Fundamental Theorem of Arithmetic. Chinese remainder theorem. Arithmetic functions, some arithmetic functions such as φ, τ, σ and their properties. **Unit-3** • Rank of a matrix, inverse of a matrix, characterizations of invertible matrices. • Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.			• Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric and hyperbolic functions of complex variable. • Theory of equations : Relation between roots and coefficients, transformation of equation, Descartes rule of signs, Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method).
	KT	2	• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued • Rank of a matrix, inverse of a matrix, characterizations of invertible matrices. • Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $AX = B$, solution sets of linear systems, applications of linear systems.
	TS	2	• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid. Tangent and normals of conicoids. • Inequality : The inequality involving $AM \geq GM \geq HM$, Cauchy-Schwartz inequality.

			• Linear difference equations with constant coefficients (up to 2nd order).

SEM-I(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Syllabus
Unit-1 : Algebra-I (15 Marks) Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions. Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications. Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation $f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.	SC	0	
	NM	1	Unit-2 : Differential Calculus-I (25 Marks) Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included). Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity. Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation. Successive derivative - Leibnitz's theorem and its application.

Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

Unit-2 : Differential Calculus-I (25 Marks)

Rational numbers, Geometrical representations, Irrational number, Real number represented as point on a line — Linear Continuum. Acquaintance with basic properties of real number (No deduction or proof is included).

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance (on proof) with the important properties of continuous functions no closed intervals. Statement of existence of inverse function of a strictly monotone function and its continuity.

Derivative - its geometrical and physical interpretation. Sign of derivative-Monotonic increasing and de- creasing functions. Relation between continuity and derivability. Differential - application in finding approximation.

Successive derivative - Leibnitz's theorem and its application.

Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables.

Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).

		Functions of two and three variables : their geometrical representations. Limit and Continuity (definitions only) for function of two variables. Partial derivatives. Knowledge and use of chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables - Successive partial Derivatives : Statement of Schwarz's Theorem on Commutative property of mixed derivatives. Euler's Theorem on homogeneous function of two and three variables. Applications of Differential Calculus : Curvature of plane curves. Rectilinear Asymptotes (Cartesian only). Envelope of family of straight lines and of curves (problems only). Definitions and examples of singular points (Viz. Node. Cusp, Isolated point).
SS	0	
MFM	0	
KT	3	**Unit-1 : Algebra-I (15 Marks)** Complex Numbers : De Moivre's Theorem and its applications. Exponential, Sine, Cosine and Logarithm of a complex number. Definition of a^x (a 0). Inverse circular and Hyperbolic functions. Polynomials : Fundamental Theorem of Algebra (Statement only). Polynomials with real coefficients, the n-th degree polynomial equation has exactly n roots. Nature of roots of an equation (surd or complex roots occur in pairs). Statement of Descarte's rule of signs and its applications. Statements of : (i) If a polynomial $f(x)$ has opposite signs for two real values a and b of x, the equation$f(x) = 0$ has odd number of real roots between a and b. If $f(a)$ and $f(b)$ are of same sign, either no realroot or an even number of roots lies between a and b. (ii) Rolle's Theorem and its direct applications. Relation between roots and coefficients, symmetric func- tions of roots, transformations of equations. Cardan's method of solution of a cubic equation.

<table>
<tr>
<td rowspan="2">
<u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.

<u>Unit-4</u> : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.

Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equationof chord joining two points. Equations of tangent and normal.

Sphere and its tangent plane. Right circular cone.
</td>
<td></td>
<td></td>
<td>
Rank of a matrix : Determination of rank either by considering minors or by sweep-out process. Consistencyand solution of a system of linear equations with not more than 3 variables by matrix method.

<u>Unit-3</u> : Differential Equation-I (15 Marks)

Order, degree and solution of an ordinary differential equation (ODE) in presence of arbitrary constants, Formation of ODE.

First order equations : (i) Exact equations and those reducible to such equation. (ii) Euler's and Bernoulli's equations (Linear). (iii) Clairaut's Equations : General and Singular solutions.

Second order linear equations : Second order linear differential equation with constant coefficients. Euler's Homogeneous equations.

Second order differential equation : (i) Method of variation of parameters, (ii) Method of undetermined coefficients.
</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>
<u>Unit-4</u> : Coordinate Geometry (25 Marks)

Transformations of Rectangular axes : Translation, Rotation and their combinations. Invariants.

General equation of second degree in x and y : Reduction to canonical forms. Classification of conic.

Pair of straight lines : Condition that the general equation of 2nd degree in x and y may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax^2 + 2hxy + by^2 = 0$. Equation of bisectors. Equation of two lines joining the origin to the points in whicha line meets a conic.

Equations of pair of tangents from an external point, chord of contact, poles and polars in case of General conic : Particular cases for Parabola, Ellipse, Circle, Hyperbola.
</td>
</tr>
</table>

			Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole. Equation of chord joining two points. Equations of tangent and normal. Sphere and its tangent plane. Right circular cone.

	NM	1	MODULE IV Group A (25 marks) Differential Calculus Statement of Rolle's theorem and its geometrical interpretation. Mean Value Theorems of Lagrange and Cauchy. Statements of Taylors and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders. Taylor's and Maclaurin's Infinite series for functions like e^x, sin x, cos x. $(1+x)^n$, log(1+x) [with restrictions wherever necessary] Indeterminate Forms : L'Hospital's Rule : Statement and problems only. Functions of two and three variables : Their geometrical representations. Limit and Continuity (definitions only) for functions of two variables. Partial derivatives : Knowledge and use of Chain Rule. Exact differentials (emphasis on solving problems only). Functions of two variables – Successive partial derivatives : Statement of Schwarz's Theorem on commutative property of mixed derivatives. Euler's theorem on homogeneous function of two and three variables. Maxima and minima of functions of not more than three variables – Lagrange's Method of undetermined multiplier – Problems only. Implicit function in case of function of two variables (existence assumed) and derivative.

			Group-B (15-Marks) <u>Integral Calculus</u> Reduction formulae of $\int sin^n x cos^m x \, dx$, $\int \frac{sin^n x}{cos^m x} \, dx$, $\int tan^n \, dx$ and associated problems (m and n are non-negative integers). Definition of Improper Integrals : Statements of (i) □ -test, (ii) Comparison test (Limit form excluded) – Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). Working knowledge of Double integral. Applications : Rectification, Quadrature, Volume and Surface areas of solids formed by revolution of plane curve and areas – Problems only.
	SS	0	
	MFM	0	
	KT	2	Group B (25 marks) <u>Analytical Geometry of 3 dimensions</u> Rectangular Cartesian co-ordinates : Distance between two points. Division of a line segment in a given ratio. Direction cosines and direction ratios of a straight line. Projection of a line segment on another line. Angle between two straight lines. Equation of a Plane : General form. Intercept and Normal form. Angle between two planes. Signed distance of a point from a plane. Bisectors of angles between two intersecting planes. Equations of Straight line : General and symmetric form. Distance of a point from a line. Coplanarity of two straight lines. Shortest distance between two skew-lines. Sphere and its tangent plane. Right circular cone.

			Group C (10 marks) <u>Differential Equations</u> Second order linear equations : Second order linear differential equations with constant. Coefficients. Euler's Homogeneous equations.
	TS	0	

	SS	0	
	MFM	2	<u>MODULE V</u> Group A (20 marks) <u>Numerical Methods</u> Approximate numbers, Significant figures, Rounding off numbers. Error – Absolute, Relative and Percentage. Operators - □ , □ and E (Definitions and some relations among them). Interpolation : The problem of Interpolation, Equispaced arguments – Difference Tables, Deduction of Newton's Forward Interpolation Formula. Remainder term (expression only). Newton's Backward Interpolation formula (statement only) with remainder term. Unequally – spaced arguments – Lagrange's Interpolation Formula (statement only). Numerical problems on Interpolation with both equi- and unequally-spaced arguments. Number Integration : Trapezoidal and Simpson's ⅓rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Location of root (Tabular

			method), Bisection method. Newton-Raphson method with geometrical significance. Numerical problems. (Note : emphasis should be given on problems) Group B (30 marks) <u>Linear Programming</u> Motivation of Linear Programming problem. Statement of L.P.P. formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, Convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.) Degenerate and Non-degenerate B.F.S. The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme point of the convex set of feasible solutions. A B.F.S. to an L.P.P. corresponds to an extreme point of the convex set of feasible solutions. Fundamental Theorem of L.P.P. (Statement only). Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of duality. Duality theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions. <u>MODULE VI</u> (Any <u>one</u> of the following groups) <u>Group A</u> <u>Analytical Dynamics</u> Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation

			of energy and momentum. Motion under impulsive forces. Equations of motion of a particle moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuo and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. Central orbit. Kepler's laws of motion. Motion under inverse square law.
	KT	0	
	TS	0	

SEM-III(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
<u>Unit-1</u> : Limit & Continuity of functions • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, sin x, cos x, tan x, log x, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions.	SC	2 2	[40 classes] • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, sin x, cos x, tan x, log x, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions.

Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point. • Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main- tenance of same sign. Continuous function on [*a, b*] is bounded and attains its bounds. Intermediate value theorem. • Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous. • Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval *I* will be uniformly continuous on *I*. A sufficient condition under which a continuous function on an unbounded open interval *I* will be uniformly continuous on *I*(statement only). Lipschitz condition and uniform continuity. **Unit-2 : Differentiability of functions** • Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule. • Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, $\log(1 + x)$, $(1 + x)^m$, $\sin x$, $\cos x$ with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities.			Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.

• Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. **Ring theory** • Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third iso- morphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring. **Unit-2 : Linear algebra** • Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace. • Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the			

inverse of a matrix,			

SEM-III(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Integral Calculus (20 Marks) Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only. **Unit-2 : Numerical Methods (30 Marks)** Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age. • Operators - Δ, O and E (Definitions and some relations among them). Interpolation : The problem of interpolation Equispaced	SC	0	
	NM	1	**Integral Calculus (20 Marks)** Evaluation of definite integrals. Integration as the limit of a sum (with equally spaced as well as unequal intervals. Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed). • Working knowledge of double integral. Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.
	SS	2	**Linear Programming (30 Marks)** Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic

arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.

- Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration.

Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

Linear Programming (30 Marks)

Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty.

Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.

MFM	0	
KT	1	Numerical Methods (30 Marks)

Numerical Methods (30 Marks)

Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age.

- Operators - Δ, O and E (Definitions and some relations among them).

Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with

Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.			both equally and unequally spaced arguments.
	TS	1	• Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration. Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

SEM-V(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.	SC	2	**Unit-1** Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.

<u>Unit-2</u> Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution. **<u>Unit-3</u>** Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance. **<u>Unit-4</u>** Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics. Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri-butions, Chi-square, t and F-distributions, sampling distribution of $\bar{X}$, s^2, $\frac{\sqrt{n}(\bar{X}-\mu)}{s}$ Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency,	NM	3	**<u>Unit-2</u>** Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution. **<u>Unit-3</u>** Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.
	SS	2	**<u>Unit-2</u> : Linear algebra** Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties. Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature. Dual spaces, dual basis, double dual, transpose of a linear

<table>
<tr>
<td rowspan="3">Minimum-Variance Unbiased Estimator (MVUE).

• Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.

<u>Unit-5</u>

Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, levelof significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values.

• Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only).

Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

<u>Unit-1</u> : Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.

<u>Unit-2</u> : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its</td>
<td></td>
<td></td>
<td>transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.</td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td><u>Unit-4</u>

Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.

Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri- butions, Chi-square, t and F-distributions, sampling distribution of X, s^2, $\sqrt{n}(X - \mu)$

Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of</td>
</tr>
</table>

basic properties. Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature. Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).			good estimators - unbiasedness, consistency,sufficiency, Minimum-Variance Unbiased Estimator (MVUE). • Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.
	TS	2	**Unit-5** Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The *p*-value (observed level of significance), Calculating *p*-values. • Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only). Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

SEM V(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and	SC	1	Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane.

normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law. Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travellingsalesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm. • Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.			Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.
	NM	1	Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.
	SS	1	Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.
	MFM	1	Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law.
	KT	1	Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

			• Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.
	TS	0	

Lesson Plane for Academic Year: 2022-2023

EVEN SEM(CBCS)

Sem-II(HONS)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R. • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R. **Unit-2** • Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.	NM	2	**Unit-1** • Intuitive idea of real numbers. Mathematical operations and usual order of real numbers revisited with their properties (closure, commutative, associative, identity, inverse, distributive). Idea of countable sets, un- countable sets and uncountability of R. Concept of bounded and unbounded sets in R. L.U.B. (supremum), G.L.B. (infimum) of a set and their properties. L.U.B. axiom or order completeness axiom. Archimedean property of R. Density of rational (and Irrational) numbers in R.
	SC	2	**Unit-1** • Intervals. Neighbourhood of a point. Interior point. Open set. Union, intersection of open sets. Limit point and isolated point of a set. Bolzano-Weirstrass theorem for sets. Existence of limit point of every uncountable set as a consequence of Bolzano-Weirstrass theorem. Derived set. Closed set. Complement of open set and closed set. Union and intersection of closed sets as a consequence. No nonempty proper subset of R is both open and closed. Dense set in R as a set having non-empty intersection with every open intervals. Q and R z Q are dense in R.

<table>
<tr>
<td rowspan="3">

• Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence

$\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $|l| < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$,

$\{a^{x_n}\}_n$(a>0). Cauchy’s first and second limit theorems.

Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy’s convergence criterion. Cauchy sequence.

Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy’s *n*-th root test, Kummer’s test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.

<u>Unit-1</u>

• Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta-
tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.

</td>
<td></td>
<td></td>
<td>

<u>Unit-2</u>

• Real sequence. Bounded sequence. Convergence and non-convergence. Examples. Boundedness of conver- gent sequence. Uniqueness of limit. Algebra of limits.

• Relation between the limit point of a set and the limit of a convergent sequence of distinct elements. Monotone sequences and their convergence. Sandwich rule. Nested interval theorem. Limit of some important sequence

$\{n^{\frac{1}{n}}\}_n, \{x^n\}_n, \{x^{\frac{1}{n}}\}_n, \{x_n\}_n$ with $\frac{x_{n+1}}{x_n} \to l$ and $|l| < 1$, $\{(1+\frac{1}{n})^n\}_n, \{1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}\}_n$,

$\{a^{x_n}\}_n$(a>0). Cauchy’s first and second limit theorems.

</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>

<u>Unit-1</u>

• Symmetries of a square, definition of group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commuta-
tive and non-commutative groups. Subgroups and examples of subgroups, necessary and sufficient condition for a nonempty subset of a group to be a subgroup. Normalizer, centralizer, center of a group, product of two subgroups.

</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>

<u>Unit-2</u>

• Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange’s theorem and consequences including Fermat’s

</td>
</tr>
</table>

Unit-2 • Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, order of an element, order of a group. Lagrange's theorem and consequences including Fermat's Little theorem. **Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems			Little theorem.
	KT	2	**Unit-2** Subsequence. Subsequential limits, lim sup as the L.U.B. and lim inf as the G.L.B of a set containing all the subsequential limits. Alternative definition of limsup and liminf of a sequence using inequality or as lim sup x_n = inf sup{x_n, x_{n+1}, . . . , } and lim inf x_n = sup inf{x_n, x_{n+1}, . . . , } h Equivalence between these definitions is assumedi . A bounded sequence {x_n} is convergent if and only if lim sup x_n = lim inf x_n. Every sequence has a monotone subsequence. Bolzano-Weirstrass theorem for sequence. Cauchy's convergence criterion. Cauchy sequence. Infinite series, convergence and non-convergence of infinite series, Cauchy criterion, tests for convergence : comparison test, limit comparison test, ratio test, Cauchy's *n*-th root test, Kummer's test and Gauss test (statements only). Alternating series, Leibniz test. Absolute and conditional convergence.
	TS	1	**Unit-3** • Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomor- phisms, correspondence theorem and one one correspondence between the set of all normal subgroups of a group and the set of all congruences on that group, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems

SEM II(GEN)

<table>
<tr><th>Syllabus</th><th>Name of Teachers</th><th>No . of Classes</th><th>Distribution of Syllabus</th></tr>
<tr><td>

<u>Unit-1</u> : Differential Calculus-II (20 Marks)

[15 classes]

Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application.

Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.

Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary.

- Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

</td><td>SC</td><td>2</td><td>

<u>Unit-1</u> : Differential Calculus-II (20 Marks)

[15 classes]

Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application.

Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.

Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, sin x, cos x, $(1 + x)^n$, log$(1 + x)$ with restrictions wherever necessary.

- Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

</td></tr>
</table>

<table>
<tr>
<td rowspan="2">Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Differential Equation-II (15 Marks)

[10 classes]

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-3 : Vector Algebra (15 Marks)

[10 classes]

Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).</td>
<td></td>
<td></td>
<td>Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.</td>
</tr>
<tr>
<td>NM</td>
<td>2</td>
<td>Unit-1 : Differential Calculus-II (20 Marks)

[15 classes]

Sequence of real numbers : Definition of bounds of a sequence and monotone sequence. Limit of a sequence.Statements of limit theorems. Concept of convergence and divergence of monotone sequences-applications of the theorems, in particular, definition of e. Statement of Cauchy's general principle of convergence and its application.

Infinite series of constant terms; Convergence and Divergence (definitions). Cauchy's principle as applied to infinite series (application only). Series of positive terms : Statements of comparison test. D.AIembert's Ratio test. Cauchy's nth root test and Raabe's test Applications. Alternating series. Statement of Leibnitz test and its applications.

Real-Valued functions defined on an interval: Statement of Rolle's Theorem and its geometrical interpre- tation. Mean value theorems of Lagrange and Cauchy. Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's from of remainders. Taylor's and Maclaurin's Infinite series of functions like e^x, $\sin x$, $\cos x$, $(1 + x)^n$, $\log(1 + x)$</td>
</tr>
</table>

Unit-4 : Discrete Mathematics (30 Marks)

[25 classes]

Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre-
sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â" Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation
â" when such an equation has solution, some applications.

Congruences : Congruence relation on integers, Basic properties of this relation.

Linear congruences,
Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â" to show it is an equivalence relation, to prove the following : *a*

i

h

with restrictions wherever necessary.

- Indeterminate Forms : L'Hospital's Rule : Statement and Problems only.

Application of the principle of Maxima and Minima for a function of single variable in geometrical, physical and to other problems.

Maxima and minima of functions of not more than three variables Lagrange's Method of undetermined multiplier - Problems only.

Unit-2 : Differential Equation-II (15 Marks)

[10 classes]

Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Unit-3 : Vector Algebra (15 Marks)

[10 classes]

Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).

b (mod m) implies (i) $(a + c)$ $(b + c)$ (mod m) (ii) ac bc (mod m) (iii) a^n b^n (≡ mod m), for any polynomial $f(x)$ with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications. Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides $(b$ 1) then $n = (a_k a_{k}$ $_1 a_1 b)$ is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International standard book number, universal product code etc. Theorem regarding error detecting capability. Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement,			**<u>Unit-4</u> : Discrete Mathematics (30 Marks)** [25 classes] Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â“ Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear Diophantine equation â“ when such an equation has solution, some applications. Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a

proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.			b (mod m) implies (iv) $(a + c)$ $(b + c)$ (mod m) (v) ac bc (mod m) (vi) a^n b^n (≡ mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications. Application of Congruences : Divisibility tests. Check-digit and an ISBN, in Universal product Code, in major credit cards. Error detecting capability. Using Congruence, develop divisibility tests for integers based on their expansions with respect to different bases, if d divides (b 1) then n = ($a_k a_{k-1} a_1 b$) is divisible by d if and only if the sum of the digits is divisible by d etc. Show that congruence can be used to schedule Round-Robin tournaments. Check digits for different identification numbers â“ International standard book number, universal product code etc. Theorem regarding error detecting capability. Congruence Classes : Congruence classes, addition and multiplication of congruence classes. Fermat's little theorem. Euler's theorem. Wilson's theorem. Some simple applications. Definition of Congruence Classes, properties of Congruence classes, addition and multiplication, existence of inverse. Fermat's little theorem. Euler's theorem. Wilson's theorem - Statement,

			proof and some applications. • Boolean algebra : Boolean Algebra, Boolean functions, Logic gates, Minimization of circuits.
	SS	1	Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\,\Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed). Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} cos^n x\, dx$ $\int_0^{\frac{\pi}{2}} tan^n x\, dx$ when they exist (using Beta and Gamma function) Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.
	MFM	1	<u>Unit-2</u> : Differential Equation-II (15 Marks) [10 classes] Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, The methodof variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Simple eigen- value problem. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

	KT	2	**<u>Unit-3</u> : Vector Algebra (15 Marks)** [10 classes] Addition of Vectors, Multiplication of a Vector by a Scalar. Collinear and Coplanar Vectors. Scalar and Vector products of two and three vectors. Simple applications to problems of Geometry. Vector equationof plane and straight line. Volume of Tetrahedron. Applications to problems of Mechanics (Work done and Moment).
	TS	1	**<u>Unit-4</u> : Discrete Mathematics (30 Marks)** [25 classes] Integers : Principle of Mathematical Induction. Division algorithm. Representation of integer in an arbi- trary base. Prime Integers. Some properties of prime integers. Fundamental theorem of Arithmetic. Eu- clid's Theorem. Linear Diophantine equations. Statement of Principle of Mathematical Induction, Strong form of Mathematical induction. Applications in different problems. Proofs of division algorithm. Repre- sentation of an integer uniquely in an arbitrary base, change of an integer from one base to another base. Computer operations with integers â“ Divisor of an integer, g.c.d. of two positive integers, prime integer, Proof of Fundamental theorem, Proof of Euclid's Theorem. To show how to find all prime numbers less than or equal to a given positive integer. Problems related to prime number. Linear

i

			Diophantine equation â“ when such an equation has solution, some applications. Congruences : Congruence relation on integers, Basic properties of this relation. Linear congruences, Chinese Remainder Theorem. System of Linear congruences. Definition of Congruence â“ to show it is an equivalence relation, to prove the following : a b (mod m) implies (vii) $(a + c)$ $(b + c)$ (mod m) (viii) ac bc (mod m) (ix) a^n b^n (mod m), for any polynomial f (x) with integral coefficients $f(a)$ $f(b)$ (mod m) etc.Linear Congruence, to show how to solve these congruences, Chinese remainder theorem â“ Statement and proof and some applications. System of linear congruences, when solution exists â“ some applications.

h

SEM IV(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

Riemann Integration & Series of Functions **Unit-1 : Riemann integration** • Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus. Unit-2 : Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.	SC	3	• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.
	NM	2	Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.

<table>
<tr><td rowspan="6">Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma\ (1\text{-}\ n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Unit-3 :

Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. • Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td><td></td><td></td><td></td></tr>
<tr><td>SS</td><td>1</td><td>Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma\ (1\text{-}\ n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td></tr>
<tr><td>MFM</td><td>1</td><td>Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td></tr>
<tr><td>KT</td><td>1</td><td>Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. •</td></tr>
<tr><td>TS</td><td>2</td><td>Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem.

• Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties</td></tr>
</table>

			of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

SEM IV(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Algebra-II (20 Marks) Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis	SC	3	**<u>Unit-1</u> : Algebra-II (20 Marks)** Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group. Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications. • Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field. Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis

of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).			of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).
• Real Quadratic Form involving not more than three variables (problems only). Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.	NM	3	• Real Quadratic Form involving not more than three variables (problems only). Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.
Unit-2 : Computer Science & Programming (30 Marks) Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc. Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc. Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables,	SS	2	Unit-2 : Computer Science & Programming (30 Marks) Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software. Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc. Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc. Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type–

Fortran Expressions. Unit-3 : Probability & Statistics (30 Marks)			Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.
Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.	MFM	1	Unit-3 : Probability & Statistics (30 Marks) Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye's Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.
Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis.	KT	3	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square	TS	5	Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: standard Normal Distribution, (ii) Chi-square

distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.			(i) distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.

SEM VI(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Unit-1 : Metric space Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.	SC	3	**Unit-2 : Complex analysis** Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete.

- Continuous mappings, sequential criterion of continuity. Uniform continuity.

  Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

- Concept of connectedness and some examples of connected metric space, connected subsets of R, C.
- Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

Unit-2 : Complex analysis

Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.

NM | 1

Unit-1 : Metric space

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete.

- Continuous mappings, sequential criterion of continuity. Uniform continuity.

  Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

- Concept of connectedness and some examples of connected metric space, connected subsets of R, C.
- Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

<table>
<tr>
<td rowspan="2">
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.

<u>Unit-3</u>

• Numerical differentiation : Methods based on interpolations, methods based on finite differences.

Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature formula.
</td>
<td>SS</td>
<td>1</td>
<td>
<u>Unit-1</u>

Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>
<u>Unit-5</u>

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.

Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).

Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method)
</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">Unit-4

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.
Numerical solution of system of nonlinear equations - Newton's method.

Unit-5

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.
Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).
Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts).
• The algebraic eigen value problem : Power method.
Unit-6

Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.</td>
<td></td>
<td></td>
<td>(operational counts).
• The algebraic eigen value problem : Power method.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>• Numerical differentiation : Methods based on interpolations, methods based on finite differences.
Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature formula.
Unit-4

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.
Numerical solution of system of nonlinear equations - Newton's method.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>Unit-6

Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.</td>
</tr>
</table>

SEM VI(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra. Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power	SC	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	NM	1	Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean

<table>
<tr>
<td rowspan="5">series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems.

• Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.

Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.</td>
<td></td>
<td></td>
<td>polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and minimization of switching circuits using Boolean algebra</td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>• Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.
Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients</td>
</tr>
</table>

ODD SEM(1ST SEM-CCF AND OTHER CBCS)

SEM I(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** Full Marks: 100 (Theory: 75 and Tutorial: 25) **Group A: Calculus** • Differentiability of a function at a point and in an interval. Meaning of sign of derivative. Differentiating hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to functions of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$. Indeterminate forms. L'Hospital's rule (statement and example). • Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin^m x\,dx$, $\int \sin^n x \cos^m x\,dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution.	NM	2	• Differentiability of a function at a point and in an interval. Meaning of sign of derivative. Differentiating hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to functions of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$. Indeterminate forms. L'Hospital's rule (statement and example).
	SC	2	• Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n dx$, $\int \sin^n x \sin^m x\,dx$, $\int \sin^n x \cos^m x\,dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution.
	SS	2	**MATH-H-SEC1-1-Th** **C Language with Mathematical Applications**

Group B: Geometry

• Rotation of axes and second degree equations, classification of conics using the discriminant, reduction to canonical form, tangent and normal, polar equations of conics.
• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, identification of quadric surfaces like cone, cylinder, ellipsoid, hyperboloid, classification of quadrics.

Group C: Vector Analysis
• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

MATH-H-SEC1-1-Th

C Language with Mathematical Applications

Full marks: 100
(Theory: 75 and Tutorial: 25)

Overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language,

Full marks: 100
(Theory: 75 and Tutorial: 25)

Overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language, higher level language

• Constants, Variables and Data type of C-Program: Character set. Constants and variables data types, expression, assignment statements, declaration.

• Operation and Expressions: Arithmetic operators, relational operators, logical operators.

• Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.

• Control Statements: While statement, do-while statement, for statement.

•Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.

• User-defined Functions: Definition of functions, Scope of variables, return values

<table>
<tr>
<td rowspan="2">higher level language

• Constants, Variables and Data type of C-Program: Character set. Constants and variables data types, expression, assignment statements, declaration.

• Operation and Expressions: Arithmetic operators, relational operators, logical operators.

• Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.

• Control Statements: While statement, do-while statement, for statement.

•Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.

• User-defined Functions: Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function.

• Introduction to Library functions: stdio.h, math.h, string.h, stdlib.h, time.h etc.</td>
<td></td>
<td></td>
<td>and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function.

• Introduction to Library functions: stdio.h, math.h, string.h, stdlib.h, time.h etc.

IDC:-

Group D: Basics of Operations Research
[Marks: 9]
• Idea of Linear Programming Problems: Objective function, decision variables, constraints.
• Formulation of daily life problems as an LPP (e.g. Carpenter problem, preparation of mixtures of chemicals, diet problems etc.);
• Solution of an LPP by graphical method.(only bounded region)
Definition of Game, Examples from daily</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>MATH-H-IDC-1-Th

Mathematics in Daily Life
Full marks: 75 (Theory: 50 and Tutorial: 25)</td>
</tr>
</table>

MATH-H-IDC-1-Th

Mathematics in Daily Life

Full marks: 75 (Theory: 50 and Tutorial: 25)

Group A: Basics of Set Theory

[Marks: 4]

- Concept and definition of sets, subsets and set operations (Union, Intersection, Complementation, Subtraction); Statements of basic laws of set algebra.
- Venn diagrams. Statement of the formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and its application in daily life.

Group B: Understanding Integers

[Marks: 20]

- Statement and simple problems on First Principle of Mathematical Induction.

Group A: Basics of Set Theory

[Marks: 4]

- Concept and definition of sets, subsets and set operations (Union, Intersection, Complementation, Subtraction); Statements of basic laws of set algebra.
- Venn diagrams. Statement of the formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and its application in daily life.

Group B: Understanding Integers

[Marks: 20]

- Statement and simple problems on First Principle of Mathematical Induction.

- Statement of Division algorithm; G.C.D. of two positive integers, Expression of G. C. D. of two integers x, y in the form $px + qy$ (p, $q$are integers), (Euclidean Algorithm

• Statement of Division algorithm; G.C.D. of two positive integers, Expression of G. C. D. of two integers x, y in the form $px + qy$ (p, $q$are integers), (Euclidean Algorithm without proof). • Representation of a positive integer in Binary and decimal mode. • Linear Diophantine equation in two variables: Statement of condition on the existence of integral solution, General / particular solution, Simple real life applications; • Prime Integers. Some elementary properties of prime integers (only statement), Fundamental theorem of Arithmetic (only statement), Algorithm for Primality test. • Congruence of Integers: Meaning of a ≡ b (mod m), Statements of elementary properties of congruence; If a ≡ b (mod m) then for any integer c, (a + c) ≡ (b + c)			without proof). • Representation of a positive integer in Binary and decimal mode. • Linear Diophantine equation in two variables: Statement of condition on the existence of integral solution, General / particular solution, Simple real life applications; • Prime Integers. Some elementary properties of prime integers (only statement), Fundamental theorem of Arithmetic (only statement), Algorithm for Primality test. • Congruence of Integers: Meaning of a ≡ b (mod m), Statements of elementary properties of congruence; If a ≡ b (mod m) then for any integer c, (a + c) ≡ (b + c) (mod m), (a – c) ≡ (b – c) (mod m), ac ≡bc (mod m), $a^n \equiv b^n$ (mod m) for natural numbers n;

(mod m), (a − c) ≡ (b − c) (mod m), ac ≡bc (mod m), $a^n \equiv b^n$ (mod m) for natural numbers n; • Application of congruence of integers: Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results and problems only), Check Digits in International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament Table using congruence of integers(Technique and Problems only). *Group C: Mathematical logic* [Marks: 7] • Proposition, propositional variables and propositional Logic; • Logical Connectives: NOT (Negation), OR (Disjunction), AND (Conjunction),			• Application of congruence of integers: Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results and problems only), Check Digits in International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament Table using congruence of integers(Technique and Problems only). *Group E: Financial Mathematics* [Marks: 10] • Time value of money:- Simple interest and Compound interest (Fundamental Formulae); Interest payable monthly, quarterly, annually; (Only

Exclusive OR(XOR), IMPLICATION(If p then q) and BI-IMPLICATION (If and only if) and their Truth Tables; Truth value of a proposition, Truth tables of expressions involving more than one logical connective; • Tautology, logical consequence, logical equivalence, contradiction; *Group D: Basics of Operations Research* [Marks: 9] • Idea of Linear Programming Problems: Objective function, decision variables, constraints. • Formulation of daily life problems as an LPP (e.g. Carpenter problem, preparation of mixtures of chemicals, diet problems etc.); • Solution of an LPP by graphical method.(only bounded region) • Definition of Game, Examples from daily life Two person zero sum game, Strategy,			problems). • Ordinary Simple Annuities – Accumulated value and Discounted Value of an ordinary simple annuity – Idea of repayment of loans, Simple problems. (No formula derivation). • Problems on Dividend calculation and Calculation of income tax on taxable income (old and new regime).
	KT	2	• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, identification of quadric surfaces like cone, cylinder, ellipsoid, hyperboloid, classification of quadrics. • Rotation of axes and second degree equations, classification of conics using the discriminant, reduction to canonical form, tangent and normal, polar equations of conics.

Payoff, Saddle point, Solution of a game problem with saddle point (only elementary problems) *Group E: Financial Mathematics* [Marks: 10] • Time value of money:- Simple interest and Compound interest (Fundamental Formulae); Interest payable monthly, quarterly, annually; (Only problems). • Ordinary Simple Annuities – Accumulated value and Discounted Value of an ordinary simple annuity – Idea of repayment of loans, Simple problems. (No formula derivation). • Problems on Dividend calculation and Calculation of income tax on taxable income (old and new regime).			IDC:- *Group C: Mathematical logic* [Marks: 7] • Proposition, propositional variables and propositional Logic; • Logical Connectives: NOT (Negation), OR (Disjunction), AND (Conjunction), Exclusive OR(XOR), IMPLICATION(If p then q) and BI-IMPLICATION (If and only if) and their Truth Tables; Truth value of a proposition, Truth tables of expressions involving more than one logical connective; • Tautology, logical consequence, logical equivalence, contradiction;
	TS	2	Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

SEM I(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** Full Marks: 100 (Theory: 75 and Tutorial: 25) **Group A: Calculus** • Differentiability of a function at a point and in an interval. Meaning of sign of derivative. Differentiating hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to functions of type e^{ax+b}sin x, e^{ax+b}cos x, $(ax + b)^n$ sin x, $(ax + b)^n$ cos x. Indeterminate forms. L'Hospital's rule (statement and example). • Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (log\,x)^n dx$, $\int \sin^n x \sin^m x\,dx$, $\int \sin^n x \cos^m x\,dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution. **Group B: Geometry** • Rotation of axes and second degree equations, classification of conics using the discriminant,	NM	2	• Differentiability of a function at a point and in an interval. Meaning of sign of derivative. Differentiating hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to functions of type e^{ax+b}sin x, e^{ax+b}cos x, $(ax + b)^n$ sin x, $(ax + b)^n$ cos x. Indeterminate forms. L'Hospital's rule (statement and example).
	SC	2	• Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (log\,x)^n dx$, $\int \sin^n x \sin^m x\,dx$, $\int \sin^n x \cos^m x\,dx$. Parametric equations, parametrizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution.
	SS	2	**MATH-H-SEC1-1-Th** **C Language with Mathematical Applications** **Full marks: 100** **(Theory: 75 and Tutorial: 25)** Overview of architecture of computer, compiler,

reduction to canonical form, tangent and normal, polar equations of conics.

• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, identification of quadric surfaces like cone, cylinder, ellipsoid, hyperboloid, classification of quadrics.

Group C: Vector Analysis

• Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

MATH-H-SEC1-1-Th

C Language with Mathematical Applications

Full marks: 100
(Theory: 75 and Tutorial: 25)

Overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language, higher level language

• Constants, Variables and Data type of C-Program: Character set. Constants and

assembler, machine language, high level language, object oriented language, programming language, higher level language

• Constants, Variables and Data type of C-Program: Character set. Constants and
variables data types, expression, assignment statements, declaration.

• Operation and Expressions: Arithmetic operators, relational operators, logical operators.

• Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.

• Control Statements: While statement, do-while statement, for statement.

•Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.

• User-defined Functions: Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function.

<table>
<tr>
<td rowspan="2">variables data types, expression, assignment statements, declaration.

• Operation and Expressions: Arithmetic operators, relational operators, logical operators.

• Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.

• Control Statements: While statement, do-while statement, for statement.

•Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.

• User-defined Functions: Definition of functions, Scope of variables, return values and their types, function declaration, function call by value, Nesting of functions, passing of arrays to functions, Recurrence of function.

• Introduction to Library functions: stdio.h, math.h, string.h, stdlib.h, time.h etc.
•</td>
<td></td>
<td></td>
<td>• Introduction to Library functions: stdio.h, math.h, string.h, stdlib.h, time.h etc.

IDC:-

Group D: Basics of Operations Research
[Marks: 9]
• Idea of Linear Programming Problems: Objective function, decision variables, constraints.
• Formulation of daily life problems as an LPP (e.g. Carpenter problem, preparation of mixtures of chemicals, diet problems etc.);
• Solution of an LPP by graphical method.(only bounded region)
Definition of Game, Examples from daily</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>MATH-H-IDC-1-Th

Mathematics in Daily Life
Full marks: 75 (Theory: 50 and Tutorial: 25)

Group A: Basics of Set Theory

[Marks: 4]

• Concept and definition of sets,</td>
</tr>
</table>

MATH-H-IDC-1-Th

Mathematics in Daily Life

Full marks: 75 (Theory: 50 and Tutorial: 25)

Group A: Basics of Set Theory

[Marks: 4]

- Concept and definition of sets, subsets and set operations (Union, Intersection, Complementation, Subtraction); Statements of basic laws of set algebra.
- Venn diagrams. Statement of the formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and its application in daily life.

Group B: Understanding Integers

[Marks: 20]

- Statement and simple problems on First Principle of Mathematical Induction.
- Statement of Division algorithm; G.C.D. of two positive integers, Expression of G.

subsets and set operations (Union, Intersection, Complementation, Subtraction); Statements of basic laws of set algebra.

- Venn diagrams. Statement of the formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and its application in daily life.

Group B: Understanding Integers

[Marks: 20]

- Statement and simple problems on First Principle of Mathematical Induction.
- Statement of Division algorithm; G.C.D. of two positive integers, Expression of G. C. D. of two integers x, y in the form $px + qy$ (p, $q$are integers), (Euclidean Algorithm without proof).
- Representation of a positive integer in Binary and decimal mode.
- Linear Diophantine equation in two

C. D. of two integers x, y in the form $px + qy$ (p, $q$are integers), (Euclidean Algorithm without proof). • Representation of a positive integer in Binary and decimal mode. • Linear Diophantine equation in two variables: Statement of condition on the existence of integral solution, General / particular solution, Simple real life applications; • Prime Integers. Some elementary properties of prime integers (only statement), Fundamental theorem of Arithmetic (only statement), Algorithm for Primality test. • Congruence of Integers: Meaning of a ≡ b (mod m), Statements of elementary properties of congruence; If a ≡ b (mod m) then for any integer c, (a + c) ≡ (b + c) (mod m), (a − c) ≡ (b − c) (mod m), ac ≡bc (mod m), $a^n \equiv b^n$ (mod m) for natural			variables: Statement of condition on the existence of integral solution, General / particular solution, Simple real life applications; • Prime Integers. Some elementary properties of prime integers (only statement), Fundamental theorem of Arithmetic (only statement), Algorithm for Primality test. • Congruence of Integers: Meaning of a ≡ b (mod m), Statements of elementary properties of congruence; If a ≡ b (mod m) then for any integer c, (a + c) ≡ (b + c) (mod m), (a − c) ≡ (b − c) (mod m), ac ≡bc (mod m), $a^n \equiv b^n$ (mod m) for natural numbers n; • Application of congruence of integers: Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results and problems only), Check

numbers n; • Application of congruence of integers: Divisibility tests by 2, 3, 4, 5, 7, 9, 11, 13 (Statements of relevant results and problems only), Check Digits in International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament Table using congruence of integers(Technique and Problems only). *Group C: Mathematical logic* [Marks: 7] • Proposition, propositional variables and propositional Logic; • Logical Connectives: NOT (Negation), OR (Disjunction), AND (Conjunction), Exclusive OR(XOR), IMPLICATION(If p then q) and BI-IMPLICATION (If and			Digits in International Standard Book Number (ISBN), Universal Product Code (UPC), VISA and MASTER card (Statements of relevant results and Problems only), Formation of Round Robin Tournament Table using congruence of integers(Technique and Problems only). *Group E: Financial Mathematics* [Marks: 10] • Time value of money:- Simple interest and Compound interest (Fundamental Formulae); Interest payable monthly, quarterly, annually; (Only problems). • Ordinary Simple Annuities – Accumulated value and Discounted Value of an

only if) and their Truth Tables; Truth value of a proposition, Truth tables of expressions involving more than one logical connective; • Tautology, logical consequence, logical equivalence, contradiction; *Group D: Basics of Operations Research* [Marks: 9] • Idea of Linear Programming Problems: Objective function, decision variables, constraints. • Formulation of daily life problems as an LPP (e.g. Carpenter problem, preparation of mixtures of chemicals, diet problems etc.); • Solution of an LPP by graphical method.(only bounded region) • Definition of Game, Examples from daily life Two person zero sum game, Strategy, Payoff, Saddle point, Solution of a game			ordinary simple annuity – Idea of repayment of loans, Simple problems. (No formula derivation). • Problems on Dividend calculation and Calculation of income tax on taxable income (old and new regime).
	KT	2	• Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, identification of quadric surfaces like cone, cylinder, ellipsoid, hyperboloid, classification of quadrics. • Rotation of axes and second degree equations, classification of conics using the discriminant, reduction to canonical form, tangent and normal, polar equations of conics. IDC:- *Group C: Mathematical logic* [Marks: 7] • Proposition, propositional variables and propositional Logic;

problem with saddle point (only elementary problems) *Group E: Financial Mathematics* [Marks: 10] • Time value of money:- Simple interest and Compound interest (Fundamental Formulae); Interest payable monthly, quarterly, annually; (Only problems). • Ordinary Simple Annuities – Accumulated value and Discounted Value of an ordinary simple annuity – Idea of repayment of loans, Simple problems. (No formula derivation). • Problems on Dividend calculation and Calculation of income tax on taxable income (old and new regime).			• Logical Connectives: NOT (Negation), OR (Disjunction), AND (Conjunction), Exclusive OR(XOR), IMPLICATION(If p then q) and BI-IMPLICATION (If and only if) and their Truth Tables; Truth value of a proposition, Truth tables of expressions involving more than one logical connective; • Tautology, logical consequence, logical equivalence, contradiction;
	TS	2	Triple product, vector equations, applications to geometry and mechanics — concurrent forces in a plane, theory of couples, system of parallel forces. Introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions of one variable.

SEM-III(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 : Limit & Continuity of functions • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, $\sin x$, $\cos x$, $\tan x$, $\log x$, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point. • Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and main- tenance of same sign. Continuous function on $[a, b]$ is bounded and attains its bounds. Intermediate value theorem. • Discontinuity of functions, type of discontinuity. Step functions. Piecewise continuity. Monotone functions. Monotone functions can have only jump discontinuity. Monotone functions can have atmost countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous. • Uniform continuity. Functions continuous on a closed and bounded interval is uniformly continuous. A necessary and sufficient condition under which a continuous function on a bounded open interval I will be uniformly continuous on I. A sufficient condition under which a continuous function on an unbounded open interval I will be uniformly continuous on I(statement only). Lipschitz condition and uniform	SC	2 2	[40 Classes] • Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Algebra of limits for functions, effect of limit on inequality involving functions, one sided limits. Infinite limits and limits at infinity. Important • Continuity of a function on an interval and at an isolated point. Sequential criteria for continuity. Concept of oscillation of a function at a point. A function is continuous at x if and only if its oscillation at x is zero. Familiarity with the figures of some well known functions : $y = x^a$ ($a = 2, 3, \frac{1}{2}, -1$), $\|x\|$, $\sin x$, $\cos x$, $\tan x$, $\log x$, e^x. Algebra of continuous functions as a consequence of algebra of limits. Continuity of composite functions. Examples of continuous functions. Continuity of a function at a point does not necessarily imply the continuity in some neighbourhood of that point.

continuity. **Unit-2 : Differentiability of functions** • Differentiability of a function at a point and in an interval, algebra of differentiable functions. Meaning of sign of derivative. Chain rule. • Darboux theorem, Rolle's theorem, Mean value theorems of Lagrange and Cauchy — as an application of Rolle's theorem. Taylor's theorem on closed and bounded interval with Lagrange's and Cauchy's form of remainder deduced from Lagrange's and Cauchy's mean value theorem respectively. Expansion of e^x, $\log(1+x)$, $(1+x)^m$, $\sin x$, $\cos x$ with their range of validity (assuming relevant theorems). Application of Taylor's theorem to inequalities. • Statement of L' Hospital's rule and its consequences. Point of local extremum (maximum, minimum) of a function in an interval. Sufficient condition for the existence of a local maximum/minimum of a function at a point (statement only). Determination of local extremum using first order derivative. Application of the principle of maximum/minimum in geometrical problems. **Ring theory** • Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield, necessary and sufficient condition for a nonempty subset of a field to be a subfield, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. First isomorphism theorem, second isomorphism theorem, third iso- morphism theorem, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all			

<table>
<tr><td>congruences on a ring.

<u>Unit-2</u> : Linear algebra

• Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces. Subspaces of R^n, dimension of subspaces of R^n. Geometric significance of subspace.

• Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, change of coordinate matrix. Algebra of linear transformations. Isomorphisms.
Isomorphism theorems, invertibility and isomorphisms. Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix,</td><td></td><td></td><td></td></tr>
</table>

SEM-III(GEN)

<table>
<tr><th>Syllabus</th><th>Name of Teacher</th><th>No. of Classes</th><th>Distribution of Sybbabus</th></tr>
<tr><td rowspan="2"><u>Unit-1</u> : Integral Calculus (20 Marks)

Evaluation of definite integrals.
Integration as the limit of a sum (with equally spaced as well as unequal intervals.
Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions (convergence and important relations being assumed).</td><td>SC</td><td>0</td><td></td></tr>
<tr><td>NM</td><td>1</td><td>Integral Calculus (20 Marks)

Evaluation of definite integrals.
Integration as the limit of a sum (with equally spaced as well as unequal intervals.
Definition of Improper Integrals : Statements of (i) μ-test (ii) Comparison test (Limit from excluded) - Simple problems only. Use of Beta and Gamma functions</td></tr>
</table>

<table>
<tr>
<td rowspan="3">

- Working knowledge of double integral.

Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.

<u>Unit-2</u> : Numerical Methods (30 Marks)

Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age.

- Operators - Δ, O and E (Definitions and some relations among them).

Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.

- Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration.

Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)

Linear Programming (30 Marks)

Motivation of Linear Programming problem. Statement of

</td>
<td></td>
<td></td>
<td>

(convergence and important relations being assumed).

- Working knowledge of double integral.

Applications : Rectification, Quadrature, volume and surface areas of solids formed by revolution of plane curve and areas problems only.

</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>

Linear Programming (30 Marks)

Motivation of Linear Programming problem. Statement of L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.

</td>
</tr>
<tr>
<td>MFM</td>
<td>0</td>
<td></td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">L.P.P. Formulation of L.P.P. Slack and Surplus variables. L.P.P. is matrix form. Convex set, Hyperplane, Extreme points, convex Polyhedron, Basic solutions and Basic Feasible Solutions (B.F.S.). Degenerate and Non-degenerate B.F.S.

The set of all feasible solutions of an L.P.P. is a convex set. The objective function of an L.P.P. assumes its optimal value at an extreme print of the convex set of feasible solutions, A.B.F.S. to an L.P.P. correspondsto an extreme point of the convex set of feasible solutions.

Fundamental Theorem of L.P.P. (Statement only) Reduction of a feasible solution to a B.F.S. Standard form of an L.P.P. Solution by graphical method (for two variables), by simplex method and method of penalty. Concept of Duality. Duality Theory. The dual of the dual is the primal. Relation between the objective values of dual and the primal problems. Dual problems with at most one unrestricted variable, one constraint of equality. Transportation and Assignment problem and their optimal solutions.</td>
<td>KT</td>
<td>1</td>
<td>Numerical Methods (30 Marks)

Approximate numbers, Significant figures, Rounding off numbers. Error : Absolute, Relative and percent- age.

• Operators - Δ, ∇ and E (Definitions and some relations among them).

Interpolation : The problem of interpolation Equispaced arguments Difference Tables, Deduction of New- ton's Forward Interpolation Formula, remainder term (expression only). Newton's Backward interpolation Formula (Statement only) with remainder term. Unequally-spaced arguments Lagrange's Interpolation Formula (Statement only). Numerical problems on Interpolation with both equally and unequally spaced arguments.</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>• Numerical Integration : Trapezoidal and Simpson's $\frac{1}{3}$-rd formula (statement only). Problems on Numerical Integration.

Solution of Numerical Equation : To find a real root of an algebraic or transcendental equation. Loca- tion of root (tabular method), Bisection method, Newton-Raphson method with geometrical significance, Numerical Problems. (Note : Emphasis should be given on problems)</td>
</tr>
</table>

SEM-V(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus

<table>
<tr>
<td rowspan="2">

<u>**Unit-1**</u>

Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.

<u>**Unit-2**</u>

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

<u>**Unit-3**</u>

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

<u>**Unit-4**</u>

</td>
<td>SC</td>
<td>2</td>
<td>

<u>**Unit-1**</u>

Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil- ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.

</td>
</tr>
<tr>
<td>NM</td>
<td>3</td>
<td>

<u>**Unit-2**</u>

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

<u>**Unit-3**</u>

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.

Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri-butions, Chi-square, t and F-distributions, sampling distribution of X, s^2, $\sqrt{n}(X - \mu)$

Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency, Minimum-Variance Unbiased Estimator (MVUE).

• Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.

<u>Unit-5</u>

Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, levelof significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values.

• Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only).

Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

<u>Unit-1</u> : Group theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td><u>Unit-2</u> : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel’s inequality, the adjoint of a linear operator and its basic properties.

Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester’s law of inertia. Index, signature.

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).</td>
</tr>
<tr>
<td>MFM</td>
<td>2</td>
<td>Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange’s theorem for finite abelian group, Cauchy’s theorem for finite abelian group, Fundamental theorem of finite abelian groups.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">
Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.
External direct product and its properties, the group of units modulo n as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.
<u>Unit-2</u> : Linear algebra
Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties.
Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature.
Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).
</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td>
<u>Unit-4</u>
Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.
Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distributions, Chi-square, t and F-distributions, sampling distribution of X, s^2, $\sqrt{n}(X-\mu)$
Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency,sufficiency, Minimum-Variance Unbiased Estimator (MVUE).
Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.
</td>
</tr>
<tr>
<td>TS</td>
<td>2</td>
<td>
<u>Unit-5</u>
Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The p-value (observed level of significance), Calculating p-values.
Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only).
Bivariate frequency Distribution : Bivariate data, Scatter
</td>
</tr>
</table>

			diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

SEM V(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law.	SC	1	Velocity and Acceleration of a particle. Expressions for velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.
	NM	1	Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.
	SS	1	Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.
	MFM	1	Motion in two dimensions : Projectiles in vacuum and

Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travellingsalesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm. • Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.			in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law.
	KT	1	Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm. • Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.
	TS	0	

Lesson Plane for Academic Year: 2023-2024

EVEN SEM(CBCS)

SEM IV(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Riemann Integration & Series of Functions **Unit-1 : Riemann integration** • Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0.	SC	3	• Partition and refinement of partition of a closed and bounded interval. Upper Darboux sum $U(P, f)$ and lower Darboux sum $L(P, f)$ and associated results. Upper integral and lower integral. Darboux's theorem. Darboux's definition of integration over a closed and bounded interval. Riemann's definition of integrability. Equivalence with Darboux definition of integrability (statement only). Necessary and sufficient condition for Riemann integrability. • Concept of negligible set (or zero set) defined as a set covered by countable number of open intervals sum of whose lengths is arbitrary small. Examples of negligible sets : any subset of a negligible set, finite set, countable union of negligible sets. A bounded function on closed and bounded interval is Riemann integrable if and only if the set of points of discontinuity is negligible. Example of Riemann integrable functions. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0.

<table>
<tr>
<td rowspan="6">

- Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

Unit-2 :

Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.

Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Unit-3 :

Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness, continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. • Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.

</td>
<td></td>
<td></td>
<td>

- Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

</td>
</tr>
<tr>
<td>NM</td>
<td>2</td>
<td>Improper integral [10 classes] • Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral in both cases. • Tests of convergence : Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product.</td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>

Convergence and working knowledge of Beta and Gamma function and their interrelation ($\Gamma(n)\ \Gamma(1-n)$ □ $\frac{\pi}{\sin n\pi}$, $0 < n < 1$, , to be assumed).

Computation of the integrals $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$ $\int_0^{\frac{\pi}{2}} tan^n x\ dx$ when they exist (using Beta and Gamma function)

Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.

</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>Fourier series : Trigonometric series. Statement of sufficient condition for a trigonometric series to be a Fourier series. Fourier coefficients for periodic functions defined on [−π, π]. Statement of Dirichlet's condition of convergence. Statement of theorem of sum of Fourier series.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>Determination of radius of convergence. Uniform and absolute convergence of power series. Properties of sum function. Differentiation and integration of power series. Abel's limit theorems. Uniqueness of power series having sum function. •</td>
</tr>
<tr>
<td>TS</td>
<td>2</td>
<td>Series of functions [30 classes] • Sequence of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weirstrass' M-test. Boundedness,</td>
</tr>
</table>

			continuity, integrability and differentiability of the limit function of a sequence of functions in case of uniform convergence. 16 • Series of functions defined on a set, Pointwise and uniform convergence. Cauchy criterion of uniform convergence. Weierstrass' M-test. Passage to the limit term by term. Boundedness, continuity, integrability, differentiability of a series of functions in case of uniform convergence. • Power series : Fundamental theorem of power series. Cauchy-Hadamard theorem. • Integrability of sum, scalar multiple, product, quotient, modulus of Riemann integrable functions. Prop- erties of Riemann integrable functions arising from the above results. • Function defined by definite integral $\int_a^x f(t)dt$ and its properties. Antiderivative (primitive or indefinite integral). Properties of Logarithmic function defined as the definite integral $\int_a^x \frac{dt}{t}$, x > 0. • Fundamental theorem of Integral Calculus. First Mean Value theorem of integral calculus.

SEM IV(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
<u>Unit-1</u> : Algebra-II (20 Marks) Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group.	SC	3	**<u>Unit-1</u> : Algebra-II (20 Marks)** Introduction of Group Theory : Definition and examples taken from various branches (example from number system, roots of Unity, 2 2 real matrices, non singular real matrices of a fixed order). Elementary properties using definition of Group.

<table>
<tr>
<td rowspan="3">Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications.

• Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field.

Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).

• Real Quadratic Form involving not more than three variables (problems only).

Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.

<u>Unit-2</u> : Computer Science & Programming (30 Marks)

Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software.

Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc.

Programming Language : Machine language,</td>
<td></td>
<td></td>
<td>Definition and examples of sub- group - Statement of necessary and sufficient condition and its applications.

• Definitions and examples of (i) Ring, (ii) Field, (iii) Sub-ring, (iv) Sub- field.

Concept of Vector space over a Field : Examples, Concepts of Linear combinations, Linear dependenceand independence of a finite number of vectors, Sub- space, Concepts of generators and basis of a finite- dimensional vector space. Problems on formation of basis of a vector space (No proof required).</td>
</tr>
<tr>
<td>NM</td>
<td>3</td>
<td>• Real Quadratic Form involving not more than three variables (problems only).

Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors (problems only). Statement and illustration of Cayley-Hamilton Theorem.</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td><u>Unit-2</u> : Computer Science & Programming (30 Marks)

Computer Science and Programming : Historical Development, Computer Generation, Computer Anatomy Different Components of a computer system. Operating System, hardware and Software.

Positional Number System. Binary to Decimal and Decimal to Binary. Other systems. Binary Arithmetic. Octal, Hexadecimal, etc. Storing of data in a Computer - BIT, BYTE, WORD etc. Coding of a data- ASCII, etc.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="3">Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc.

Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.

Unit-3 : Probability & Statistics (30 Marks)

Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye’s Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.

Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.

Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency</td>
<td></td>
<td></td>
<td>Programming Language : Machine language, Assembly language and High level language, Compiler and interpreter. Object Programme and source Programme. Ideas about some HLL– e.g. BASIC, FORTRAN,C, C++, COBOL, PASCAL, etc.

Algorithms and Flow Charts– their utilities and important features, Ideas about the complexities of an algo- rithm. Application in simple problems. FORTRAN 77/90: Introduction, Data Type– Keywords, Constants and Variables - Integer, Real, Complex, Logical, character, subscripted variables, Fortran Expressions.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>Unit-3 : Probability & Statistics (30 Marks)

Elements of probability Theory : Random experiment, Outcome, Event, Mutually Exclusive Events, Equally likely and Exhaustive. Classical definition of probability, Theorems of Total Probability, Con- ditional probability and Statistical Independence. Baye’s Theorem. Problems, Shortcoming of the classical definition. Axiomatic approach problems, Random Variable and its Expectation, Theorems on mathemat- ical expectation. Joint distribution of two random variables.</td>
</tr>
<tr>
<td>KT</td>
<td>3</td>
<td>Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.
Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency</td>
</tr>
</table>

distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis. Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: (i) standard Normal Distribution, (ii) Chi-square distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.			distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
	TS	5	Sampling Theory : Meaning and objects of sampling. Some ideas about the methods of selecting samples, Statistic and parameter, Sampling Proportion. Four fundamental distributions, derived from the normal: standard Normal Distribution, (ii) Chi-square (i) distribution (iii) Student's distribution (iv) Snedecor's F-distribution. Estimation and Test of Significance. Statistical Inference. Theory of estimation Point estimation and Interval estimation. Confidence Interval / Confidence Limit. Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis. Level of significance. Critical Region. Type I and II error. Problems. Bivariate Frequency Distribution. Scatter Diagram, Co-relation co-efficient Definition and properties. Re- gression lines.

SEM VI(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus

<table>
<tr>
<td rowspan="2"><u>Unit-1</u> : Metric space

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.

• Continuous mappings, sequential criterion of continuity. Uniform continuity.
Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

• Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

<u>Unit-2</u> : Complex analysis

Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions.</td>
<td>SC</td>
<td>3</td>
<td><u>Unit-2</u> : Complex analysis

Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation.

Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.

Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.</td>
</tr>
<tr>
<td>NM</td>
<td>1</td>
<td><u>Unit-1</u> : Metric space

Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor’s intersection theorem. R is a complete metric space. Q is not complete.</td>
</tr>
</table>

<table>
<tr>
<td rowspan="2">
Möbius transformation.
Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series.
Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.
<u>Unit-1</u>
Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.
<u>Unit-2</u>
Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).
Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.
Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
</td>
<td></td>
<td></td>
<td>

Continuous mappings, sequential criterion of continuity. Uniform continuity.
Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.
Concept of connectedness and some examples of connected metric space, connected subsets of R, C.
Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.

</td>
</tr>
<tr>
<td>SS</td>
<td>1</td>
<td>
<u>Unit-1</u>
Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.
<u>Unit-2</u>
Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).
Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.
Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.
</td>
</tr>
</table>

Unit-3

- Numerical differentiation : Methods based on interpolations, methods based on finite differences.

Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule, Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature formula. 3

Unit-4

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.

Numerical solution of system of nonlinear equations - Newton's method.

Unit-5

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.

Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).

MFM	1	**Unit-5** System of linear algebraic equations : Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies. Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LUdecomposition method (Crout's LU decomposition method). Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts). • The algebraic eigen value problem : Power method.	
KT	1	• Numerical differentiation : Methods based on interpolations, methods based on finite differences. Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule, Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule, composite Weddle's rule. Gaussian quadrature formula.	3
		Unit-4 Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.	

Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts). • The algebraic eigen value problem : Power method. **Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.			Numerical solution of system of nonlinear equations - Newton's method.
	TS	1	**Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

SEM VI(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra.	SC	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of

Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on PowerSeries. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), (1+x)^n. Simple problems. • Periodic Fourier series on –(π, π) : Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series. Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.			uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	NM	1	Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia-grams, switching circuits and minimization of switching circuits using Boolean algebra
	SS	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	MFM	1	• Periodic Fourier series on –(π, π) : Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.
	KT	1	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties.

			Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
	TS	1	Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients

SEM-V(Hons)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Unit-1 Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal, exponential.	SC	2	**Unit-1** Random experiment, σ-field, Sample space, probability as a set function, probability axioms, probabil-ity space. Finite sample spaces. Conditional probability, Bayes theorem, independence. Real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function. Discrete distri- butions : uniform, binomial, Poisson, geometric, negative binomial, Continuous distributions : uniform, normal,

<table>
<tr>
<td rowspan="3">

Unit-2

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

Unit-3

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

Unit-4

Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics.

Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri-butions, Chi-square, t and F-distributions, sampling distribution of $\bar{X}$, s^2, $\frac{\sqrt{n}(\bar{X}-\mu)}{s}$

Estimation of parameters : Point estimation. Interval Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency, sufficiency,

</td>
<td></td>
<td></td>
<td>exponential.</td>
</tr>
<tr>
<td>NM</td>
<td>3</td>
<td>

Unit-2

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, moments, covariance, correlation coefficient, independent random variables, joint moment generating function (jmgf) and calculation of covariance from jmgf, characteristic function. Conditional expectations, linear regression for two variables, regression curves. Bivariate normal distribution.

Unit-3

Markov and Chebyshev's inequality, Convergence in Probability, statement and interpretation of weak law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance.

</td>
</tr>
<tr>
<td>SS</td>
<td>2</td>
<td>

Unit-2 : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator and its basic properties.

Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature.

</td>
</tr>
</table>

Minimum-Variance Unbiased Estimator (MVUE).

- Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.

Unit-5

Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, levelof significance. Power function of a test, most powerful test. The *p*-value (observed level of significance), Calculating *p*-values.

- Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only).

Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

Unit-1 : Group theory

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

External direct product and its properties, the group of units modulo *n* as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.

Unit-2 : Linear algebra

Inner product spaces and norms, Gram-Schmidt orthonormalisation process, orthogonal complements,

		Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).
MFM	2	**Group theory** Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups. External direct product and its properties, the group of units modulo *n* as an external direct product, internal direct product, converse of Lagrange's theorem for finite abelian group, Cauchy's theorem for finite abelian group, Fundamental theorem of finite abelian groups.
KT	3	**Unit-4** Sampling and Sampling Distributions : Populations and Samples, Random Sample, distribution of the sample, Simple random sampling with and without replacement. Sample characteristics. Sampling Distributions : Statictic, Sample moments. Sample variance, Sampling from the normal distri- butions, Chi-square, t and F-distributions, sampling distribution of X, s^2, $\sqrt{n}(X-\mu)$ Estimation of parameters : Point estimation. Interval

Bessel's inequality, the adjoint of a linear operator and its basic properties. Bilinear and quadratic forms, Diagonalisation of symmetric matrices, Second derivative test for critical point of a function of several variables, Hessian matrix, Sylvester's law of inertia. Index, signature. Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigenspaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms (Jordan & rational).			Estimation- Confidence Intervals for mean and vari- ance of Normal Population. Mean-squared error. Properties of good estimators - unbiasedness, consistency,sufficiency, Minimum-Variance Unbiased Estimator (MVUE). • Method of Maximum likelihood : likelihood function, ML estimators for discrete and continuous models.
	TS	2	**<u>Unit-5</u>** Statistical hypothesis : Simple and composite hypotheses, null hypotheses, alternative hypotheses, one- sided and two-sided hypotheses. The critical region and test statistic, type I error and type II error, level of significance. Power function of a test, most powerful test. The *p*-value (observed level of significance), Calculating *p*-values. • Simple hypothesis versus simple alternative : Neyman-Pearson lemma (Statement only). Bivariate frequency Distribution : Bivariate data, Scatter diagram, Correlation, Linear Regression, principleof least squares and fitting of polynomials and exponential curves.

SEM V(GEN)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
Velocity and Acceleration of a particle. Expressions for velocity	SC	1	Velocity and Acceleration of a particle. Expressions for

and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve. Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane. Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces. Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law. Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travellingsalesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm. • Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.			velocity and acceleration in rectangular Cartesian and polar co-ordinates for a particle moving in a plane. Tangential and normal components of velocity and acceleration of a particle moving along a plane curve.
	NM	1	Concept of Force : Statement and explanation of Newton's laws of motion. Work, power and energy. Principles of conservation of energy and momentum. Motion under impulsive forces. Equations of motion of a particle (i) moving in a straight line, (ii) moving in a plane.
	SS	1	Study of motion of a particle in a straight line under (i) constant forces, (ii) variable forces (S.H.M., Inverse square law, Damped oscillation, Forced and Damped oscillation, Motion in an elastic string). Equation of Energy. Conservative forces.
	MFM	1	Motion in two dimensions : Projectiles in vacuum and in a medium with resistance varying linearly as velocity. Motion under forces varying as distance from a fixed point. • Central orbit. Kepler's laws of motion. Motion under inverse square law.
	KT	1	Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs Paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's

			algorithm, Floyd-Warshall algorithm. • Definition of Trees and their elementary properties. Definition of Planar graphs, Kuratowski's graphs.
	TS	0	

CCF

SEM II(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC2-2-TH Basic Algebra **Group A** **Group B** **Group C** **<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex**	NM	2	Basic Algebra **Group B**
	SC	2	Basic Algebra **Group B**
	SS	2	**<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex**

Group A: Python Programming Group B: Introduction to Latex			
	MFM	1	Basic Algebra **Group A**
	KT	2	Basic Algebra **Group C**
	TS	2	Basic Algebra **Group A**

SEM II(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC2-2-TH Basic Algebra **Group A** **Group B**	NM	2	Basic Algebra **Group B**
	SC	2	Basic Algebra **Group B**

Group C **MATH-H-SEC 2.1-2-Th** **Python Programming and Introduction to Latex** Group A: Python Programming Group B: Introduction to Latex	SS	2	**MATH-H-SEC 2.1-2-Th** **Python Programming and Introduction to Latex**
	MFM	1	Basic Algebra **Group A**
	KT	2	Basic Algebra **Group C**
	TS	2	Basic Algebra **Group A**

SEM I(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
	NM	3	**Calculus**

<table>
<tr><td rowspan="5">MATH-H-CC1-1-Th
Calculus, Geometry & Vector Analysis
Group A: Calculus

Group B: Geometry

Group C: Vector Analysis

<u>MATH-H-SEC1-1-Th</u>

C Language with Mathematical Applications
MATH-H-IDC-1-Th

Mathematics in Daily Life
Full marks: 75 (Theory: 50 and Tutorial: 25)

Group A: Basics of Set Theory

Group B: Understanding Integers

Group C: Mathematical logic</td><td>SC</td><td>2</td><td>Calculus</td></tr>
<tr><td>SS</td><td>3</td><td><u>MATH-H-SEC1-1-Th</u>

C Language with Mathematical Applications

IDC: Group D: Basics of Operations Research</td></tr>
<tr><td>MFM</td><td>2</td><td>IDC: Group A: Basics of Set Theory

Group B: Understanding Integers
Group E: Financial Mathematics</td></tr>
<tr><td>KT</td><td>1</td><td>Geometry & Vector Analysis
IDC: Group C: Mathematical logic</td></tr>
<tr><td>TS</td><td>2</td><td>Vector Analysis</td></tr>
</table>

Group D: Basics of Operations Research Group E: Financial Mathematics			

SEM I(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** **Group A: Calculus** **Group B: Geometry** **Group C: Vector Analysis** **<u>MATH-H-SEC1-1-Th</u>**	NM	3	**Calculus**
	SC	2	**Calculus**
	SS	3	**<u>MATH-H-SEC1-1-Th</u>** **C Language with Mathematical Applications** IDC: Group D: Basics of Operations Research
	MFM	2	IDC: Group A: Basics of Set Theory Group B: Understanding Integers Group E: Financial Mathematics

C Language with Mathematical Applications MATH-H-IDC-1-Th **Mathematics in Daily Life** Full marks: 75 (Theory: 50 and Tutorial: 25) Group A: Basics of Set Theory Group B: Understanding Integers Group C: Mathematical logic Group D: Basics of Operations Research Group E: Financial Mathematics	KT	1	**Geometry & Vector Analysis** *IDC:* Group C: Mathematical logic
	TS	2	**Vector Analysis**

SEM III(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC 3-3-TH Real Analysis Group A Group B Group C **MATH-H-CC 4-3-TH** **Ordinary Differential Equations – I and Group Theory - I** Group A: Ordinary Differential Equations – I Group-B: Group Theory – I	NM	3	Group A & Group B
	SC	3	Group A & Group B
	SS	2	Group A: Ordinary Differential Equations – I
	MFM	2	Group C
	KT	2	Group A: Ordinary Differential Equations – I
	TS	2	Group-B: Group Theory – I

SEM III(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
	NM	2	**Calculus**
	SC	2	**Calculus**
	SS	1	**MATH-H-SEC1-1-Th**

<table>
<tr>
<td rowspan="4">MATH-H-CC1-1-Th
Calculus, Geometry & Vector Analysis
Group A: Calculus

Group B: Geometry

Group C: Vector Analysis

<u>MATH-H-SEC1-1-Th</u>

C Language with Mathematical Applications
MATH-H-IDC-1-Th

Mathematics in Daily Life
Full marks: 75 (Theory: 50 and Tutorial: 25)

Group A: Basics of Set Theory

Group B: Understanding Integers

Group C: Mathematical logic</td>
<td></td>
<td></td>
<td>C Language with Mathematical Applications

IDC: Group D: Basics of Operations Research</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td>IDC: Group A: Basics of Set Theory

Group B: Understanding Integers
Group E: Financial Mathematics</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>Geometry & Vector Analysis
IDC: Group C: Mathematical logic</td>
</tr>
<tr>
<td>TS</td>
<td>1</td>
<td>Vector Analysis</td>
</tr>
</table>

Group D: Basics of Operations Research Group E: Financial Mathematics			

Lesson Plane for Academic Year: 2024-2025

EVEN SEM(CBCS)

SEM VI(Hons)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Unit-1 : Metric space Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space. Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete. • Continuous mappings, sequential criterion of continuity. Uniform continuity. Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.	SC	3	**Unit-2 : Complex analysis** Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation. Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series. Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.

• Concept of connectedness and some examples of connected metric space, connected subsets of R, C. • Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations. **Unit-2 : Complex analysis** Stereographic projection. Regions in the complex plane. Limits, limits involving the point at infinity. Continuity of functions of complex variable. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, exponential function, logarithmic function, trigonometric functions, hyperbolic func- tions. Möbius transformation. Power series : Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions represented by power series. Uniqueness of power series. Contours, complex integration along a contour and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem (statement only) and its consequences, Cauchy integral formula.	NM	1	**Unit-1 : Metric space** Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space. Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete. • Continuous mappings, sequential criterion of continuity. Uniform continuity. Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets. • Concept of connectedness and some examples of connected metric space, connected subsets of R, C. • Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equations.
Unit-1 Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms -	SS	1	**Unit-1** Representation of real numbers, Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence.

<table>
<tr>
<td rowspan="3">stability and convergence.

<u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.

<u>Unit-3</u>

• Numerical differentiation : Methods based on interpolations, methods based on finite differences.

Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule,
composite Weddle's rule. Gaussian quadrature 3
formula.

<u>Unit-4</u>

Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method.</td>
<td></td>
<td></td>
<td><u>Unit-2</u>

Approximation : Classes of approximating functions, Types of approximations- polynomial approximation,The Weierstrass polynomial approximation theorem (statement only).

Interpolation : Lagrange and Newton's methods. Error bounds. Finite difference operators. Newton(Gregory) forward and backward difference interpolation.

Central Interpolation : Stirling's and Bessel's formulas. Different interpolation zones, Error estimation.Hermite interpolation.</td>
</tr>
<tr>
<td>MFM</td>
<td>1</td>
<td><u>Unit-5</u>

System of linear algebraic equations :
Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies.

Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

LUdecomposition method (Crout's LU decomposition method).

Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts).

• The algebraic eigen value problem : Power method.</td>
</tr>
<tr>
<td>KT</td>
<td>1</td>
<td>• Numerical differentiation : Methods based on interpolations, methods based on finite differences.

Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's $\frac{1}{3}$-rd rule, Simpson's $\frac{3}{8}$-th rule,Weddle's rule,</td>
</tr>
</table>

Numerical solution of system of nonlinear equations - Newton's method. **Unit-5** System of linear algebraic equations : Direct methods : Gaussian elimination and Gauss Jordan methods, Pivoting strategies. Iterative methods : Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LUdecomposition method (Crout's LU decomposition method). Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts). • The algebraic eigen value problem : Power method. **Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.			Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's $\frac{1}{3}$-rd rule, composite Weddle's rule. Gaussian quadrature formula. **Unit-4** Transcendental and polynomial equations : Bisection method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Condition of convergence (if any), Order of convergence, Rate of convergence of these methods. Modified Newton-Raphson method for multiple roots, Complex roots of an algebraic equation by Newton-Raphson method. Numerical solution of system of nonlinear equations - Newton's method.
	TS	1	**Unit-6** Ordinary differential equations : Single-step difference equation methods- error, convergence. The method of successive approximations (Picard), Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

SEM VI(GEN)

Syllabus	Name of Teachers	No . of Classes	Distribution of Syllabus
Definition, examples and basic properties of ordered sets, maps between ordered sets, duality	SC	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of

principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra. Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with special reference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power series. Term by term integration and Term by term differentiation of Power Series. Statements of Abel's Theorems on PowerSeries. Convergence of Power Series. Expansions of elementary functions such as e^x, sin x, log(1+x), $(1+x)^n$. Simple problems. • Periodic Fourier series on –(π, π) : Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.			sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of convergence of Power Series. Statement of properties of continuity of sum function power
	NM	1	Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements, lattices as ordered sets, complete lattices, lattices as algebraic structures, sublattices, products and homomorphisms. Definition, examples and properties of modular and distributive lattices, Boolean algebras. Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh dia- grams, switching circuits and minimization of switching circuits using Boolean algebra
	SS	1	Concept of Point-wise and Uniform convergence of sequence of functions and series of functions with specialreference of Power Series. Statement of Weierstrass M-Test for Uniform convergence of sequence of functions and of series of functions. Simple applications. Statement of important properties like boundedness, continuity, differentiability and integrability of the limit function of uniformly convergent sequence of functions and of the sum function of uniformly convergent series of functions. Determination of Radius of

Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients.			convergence of Power Series. Statement of properties of continuity of sum function power
	MFM	1	• Periodic Fourier series on $(-\pi, \pi)$: Periodic function. Determination of Fourier coefficients. Statement of Dirichlet's conditions of convergence and statement of the theorem on convergence of Fourier Sine and Cosine series.
	KT	1	Theoretical Probability Distribution Discrete and Continuous (p.m.f., p.d.f.) Binomial, Poisson and Normal distributions and their properties. Elements of Statistical Methods. Variables, Attributes. Primary data and secondary data, Population and sample. Census and Sample Survey. Tabulation Chart and Diagram, Graph, Bar diagram, Pie diagram etc. Frequency Distribution Un-grouped and grouped cumulative frequency distribution. Histogram, Fre- quency curve, Measures of Central tendencies. Averages : AM,; GM, HM, Mean, Median and Mode (their advantages and disadvantages). Measures of Dispersions - Range, Quartile Deviation, Mean Deviation, Variance / S.D., Moments, Skewness and Kurtosis
	TS	1	Laplace Transform and its application to ordinary differential equation. Laplace Transform and Inverse Laplace Transform. Statement of Existence theorem. Elementary properties of Laplace Transform andits Inverse. Application to the solution of ordinary differential equation of second order with constant coefficients

CCF

SEM II(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC2-2-TH Basic Algebra **Group A** **Group B** **Group C** **<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex** Group A: Python Programming Group B: Introduction to Latex	NM	2	Basic Algebra **Group B**
	SC	2	Basic Algebra **Group B**
	SS	2	**<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex**
	MFM	1	Basic Algebra **Group A**
	KT	2	Basic Algebra **Group C**

	TS	2	Basic Algebra **Group A**

SEM II(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC2-2-TH Basic Algebra **Group A** **Group B** **Group C** **<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex** Group A: Python Programming Group B: Introduction to Latex	NM	2	Basic Algebra **Group B**
	SC	2	Basic Algebra **Group B**
	SS	2	**<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex**
	MFM	1	Basic Algebra **Group A**

	KT	2	Basic Algebra **Group C**
	TS	2	Basic Algebra **Group A**

SEM IV(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC 5-4-TH **Theory of Real Functions** Group A : Limit and Continuity of Functions Group B: Differentiability of Functions **MATH-H-CC 6-4-TH** Mechanics-I Statics-I: **Particle Dynamics-I:** **MATH-H-CC 7-4-TH** **Multivariate Calculus – I and Partial Differential**	NM	4	Group A : Limit and Continuity of Functions & Group B: Differentiability of Functions
	SC	2	Group A : Limit and Continuity of Functions **Group B: Ring Theory**- I
	SS	2	**Group B: Partial Differential Equations - I** **Group B: Ring Theory**- I
	MFM	2	Mechanics-I & **Particle Dynamics-I:**

<u>Equations – I</u> **Group A: Multivariate Calculus – I** **Group B: Partial Differential Equations – I** **MATH-H-CC 8-4-TH** **<u>Group Theory – II and Ring Theory – I</u>** **Group A : Group Theory**- II **Group B: Ring Theory**- I	KT	1	Statics-I:
	TS	2	**Group A: Multivariate Calculus – I** **Group A : Group Theory**- II

SEM IV(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC2-2-TH Basic Algebra **Group A** **Group B**	NM	2	Basic Algebra **Group B**
	SC	2	Basic Algebra **Group B**

Group C **<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex** Group A: Python Programming Group B: Introduction to Latex	SS	2	**<u>MATH-H-SEC 2.1-2-Th</u>** **Python Programming and Introduction to Latex**
	MFM	1	Basic Algebra **Group A**
	KT	2	Basic Algebra **Group C**
	TS	2	Basic Algebra **Group A**

SEM I(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
	NM	3	**Calculus**

MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** **Group A: Calculus** **Group B: Geometry** **Group C: Vector Analysis** **<u>MATH-H-SEC1-1-Th</u>** **C Language with Mathematical Applications** MATH-H-IDC-1-Th **Mathematics in Daily Life** Full marks: 75 (Theory: 50 and Tutorial: 25) Group A: Basics of Set Theory Group B: Understanding Integers Group C: Mathematical logic	SC	2	**Calculus**
	SS	3	**<u>MATH-H-SEC1-1-Th</u>** **C Language with Mathematical Applications** IDC: Group D: Basics of Operations Research
	MFM	2	IDC: Group A: Basics of Set Theory Group B: Understanding Integers Group E: Financial Mathematics
	KT	1	**Geometry & Vector Analysis** *IDC:* Group C: Mathematical logic
	TS	2	**Vector Analysis**

Group D: Basics of Operations Research Group E: Financial Mathematics			

SEM I(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** **Group A: Calculus** **Group B: Geometry** **Group C: Vector Analysis** **<u>MATH-H-SEC1-1-Th</u>**	NM	3	**Calculus**
	SC	2	**Calculus**
	SS	3	**<u>MATH-H-SEC1-1-Th</u>** **C Language with Mathematical Applications** IDC: Group D: Basics of Operations Research
	MFM	2	IDC: Group A: Basics of Set Theory

C Language with Mathematical Applications MATH-H-IDC-1-Th **Mathematics in Daily Life** Full marks: 75 (Theory: 50 and Tutorial: 25) Group A: Basics of Set Theory Group B: Understanding Integers Group C: Mathematical logic Group D: Basics of Operations Research Group E: Financial Mathematics			Group B: Understanding Integers Group E: Financial Mathematics
	KT	1	**Geometry & Vector Analysis** *IDC:* Group C: Mathematical logic
	TS	2	**Vector Analysis**

SEM III(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC 3-3-TH Real Analysis Group A Group B Group C **MATH-H-CC 4-3-TH** **Ordinary Differential Equations – I and Group Theory - I** Group A: Ordinary Differential Equations – I Group-B: Group Theory – I	NM	3	Group A & Group B
	SC	3	Group A & Group B
	SS	2	Group A: Ordinary Differential Equations – I
	MFM	2	Group C
	KT	2	Group A: Ordinary Differential Equations – I
	TS	2	Group-B: Group Theory – I

SEM III(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC1-1-Th **Calculus, Geometry & Vector Analysis** **Group A: Calculus**	NM	2	**Calculus**
	SC	2	**Calculus**
	SS	1	**MATH-H-SEC1-1-Th** **C Language with Mathematical Applications**

Group B: Geometry **Group C: Vector Analysis** **<u>MATH-H-SEC1-1-Th</u>** **C Language with Mathematical Applications** MATH-H-IDC-1-Th **Mathematics in Daily Life** Full marks: 75 (Theory: 50 and Tutorial: 25) Group A: Basics of Set Theory Group B: Understanding Integers Group C: Mathematical logic Group D: Basics of Operations Research Group E: Financial Mathematics			IDC: Group D: Basics of Operations Research
	MFM	1	IDC: Group A: Basics of Set Theory Group B: Understanding Integers Group E: Financial Mathematics
	KT	1	**Geometry & Vector Analysis** ***IDC:*** Group C: Mathematical logic
	TS	1	**Vector Analysis**

SEM V(MAJOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC 9-5-TH <u>Probability and Statistics</u> Group – A: Probability Group – B: Statistics MATH-H-CC 10-5-TH <u>Ring Theory - II and Linear Algebra - I</u> Group – A: Ring Theory - II Group –B: Linear Algebra - I MATH-H-CC 11-5-TH <u>Riemann Integration and Series of Functions</u> Group – A: Riemann Integration	NM	4	Group – A: Riemann Integration Group B: Series of Functions
	SC	3	Group – A: Probability Group – B: Statistics
	SS	2	Group –B: Linear Algebra - I Group – A: Probability
	MFM	3	Mechanics-II Statics-II:
	KT	3	Group – A: Probability Group – B: Statistics

Group B: Series of Functions MATH-H-CC 12-5-TH Mechanics-II Statics-II: Dynamics of a Particle-II: Dynamics of rigid body:			
	TS	2	Group – A: Ring Theory - II

SEM V(MINOR)

Syllabus	Name of Teacher	No. of Classes	Distribution of Sybbabus
MATH-H-CC 3-3-TH Real Analysis Group A Group B Group C **MATH-H-CC 4-3-TH** **Ordinary Differential Equations – I and** **Group Theory - I**	NM	2	Group A & Group B
	SC	2	Group A & Group B
	SS	1	Group A: Ordinary Differential Equations – I
	MFM	1	Group C

Group A: Ordinary Differential Equations – I Group-B: Group Theory – I	KT	2	Group A: Ordinary Differential Equations – I
	TS	1	Group-B: Group Theory – I