Lesson Plan – Even Semester
B.Sc. (Major) in Mathematics
Sem-II

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM II (Major) MATH-H-CC2-2-TH Basic Algebra					
Group A: 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.	Complex Analysis	S K Mapa, Higher Algebra Dennis Zill, Complex Analysis	2	Chalk and Talk, Notes	PL
Group A: Theory of equations: Relation between roots and coefficients, transformation of equation, Descartes rule of signs. Application of Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method). Inequalities: The inequality involving AM $\geq$ GM $\geq$ HM, Cauchy-Schwarz inequality.	Classical Algebra	W.S. Burnside and A.W. Panton, *Theory of equations*	6	Chalk and Talk, Notes, tutorial, class work	PL

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Relation: equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. 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 $B \subseteq Y$.	Classical Algebra	S K Mapa, Higher Algebra	5	Chalk and Talk, Notes, tutorial, class work	BS
Group B: Well-ordering property of positive integers, Principles of Mathematical induction, equivalence of Wellordering property and Principles of Mathematical induction (statement only), division algorithm, divisibility 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.	Classical Algebra	S K Mapa, Higher Algebra	6	Chalk and Talk, Notes, tutorial, class work	AB
Group C: Systems of linear equations, homogeneous and non-homogeneous systems. Existence and Uniqueness of solution. The matrix equation $Ax = b$, row reduction and echelon forms, uniqueness of reduced echelon form. Rank of a matrix and characterization of invertible matrices, Pivot positions, basic and free variables, parametric description of the solution set. Existence and uniqueness theorem.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition) David C. Lay, *Linear Algebra and its Applications*	6	Chalk and Talk, Notes, tutorial, class work	AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group C: Vectors in $\mathbb{R}^n$, algebraic and geometric properties of the vectors. Vector form of a linear system and the column picture. Existence of solutions and linear combination of vectors. Geometry of linear combination and subsets spanned by some vectors. Uniqueness of solution and linear independence of vectors. Algebraic and geometric characterizations of linearly independent subsets.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition)	6	Chalk and Talk, Notes, tutorial, class work	BS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM II (Major) MATH-H-SEC 2.2-2-Th Artificial Intelligence					
Unit 1: Introduction to Artificial Intelligence • Definition and scope of AI • Historical overview and key milestones • Differentiating AI from human intelligence	Artificial Intelligence	Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach	2	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP
Unit 2: AI Subfields and Technologies • Machine learning: Supervised, unsupervised, and reinforcement learning • Deep learning and neural networks • Natural language processing (NLP) and computer vision	Artificial Intelligence	Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach	3	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP
Unit 3: Applications of AI • AI in healthcare: Diagnosis, treatment, and medical imaging • AI in finance: Fraud detection, algorithmic trading, and risk assessment • AI in transportation: Autonomous vehicles and traffic optimization • AI in customer service and chatbots • AI in education: Personalized learning and intelligent tutoring systems	Artificial Intelligence	Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach	6	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP
Unit 4: Ethical and Social Implications of AI • Bias and fairness in AI systems • Privacy and data protection concerns • Impact of AI on employment and the workforce • AI and social inequality	Artificial Intelligence	Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach	6	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Unit 5: Other Important Issues • Ethical guidelines and responsible AI practices • AI and Innovation • Emerging trends and future directions in AI • AI and creativity: Generative models and artistic applications	Artificial Intelligence	Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach	6	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP

Sem-IV

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (Major) MATH-H-CC5-4-Th Theory of Real Functions					
Group A: Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits. Cauchy's criterion of existence of limit (statement only). Limit theorems, one sided limits. Infinite limits and limits at infinity. Important limits like $\frac{\sin x}{x}$, $\frac{\log(1+x)}{x}$, $\frac{a^x-1}{x}$ $(a > 0)$ as $x \to 0$.	Limit and Continuity	R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis. T. M. Apostol, Mathematical Analysis,	5	Chalk and Talk, Notes	AB
Group A: 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: $y = x^a$ $(a = 2, 3, 1/2, -1)$, $\|x\|$, $[x]$, $\sin x$, $\cos x$, $\tan x$, $\log x$, 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.	Limit and Continuity	R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis. T. M. Apostol, Mathematical Analysis,	10	Chalk and Talk, Notes	AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group A: Bounded functions. Neighbourhood properties of continuous functions regarding boundedness and maintenance of same sign. Continuous function on a closed interval $[a, b]$ is bounded and attains its bounds therein. Bolzano's theorem. 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 at most countably many points of discontinuity. Monotone bijective function from an interval to an interval is continuous and its inverse is also continuous.	Limit and Continuity	Same as above	15	Chalk and Talk, Notes	AB
Group A: 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.	Limit and Continuity	Same as above	10	Chalk and Talk, Notes	AB
Review of **Group A**	Limit and Continuity	Same as above	5	Chalk and Talk, Notes, Interactive session	AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: 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. 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. 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). Application of the principle of maximum/minimum in geometrical problems.	Differentiability of Functions	Same as above	20	Chalk and Talk, Notes, Interactive session	PL
Review of Group B	Differentiability of Functions	Same as above	4	Chalk and Talk, Notes, Interactive session	PL

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (Major) MATH-H-CC6-4-Th Mechanics – I					
Statics-I: Idea about Physical Independence Principle of Forces, Principle of transmissibility of a force, Principle of action and reaction and Principle of parallelogram law of forces, Composition and resolution of forces, Concurrent Forces in a plane, Composition and resolution of forces, Equilibrium of three forces acting at a point, Lami's theorem, Moment of a force about a point and an axis, Varignon's theorem, Resultant forces and resultant couple, Coplanar forces: Its reduction and conditions of equilibrium	Statics-I	S. L. Loney, An Elementary Treatise on Statics, Cambridge University Press, 1917 (2nd edition). A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	07	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Statics-I	Statics	Same as above	01	Chalk and Talk, Google Classroom, Hand Notes	MH
Particle Dynamics-I: Law of gravitation, Concept of inertial frame, Newton's laws of motion, Concept of equation of motion of a particle, Rectilinear motion in a given force field, Simple harmonic motion, damped and forced oscillations, Concept of resonance, motion of elastic strings, Rectilinear motion under uniform gravity, Rectilinear motion in a resisting medium where resistance is proportional to velocity.	Particle Dynamics	S. L. Loney, An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Cambridge University Press, 1913 A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	16	Chalk and Talk , Google Classroom, Hand Notes	MH
Work, power, energy, Conservative forces, Potential energy, Existence of potential energy function, Conservative field and Principle of conservation of energy.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Impulse of a force, Impulsive force, Principle of conservation of linear momentum, Collision of elastic bodies: Coefficient of restitution, Newton's law of collision, Direct and oblique impact of a smooth sphere with a fixed plane, Direct and oblique impact of two smooth spheres.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH
Motion of a particle in a plane (2D Cartesian): Angular velocity and angular acceleration, xpressions for components of velocity and ccelleration, Tangential and normal components of velocity and acceleration, Motion of a projectile in a resisting medium under gravity. Motion of a particle in a plane (2D Polar): Expressions for components of velocity and acceleration.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Central forces and central orbits, Motion under inverse square law, Times of describing the arcs of central orbits for a particle moving under inverse square law, Kepler's laws on planetary motion, Motion of artificial satellites, Tangential and normal components of velocity and acceleration, Constrained motion of a particle on smooth curve.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Paticle Dynamics-I	Particle Dynamics	Same as above	6	Chalk and Talk, Google Classroom, Hand Notes	MH

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (Major) MATH-H-CC7-4-Th Multivariate Calculus – I and Partial Differential Equations – I					
Group A: Multivariate Calculus - I: Concept of neighbourhood of a point in $\mathbb{R}^n$ $(n > 1)$, interior point, limit point, open sets and closed sets in $\mathbb{R}^n$ $(n > 1)$. Functions from $\mathbb{R}^n$ $(n > 1)$ to $\mathbb{R}$, limit and continuity of functions of two or more variables. Partial derivatives, related mean value theorem, sufficient condition for continuity. Differentiability, sufficient condition for differentiability.	Multivariate Calculus	J. Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed T. Apostol, Mathematical Analysis, Narosa Publishing House. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus,	10	Chalk and Talk, Google Classroom, Hand Notes	BS
Directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes. Partial derivatives of higher order, sufficient condition for equality of mixed order partial derivatives (Schwarz's and Young's theorems), differentials of higher orders, total differential for function of functions, Chain rule for one and two independent parameters. Euler's theorem on homogeneous functions of two and three variables, change of variables – simple problems. Taylor's theorem of two variables.	Multivariate Calculus	Same as above	10	Chalk and Talk, Google Classroom, Hand Notes	BS

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Implicit functions, statement of the existence theorem, derivative of implicit functions – simple problems. Jacobians – elementary properties (statements only) and simple problems. Extrema of functions of two variables, constrained optimization problems, method of Lagrangian multipliers for two variables. 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.	Multivariate Calculus	Same as above	15	Chalk and Talk, Google Classroom, Hand Notes	BS
Iterated or repeated integral, Statement of Fubini's theorem. Change of order of integration. Areas of plane regions. Triple integral. Cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals. Transformation of double and triple integrals (problems only). Determination of volume and surface area by multiple integrals (problems only). Differentiation under the integral sign, Leibniz's rule (problems only).	Multivariate Calculus	Same as above	10	Chalk and Talk, Google Classroom, Hand Notes	BS
Review of Multivariate Calculus	Multivariate Calculus	Same as above	05	Chalk and Talk, Google Classroom, Hand Notes	BS

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Partial Differential Equations – I : Definition, order and degree of PDE, classification of PDE (linear, quasilinear, semilinear and nonlinear), derivation of partial differential equations (by elimination of arbitrary constants / functions). Examples of PDEs that are central to the study of different problems in science and technology (e.g. Heat equation, Wave equation, Laplace equation, KDV equation). First order equations: Solution of quasilinear equations, Lagrange's method of solution. Cauchy problem for quasilinear PDE, The method of characteristics, method of characteristics for linear, semilinear equations; Solution via method of characteristics; Local existence and uniqueness theorem (statement and examples). Nonlinear first order partial differential equations, Charpit's general method of solution.	Partial Differential Equation	I. Sneddon, Elements of Partial Differential equations, McGraw-Hill International Edition W. A. Strauss, Partial Differential Equations L. C. Evans, Partial Differential equations	08	Chalk and Talk, Google Classroom, Hand Notes	BS
Review of Partial Differential Equation-I	Partial Differential Equation	Same as above	05	Chalk and Talk, Google Classroom, Hand Notes	BS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (Major) MATH-H-CC8-4-Th Group Theory – II & Ring Theory - I					
Group A: : Group Theory- II Normal subgroup and its properties. Quotient group. Group homomorphisms, properties of homomorphisms, 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.	Abstract Algebra	D. S. Malik, J. M. Mordeson and M. K. Sen; Fundamentals of Abstract Algebra; S. K. Mapa, Higher Algebra (Abstract and Linear)	14	Chalk and Talk, Google Classroom, Hand Notes	PL
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.	Abstract Algebra	M. K. Sen, S. Ghosh, P. Mukhopadhyay, S. K. Maity, Topics in Abstract Algebra, D. S. Malik, J. M. Mordeson and M. K. Sen; Fundamentals of Abstract Algebra;	14	Chalk and Talk, Google Classroom, Hand Notes	PL
Review of Group Theory -II	Abstract Algebra	Same as above	4	Chalk and Talk, Google Classroom, Hand Notes	PL

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Ring Theory- I 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, Second and Third isomorphism theorems, Correspondence theorem, congruence on rings, one-one correspondence between the set of ideals and the set of all congruences on a ring.	Abstract Algebra	S. K. Mapa, Higher Algebra (Abstract and Linear) D. S. Malik, J. M. Mordeson and M. K. Sen; Fundamentals of Abstract Algebra;	25	Chalk and Talk, Google Classroom, Hand Notes	PL
Review of Ring Theory-I	Abstract Algebra	Same as above	3	Chalk and Talk, Google Classroom, Hand Notes	PL

Sem-VI

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM VI (Major) MATH-H-CC 13-6-TH Metric Space and Complex Analysis-I					
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 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. Continuous mappings. Uniform continuity. Isometry.	Metric Spaces	S. Kumaresan, Topology of Metric Spaces M. N. Mukherjee, Elements of Metric Space	10	Chalk and Talk, Notes	MH
Convergent sequence. Sequential criterion of continuity. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. $\mathbb{R}$ is a complete metric space. $\mathbb{Q}$ is not complete. Completion of metric spaces. Nowhere dense set. Baire Category theorem.	Metric Spaces	S. Kumaresan, Topology of Metric Spaces M. N. Mukherjee, Elements of Metric Space	10	Chalk and Talk, Notes	MH

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Compactness, Sequential compactness, Concept of Lebesgue number. Lebesgue covering lemma. Equivalence of compactness and sequential compactness of a metric space. Heine-Borel theorem in $\mathbb{R}$. Finite intersection property, continuous functions on compact sets. Total boundedness and its properties. A metric space is compact if and only if the space is complete and totally bounded (statement only). Concept of connectedness and some examples of connected metric spaces, connected subsets of $\mathbb{R}$, $\mathbb{C}$. Contraction mappings, Banach Fixed point theorem and its applications.	Metric Spaces	S. Kumaresan, Topology of Metric Spaces M. N. Mukherjee, Elements of Metric Space	10	Chalk and Talk, Notes	MH
Group-B: Complex Analysis-I Stereographic projection: Regions in the complex plane: Limits, limits involving the point at infinity, Continuity of functions of a complex variable. Derivatives, differentiation formulae, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic function, entire function, exponential function, logarithmic function, trigonometric functions, hyperbolic functions. Möbius transformations and its properties. Power series: Cauchy-Hadamard theorem. Determination of radius of convergence. Uniform and absolute convergence of power series. Analytic functions presented by power series. Uniqueness of power series. Harmonic functions and its properties, Milne-Thompson method.	Complex Analysis	Dennis G. Zill & Patrick D. Shanahan, A First Course in Complex Analysis S. P. Ponnusamy, Foundations of Complex Analysis	20	Chalk and Talk, Notes	DP

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks Comments
SEM VI (Major) MATH-H-CC 14-6-TH Multivariate Calculus-II & Application of Calculus					
Group A: Functions from $\mathbb{R}^n (n > 1)$ to $\mathbb{R}^m (m > 1)$. Continuity and differentiability of such functions. Jacobian matrix. A function $f : \mathbb{R}^n \to \mathbb{R}^m$ is differentiable if and only if its every component is differentiable. Inverse function theorem (statement only), implicit function theorem (statement only). Level sets, tangent spaces.	Multivariate Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus James Stewart, Multivariable Calculus, Concepts and Contexts	12	Chalk and Talk, Notes	BS
Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar coordinates, Triple integrals, triple integral over a parallelepiped and solid regions, Volume by triple integrals, cylindrical and spherical coordinates, Change of variables in double integrals and triple integrals, Differentiation under the integral sign, Leibniz's rule.	Multivariate Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus James Stewart, Multivariable Calculus, Concepts and Contexts	15	Chalk and Talk, Notes	BS
Definition of vector field, divergence and curl, Line integrals, applications of line integrals, mass and work, Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces, Stokes's theorem, The Divergence theorem.	Multivariate Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus James Stewart, Multivariable Calculus, Concepts and Contexts	12	Chalk and Talk, Notes	BS

Review of Multivariate Calculus	Multivariate Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus James Stewart, Multivariable Calculus, Concepts and Contexts	3	Chalk and Talk, Notes	BS
Group B: Curvature, concavity and points of inflection, envelopes (Cartesian coordinates only), rectilinear asymptotes (Cartesian Parametric form only), curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves.	Applications of Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus T. Apostol, Mathematical Analysis	18	Chalk and Talk, Notes	BS
Review of Application of Calculus	Applications of Calculus	J. Strauss, G. L. Bradley and K. J. Smith, Calculus T. Apostol, Mathematical Analysis	2	Chalk and Talk, Notes	BS

Planned				After Implementation	
Unit / Group / Module / Article	Topics	Reference Books	No of Lecture Planned	Content Delivery Technique	Remarks Comments
SEM VI (Major) MATH-H-CC 15-6-TH Numerical Analysis					

Representation of numbers and errors in Numerical Analysis: Machine Numbers - floating point and fixed point. Sources of Errors, Rounding of numbers, Absolute and Relative Error, Significant digits and Error Propagation in machine arithmetic operations. Numerical Algorithms - stability and convergence. Approximation: Classes of approximating functions, polynomial approximation. The Weierstrass' polynomial approximation theorem (statement only). Interpolation: Prerequisite - Divided difference: Definition of n-th divided difference.	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	10	Chalk, Talk, Notes & Computer Demonstration	MH
Numerical Integration: Newton-Cotes formula/deduction of closed type, Trapezoidal rule and Simpson's $\frac{1}{3}$ rule - composite form. Statement of Weddle's rule and composite Weddle's rule. Error formulae (only statements), Degree of precision. Numerical solution of non-linear 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. Advantages and disadvantages of the methods.	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	15	Chalk, Talk, Notes & Computer Demonstration	MH
Numerical solution of system of linear equations: Direct methods - Gaussian elimination and Gauss-Jordan methods, partial pivoting strategies, operational count. Iterative methods - Gauss-Jacobi method, Gauss-Seidel method and their convergence analysis, Advantages and disadvantages of the methods. Matrix inversion by Gaussian elimination.	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	10	Chalk, Talk, Notes & Computer Demonstration	MH

Algebraic eigenvalue problem: The Power method. Numerical solution of initial value problems for ordinary differential equations: Single-step difference equation methods - idea of local truncation error, consistency and convergence. Euler's method, Modified Euler method, Higher order Taylor methods, Runge-Kutta method of order four. Picard's method of successive approximation.	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	10	Chalk, Talk, Notes & Computer Demonstration	MH
Problems for Practical (using C programming language) 1. Interpolation by Lagrange's formula 2. Interpolation by Newton's forward formula 3. Interpolation by Newton's backward formula 4. Integration by composite Trapezoidal rule 5. Integration by composite Simpson's $\frac{1}{3}$ rule 6. Integration by composite Weddle's rule 7. Solution of equation by Bisection method 8. Solution of equation by Newton-Raphson method	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	8	Computer Laboratory	MH

Problems for Practical (using C programming language) 9. Solution of equation by Regula-falsi method 10. Solution of a system of linear equations by Gaussian elimination method 11. Solution of a system of linear equations by Gauss-Seidel method 12. Matrix inversion by Gaussian elimination method 13. Finding largest eigen-pair of a matrix Power method 14. Solution of ordinary differential equation by modified Euler method 15. Solution of ordinary differential equation by fourth order Runge-Kutta method	Numerical Analysis	M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation K. E. Atkinson, An Introduction to Numerical Analysis	7	Computer Laboratory	MH

Lesson Plan – Even Semester
MDC and Minor Courses in Mathematics

Sem-II

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM II (MDC) MATH-MD-CC 2-2-Th (same as MATH-MD-MC 2-4-Th) Basic Algebra					
Group A: 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.	Complex Analysis	S K Mapa, Higher Algebra Dennis Zill, Complex Analysis	2	Chalk and Talk, Notes	PL
Group A: Theory of equations: Relation between roots and coefficients, transformation of equation, Descartes rule of signs. Application of Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method). Inequalities: The inequality involving AM $\geq$ GM $\geq$ HM, Cauchy-Schwarz inequality.	Classical Algebra	W.S. Burnside and A.W. Panton, *Theory of equations*	6	Chalk and Talk, Notes, tutorial, class work	PL

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Relation: equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. 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 $B \subseteq Y$.	Classical Algebra	S K Mapa, Higher Algebra	5	Chalk and Talk, Notes, tutorial, class work	BS
Group B: Well-ordering property of positive integers, Principles of Mathematical induction, equivalence of Wellordering property and Principles of Mathematical induction (statement only), division algorithm, divisibility 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.	Classical Algebra	S K Mapa, Higher Algebra	6	Chalk and Talk, Notes, tutorial, class work	AB
Group C: Systems of linear equations, homogeneous and non-homogeneous systems. Existence and Uniqueness of solution. The matrix equation $Ax = b$, row reduction and echelon forms, uniqueness of reduced echelon form. Rank of a matrix and characterization of invertible matrices, Pivot positions, basic and free variables, parametric description of the solution set. Existence and uniqueness theorem.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition) David C. Lay, *Linear Algebra and its Applications*	6	Chalk and Talk, Notes, tutorial, class work	AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group C: Vectors in $\mathbb{R}^n$, algebraic and geometric properties of the vectors. Vector form of a linear system and the column picture. Existence of solutions and linear combination of vectors. Geometry of linear combination and subsets spanned by some vectors. Uniqueness of solution and linear independence of vectors. Algebraic and geometric characterizations of linearly independent subsets.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition)	6	Chalk and Talk, Notes, tutorial, class work	BS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM II (MDC) MATH-MD-SEC 2-2-Th C Language with Mathematical Applications					
Overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language, higher level language	C Language with Mathematical Applications	V. Rajaraman: Fundamentals of Computers; PHI Learning Private limited, 2013	2	Chalk and Talk, Notes	DP
Constants, Variables and Data type of C-Program: Character set. Constants and variables data types, expression, assignment statements, declaration.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	6	Chalk and Talk, Notes, tutorial, class work	DP
Operation and Expressions: Arithmetic operators, relational operators, logical operators.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	5	Chalk and Talk, Notes, tutorial, class work	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Decision Making and Branching: decision making with if statement, if-else statement, Nesting if statement, switch statement, break and continue statement.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	6	Chalk and Talk, Notes, tutorial, class work	DP
Control Statements: While statement, do-while statement, for statement	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	5	Chalk and Talk, Notes, tutorial, class work	DP
Arrays: One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	4	Chalk and Talk, Notes, tutorial, class work	DP
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.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	5	Chalk and Talk, Notes, tutorial, class work	DP
Introduction to Library functions: stdio.h, math.h, string.h, stdlib.h, time.h etc.	C Language with Mathematical Applications	Y. Kanetkar: Let Us C; BPB Publication, 1999., E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill, 2004.	1	Chalk and Talk, Notes	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Sample problems	C Language with Mathematical Applications	C. Xavier: C-Language and Numerical Methods, New Age International, 2007., V. Rajaraman: Computer Oriented Numerical Methods, Prentice Hall of India, 1980	26	Practical: hands on experience	DP

Sem-IV

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (Minor/MDC-mn) MATH-H-MC 4-4-Th / MATH-MD-MC 2-4-Th Basic Algebra					
Group A: 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.	Complex Analysis	S K Mapa, Higher Algebra Dennis Zill, Complex Analysis	2	Chalk and Talk, Notes	PL
Group A: Theory of equations: Relation between roots and coefficients, transformation of equation, Descartes rule of signs. Application of Sturm's theorem, cubic equation (solution by Cardan's method) and biquadratic equation (solution by Ferrari's method). Inequalities: The inequality involving AM $\geq$ GM $\geq$ HM, Cauchy-Schwarz inequality.	Classical Algebra	W.S. Burnside and A.W. Panton, *Theory of equations*	6	Chalk and Talk, Notes, tutorial, class work	PL
Group B: Relation: equivalence relation, equivalence classes & partition, partial order relation, poset, linear order relation. 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 $B \subseteq Y$.	Classical Algebra	S K Mapa, Higher Algebra	5	Chalk and Talk, Notes, tutorial, class work	BS

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Well-ordering property of positive integers, Principles of Mathematical induction, equivalence of Wellordering property and Principles of Mathematical induction (statement only), division algorithm, divisibility 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.	Classical Algebra	S K Mapa, Higher Algebra	6	Chalk and Talk, Notes, tutorial, class work	AB
Group C: Systems of linear equations, homogeneous and non-homogeneous systems. Existence and Uniqueness of solution. The matrix equation $Ax = b$, row reduction and echelon forms, uniqueness of reduced echelon form. Rank of a matrix and characterization of invertible matrices, Pivot positions, basic and free variables, parametric description of the solution set. Existence and uniqueness theorem.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition) David C. Lay, *Linear Algebra and its Applications*	6	Chalk and Talk, Notes, tutorial, class work	AB
Group C: Vectors in $\mathbb{R}^n$, algebraic and geometric properties of the vectors. Vector form of a linear system and the column picture. Existence of solutions and linear combination of vectors. Geometry of linear combination and subsets spanned by some vectors. Uniqueness of solution and linear independence of vectors. Algebraic and geometric characterizations of linearly independent subsets.	Linear Algebra	Gilbert Strang; Introduction to Linear Algebra (5th Edition)	6	Chalk and Talk, Notes, tutorial, class work	BS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (MDC) MATH-MD-CC 4-4-Th Mechanics					
Statics-I: Idea about Physical Independence Principle of Forces, Principle of transmissibility of a force, Principle of action and reaction and Principle of parallelogram law of forces, Composition and resolution of forces, Concurrent Forces in a plane, Composition and resolution of forces, Equilibrium of three forces acting at a point, Lami's theorem, Moment of a force about a point and an axis, Varignon's theorem, Resultant forces and resultant couple, Coplanar forces: Its reduction and conditions of equilibrium	Statics-I	S. L. Loney, An Elementary Treatise on Statics, Cambridge University Press, 1917 (2nd edition). A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	07	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Statics-I	Statics	Same as above	01	Chalk and Talk, Google Classroom, Hand Notes	MH
Particle Dynamics-I: Law of gravitation, Concept of inertial frame, Newton's laws of motion, Concept of equation of motion of a particle, Rectilinear motion in a given force field, Simple harmonic motion, damped and forced oscillations, Concept of resonance, motion of elastic strings, Rectilinear motion under uniform gravity, Rectilinear motion in a resisting medium where resistance is proportional to velocity.	Particle Dynamics	S. L. Loney, An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Cambridge University Press, 1913 A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	16	Chalk and Talk , Google Classroom, Hand Notes	MH
Work, power, energy, Conservative forces, Potential energy, Existence of potential energy function, Conservative field and Principle of conservation of energy.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Impulse of a force, Impulsive force, Principle of conservation of linear momentum, Collision of elastic bodies: Coefficient of restitution, Newton's law of collision, Direct and oblique impact of a smooth sphere with a fixed plane, Direct and oblique impact of two smooth spheres.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH
Motion of a particle in a plane (2D Cartesian): Angular velocity and angular acceleration, xpressions for components of velocity and ccelleration, Tangential and normal components of velocity and acceleration, Motion of a projectile in a resisting medium under gravity. Motion of a particle in a plane (2D Polar): Expressions for components of velocity and acceleration.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Central forces and central orbits, Motion under inverse square law, Times of describing the arcs of central orbits for a particle moving under inverse square law, Kepler's laws on planetary motion, Motion of artificial satellites, Tangential and normal components of velocity and acceleration, Constrained motion of a particle on smooth curve.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Paticle Dynamics-I	Particle Dynamics	Same as above	6	Chalk and Talk, Google Classroom, Hand Notes	MH

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (MDC) MATH-MD-CC5-4-Th Advanced Calculus					

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group A: equence of real numbers: Definition of bounds of a sequence and monotone sequence. Limit and convergence of a sequence. Statements of limit theorems. Convergence and divergence of monotone sequences and applications. Convergence of r^n, n^2 and $n!$ in particular. Statement of Cauchy's general principle of convergence and its applications.	Calculus	J. Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed T. Apostol, Mathematical Analysis, Narosa Publishing House. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus,	10	Chalk and Talk, Google Classroom, Hand Notes	PL
Infinite series of constant terms: Convergence and Divergence (definitions and examples), Cauchy's principle as applied to infinite series (application only). Series of positive terms: Statements of Comparison test, Limit form of Comparison Test, D'Alembert's/Ratio test, Cauchy's root test and Raabe's test. Applications, Alternating series: Statement of Leibnitz's test and its applications.	Calculus	Same as above	10	Chalk, Talk, and Notes	AB
Group B: Real-valued functions defined on an interval: Limits of functions ($\epsilon - \delta$ approach), Cauchy's criterion of existence of limit (statement only). Algebra of limits (statements only), Continuity of a function at a point and on an interval, Properties of continuous functions on closed and bounded intervals without proof (Boundedness and Intermediate value property). Statement of existence of inverse function of a strictly monotone function and its continuity.	Calculus	T. Apostol, Calculus S. C. Malik and S. Arora, Mathematical Analysis	10		AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Derivative: Statement of Rolle's theorem and its geometrical interpretation, Mean Value Theorems of Lagrange and Cauchy as a consequence of Rolle's theorem, Geometrical interpretation of Lagrange's Mean Value Theorem, Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders, Taylor's and Maclaurin's Infinite series, Expansion of the functions e^x, $\sin x$, $\cos x$, $(1+x)^n$ and $\log(1+x)$ [with restrictions wherever necessary and assuming $R_n \to 0$].	Calculus	T. Apostol, Calculus S. C. Malik and S. Arora, Mathematical Analysis	10		PL
Group C: Multivariate Calculus: Real-valued Functions of two and three real variables: Their geometrical representations, Limit and Continuity (definitions only) for functions of two variables, Partial derivatives, Differentiability, sufficient condition for differentiability (statement only), Chain rule for two independent variables, Higher order partial derivatives up to second order, Statement of Schwarz's Theorem for equality of mixed partial derivatives, Euler's theorem on homogeneous functions of two variables. Derivative of Implicit functions of two variables (existence assumed).	Multivariate Calculus	J. Stewart, Multivariable Calculus, Concepts and Contexts, T. Apostol, Mathematical Analysis, E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus,	24	Chalk, Talk and Notes	BS

Sem-VI

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM VI (Minor) MATH-H-MC 5-6-TH Ordinary Differential Equations – I and Group Theory - I					
Group A: Formation of differential equations, order and degree of a differential equation, First order and first degree differential equations; Homogeneous and exact differential equations, conditions for an equation of the first order to be exact, Integrating factors, Rules for finding integrating factors, Linear equations and Bernoulli equations.	Ordinary Differential Equation	S. L. Ross, Differential Equations G. F. Simmons, Differential Equations with Applications and Historical Notes	10	Chalk and Talk, Notes	BS
Group A: First order higher degree differential equations solvable for x, y and p, Clairaut's forms. Singular solutions, Equations of tac-locus, nodal locus, cuspidal locus.	Ordinary Differential Equations	S. L. Ross, Differential Equations G. F. Simmons, Differential Equations with Applications and Historical Notes	8	Chalk and Talk, Notes	BS
Group A: Higher order linear and nonlinear equations, Concept of Wronskian and its properties, Complementary functions, Particular integrals, linear homogeneous and non-homogeneous equations with constant coefficients, Method of undetermined coefficients, Method of variation of parameters. Simultaneous linear differential equations.	Ordinary Differential Equations	S. L. Ross, Differential Equations G. F. Simmons, Differential Equations with Applications and Historical Notes	8	Chalk and Talk, Notes	BS

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group A: Higher order linear equations with variable coefficients reducible to linear equations with constant coefficients (Euler's equation), Condition for exactness of higher order linear equations, Integrating factors, Equations of the form $\frac{d^n y}{dx^n} = f(y)$ $(n \geq 2)$.	Ordinary Differential Equations	S. L. Ross, Differential Equations G. F. Simmons, Differential Equations with Applications and Historical Notes	10	Chalk and Talk, Notes	BS
Group B: Definition of a group, examples of groups including permutation groups, dihedral groups and quaternion groups (through matrices), elementary properties of groups, examples of commutative and non-commutative groups.	Abstract Algebra	J. A. Gallian, Contemporary Abstract Algebra I. N. Herstein, Topics in Algebra	6	Chalk and Talk, Notes	PL
Group B: 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 subgroups.	Abstract Algebra	J. A. Gallian, Contemporary Abstract Algebra I. N. Herstein, Topics in Algebra	6	Chalk and Talk, Notes	PL
Group B: Order of an element of a group, order of a group, cyclic group, properties of cyclic groups, classification of subgroups of cyclic groups	Abstract Algebra	J. A. Gallian, Contemporary Abstract Algebra I. N. Herstein, Topics in Algebra	6	Chalk and Talk, Notes	PL
Group B: Permutation, cycle notation for permutations, properties of permutation, even and odd permutations, Alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's little theorem.	Abstract Algebra	J. A. Gallian, Contemporary Abstract Algebra I. N. Herstein, Topics in Algebra	6	Chalk and Talk, Notes	PL

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM VI (Minor) MATH-H-MC 6-6-Th Mechanics					
Statics-I: Idea about Physical Independence Principle of Forces, Principle of transmissibility of a force, Principle of action and reaction and Principle of parallelogram law of forces, Composition and resolution of forces, Concurrent Forces in a plane, Composition and resolution of forces, Equilibrium of three forces acting at a point, Lami's theorem, Moment of a force about a point and an axis, Varignon's theorem, Resultant forces and resultant couple, Coplanar forces: Its reduction and conditions of equilibrium	Statics-I	S. L. Loney, An Elementary Treatise on Statics, Cambridge University Press, 1917 (2nd edition). A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	07	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Statics-I	Statics	Same as above	01	Chalk and Talk, Google Classroom, Hand Notes	MH
Particle Dynamics-I: Law of gravitation, Concept of inertial frame, Newton's laws of motion, Concept of equation of motion of a particle, Rectilinear motion in a given force field, Simple harmonic motion, damped and forced oscillations, Concept of resonance, motion of elastic strings, Rectilinear motion under uniform gravity, Rectilinear motion in a resisting medium where resistance is proportional to velocity.	Particle Dynamics	S. L. Loney, An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Cambridge University Press, 1913 A. S. Ramsey, Dynamics (Part I& Part II), CBS Publishers, 2002 (2nd edition).	16	Chalk and Talk , Google Classroom, Hand Notes	MH
Work, power, energy, Conservative forces, Potential energy, Existence of potential energy function, Conservative field and Principle of conservation of energy.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Impulse of a force, Impulsive force, Principle of conservation of linear momentum, Collision of elastic bodies: Coefficient of restitution, Newton's law of collision, Direct and oblique impact of a smooth sphere with a fixed plane, Direct and oblique impact of two smooth spheres.	Particle Dynamics	Same as above	06	Chalk and Talk, Google Classroom, Hand Notes	MH
Motion of a particle in a plane (2D Cartesian): Angular velocity and angular acceleration, xpressions for components of velocity and ccelleration, Tangential and normal components of velocity and acceleration, Motion of a projectile in a resisting medium under gravity. Motion of a particle in a plane (2D Polar): Expressions for components of velocity and acceleration.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Central forces and central orbits, Motion under inverse square law, Times of describing the arcs of central orbits for a particle moving under inverse square law, Kepler's laws on planetary motion, Motion of artificial satellites, Tangential and normal components of velocity and acceleration, Constrained motion of a particle on smooth curve.	Particle Dynamics	Same as above	08	Chalk and Talk, Google Classroom, Hand Notes	MH
Review of Paticle Dynamics-I	Particle Dynamics	Same as above	6	Chalk and Talk, Google Classroom, Hand Notes	MH

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
MATH-MD-CC-8-6-TH: Discrete Mathematics					
Propositional logic, logical equivalences, predicates and quantifiers, rules of inference.	Logic and Proofs	1) K. H. Rosen, *Discrete Mathematics and its applications with combinations and Graph Theory* (7th Edition), McGraw-Hill Education (India) Pvt. Ltd., 2011 2) J. L. Mott, A. Kandel and T. P. Baker, *Discrete Mathematics for Computer Scientists and Mathematicians*, 2nd Ed., Prentice Hall, 1986	20	Chalk & Blackboard, Notes	AB
Methods of proof: direct proof, indirect proof (contradiction, contraposition), proof by induction.	Logic and Proofs	Same as above	20	Chalk & Blackboard, Notes	AB
Sets, set operations, Cartesian product, power sets. Functions: one-to-one, onto, inverse functions, composition of functions.	Set Theory and Combinatorics	Same as above	20	Chalk & Blackboard, Notes	AB
Counting techniques: Permutations and combinations, pigeonhole principle, inclusion-exclusion principle.	Set Theory and Combinatorics	Same as above	20	Chalk & Blackboard, Notes	AB
Recurrence relations: Solving linear homogeneous and non-homogeneous recurrence relations.	Set Theory and Combinatorics	Same as above	20	Chalk & Blackboard, Notes	AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Graphs and graph models, graph terminology, special types of graphs, bipartite graphs, complete graphs, regular graphs.	Graph Theory	1) N. Deo, *Graph Theory with applications to Engineering and Computer Science*, Prentice-Hall of India, 2000 2) J. A. Bondy and U. S. R. Murty, *Graph Theory*, Springer, 2008	20	Chalk & Blackboard, Notes	AB
Representing graphs: Adjacency matrices, incidence matrices. Graph isomorphism. Connectivity: Paths, cycles, Eulerian and Hamiltonian paths and circuits.	Graph Theory	Same as above	20	Chalk & Blackboard, Notes	AB
Planar graphs, Euler's formula. Graph coloring. Trees: Properties of trees, rooted trees, spanning trees. Minimal spanning trees (Kruskal's and Prim's algorithms).	Graph Theory	Same as above	20	Chalk & Blackboard, Notes	AB

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM IV (MDC-mn) MATH-MD-MC 5-6-Th Advanced Calculus					
Group A: equence of real numbers: Definition of bounds of a sequence and monotone sequence. Limit and convergence of a sequence. Statements of limit theorems. Convergence and divergence of monotone sequences and applications. Convergence of r^n, n^2 and $n!$ in particular. Statement of Cauchy's general principle of convergence and its applications.	Calculus	J. Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed T. Apostol, Mathematical Analysis, Narosa Publishing House. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus,	10	Chalk and Talk, Google Classroom, Hand Notes	PL

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Infinite series of constant terms: Convergence and Divergence (definitions and examples), Cauchy's principle as applied to infinite series (application only). Series of positive terms: Statements of Comparison test, Limit form of Comparison Test, D'Alembert's/Ratio test, Cauchy's root test and Raabe's test. Applications, Alternating series: Statement of Leibnitz's test and its applications.	Calculus	Same as above	10	Chalk, Talk, and Notes	AB
Group B: Real-valued functions defined on an interval: Limits of functions ($\epsilon - \delta$ approach), Cauchy's criterion of existence of limit (statement only). Algebra of limits (statements only), Continuity of a function at a point and on an interval, Properties of continuous functions on closed and bounded intervals without proof (Boundedness and Intermediate value property). Statement of existence of inverse function of a strictly monotone function and its continuity.	Calculus	T. Apostol, Calculus S. C. Malik and S. Arora, Mathematical Analysis	10		AB

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Derivative: Statement of Rolle's theorem and its geometrical interpretation, Mean Value Theorems of Lagrange and Cauchy as a consequence of Rolle's theorem, Geometrical interpretation of Lagrange's Mean Value Theorem, Statements of Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders, Taylor's and Maclaurin's Infinite series, Expansion of the functions e^x, $\sin x$, $\cos x$, $(1+x)^n$ and $\log(1+x)$ [with restrictions wherever necessary and assuming $R_n \to 0$].	Calculus	T. Apostol, Calculus S. C. Malik and S. Arora, Mathematical Analysis	10		PL
Group C: Multivariate Calculus: Real-valued Functions of two and three real variables: Their geometrical representations, Limit and Continuity (definitions only) for functions of two variables, Partial derivatives, Differentiability, sufficient condition for differentiability (statement only), Chain rule for two independent variables, Higher order partial derivatives up to second order, Statement of Schwarz's Theorem for equality of mixed partial derivatives, Euler's theorem on homogeneous functions of two variables. Derivative of Implicit functions of two variables (existence assumed).	Multivariate Calculus	J. Stewart, Multivariable Calculus, Concepts and Contexts, T. Apostol, Mathematical Analysis, E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus,	24	Chalk, Talk and Notes	BS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Sem VI (MDC-mn) MATH-MD-MC 6-6-TH – Statistics and Numerical Analysis					

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group A: Statistics Probability Theory: Theorems on Total Probability, Conditional probability and Multiplication theorem, Bayes' Theorem (Application only), Independence of events, Related Problems. Compound experiment, Independent trials, Bernoulli's trials, Binomial law. Probability Distribution: Random Variables, Probability Distribution function, Properties of probability distribution function, Discrete and continuous distribution, Probability mass and probability density function, Some important probability distributions and their properties - Binomial, Poisson, Uniform and Normal, Related problems.	Statistics (Probability, Distributions, Expectation, Methods, Inference)	Feller (1968), Hogg et al. (2007), Goon et al. (2013/2016)	10	Lectures, Examples	DP
Two-dimensional random variables and bivariate distribution (discrete and continuous), Marginal distribution, Bivariate Uniform and Normal distributions, Related problems. Mathematical Expectation: Definition of mathematical expectation, Mean, Variance, Standard Deviation, Moments, Theorems on mathematical expectation (statement only), Standardized random variate, Mean, Variance and standard deviation of Binomial, Poisson and Normal distributions. Mathematical Expectation in bivariate distribution, Moments, Covariance, Correlation coefficient, $E(X+Y) = E(X) + E(Y)$, $E(XY) = E(X)E(Y)$ for independent variates.	Statistics (Probability, Distributions, Expectation, Methods, Inference)	Feller (1968), Hogg et al. (2007), Goon et al. (2013/2016)	10	Lectures, Examples	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Elements of Statistical Methods: Measure of Central tendency: Arithmetic Mean, Geometric Mean, Harmonic Mean, Median and Mode (their advantages and disadvantages), Relation between Mean, Median and Mode. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance / Standard Deviation. Moments, Raw moments and Central moments and relation between them, Effect of change of origin and change of scale on moments. Correlation and Regression: Bivariate data, Scatter Diagram, Correlation coefficient - its determination and properties, Regression lines of y on x and x on y - their deductions and properties.	Statistics (Probability, Distributions, Expectation, Methods, Inference)	Feller (1968), Hogg et al. (2007), Goon et al. (2013/2016)	10	Lectures, Examples	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Sampling Theory: Meaning and objects of sampling, Parameter and Statistic, Sampling distribution of a statistic, Methods of drawing random sample, Mean and Variance of sample mean, Basic idea of some distributions used in Sampling Theory - (i) Standard Normal distribution, (ii) Chi-square distribution, (iii) Student's t-distribution, (iv) Snedecor's F-distribution, Related problems. Statistical Inference: Estimation of Parameters, Unbiased estimator, Consistent estimator, Sample mean is an unbiased estimate of population mean, Sample variance is a biased estimator of population variance, Point estimation, Interval estimation, Method for finding Confidence Intervals, Confidence intervals for mean of Normal (μ, σ) population when σ is known and when σ is unknown, Statistical Hypothesis - Null Hypothesis and Alternative Hypothesis, Critical Region, Type I and II error, Level of significance, Related simple problems.	Statistics (Probability, Distributions, Expectation, Methods, Inference)	Feller (1968), Hogg et al. (2007), Goon et al. (2013/2016)	10	Lectures, Examples	DP

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
Group B: Numerical Analysis Approximate numbers: Significant figures, Rounding off of numbers. Errors Absolute, Relative and Percentage. Operators - Δ, ∇ and E (Definitions and some relations among them). Interpolation: Problem of interpolation, Equispaced arguments, Difference Table, 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), Related problems.	Numerical Analysis (Errors, Operators, Interpolation)	Bradie (2007), Jain et al. (2005), Gerald & Wheatley (2008)	10	Lectures, Numerical Problems	DP
Numerical Integration: Trapezoidal rule and Simpson's $\frac{1}{3}$ rule with geometrical interpretation, Related problems. Numerical solution of nonlinear equations: To find a real root of an algebraic or transcendental equation. Location of root (tabular method), Bisection method, Newton-Raphson method with geometrical interpretation. Related problems. Numerical solution of system of linear equations: Gauss elimination method using partial pivoting for solution of system of three linear equations in three unknowns.	Numerical Analysis (Integration, Solutions)	Bradie (2007), Jain et al. (2005), Gerald & Wheatley (2008)	10	Lectures, Numerical Problems	DP

IDC Courses (Sem-II)
Department of Mathematics

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No. of Lectures**	**Delivery Technique**	**Remarks**
SEM I / II / III (IDC) – MATH-H-IDC-1/2/3-TH – Mathematics in Daily Life					
Group A: Concept and definition of sets, subsets, set operations (union, intersection, complementation, subtraction), basic laws of set algebra. Venn diagrams, formula $n(A \cup B) = n(A) + n(B) - n(A \cap B)$ and its daily life applications.	Set Theory	Courant & Robbins (1995)	4	Chalk & Blackboard	AB
Group B: First Principle of Mathematical Induction: Statement and simple problems. Division Algorithm: G.C.D. of two positive integers, expression of G.C.D. as $px + qy$ (Euclidean Algorithm without proof). Representation of positive integers in binary and decimal modes. Linear Diophantine Equation in Two Variables: Existence of integral solutions, general/particular solutions, real-life applications. Prime Integers: Elementary properties, Fundamental Theorem of Arithmetic (statement only), primality test algorithm. Congruence of Integers: Meaning of $a \equiv b \pmod{m}$, elementary properties, divisibility tests (2, 3, 4, 5, 7, 9, 11, 13), check digits (ISBN, UPC, VISA, MasterCard), round-robin tournament table using congruence.	Number Theory	Burton (1989), Rosen (1984)	18	Blackboard, Examples	AB

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Group C: Proposition, propositional variables, logical connectives (NOT, OR, AND, XOR, IMPLICATION, BI-IMPLICATION), truth tables, truth value, tautology, logical consequence, logical equivalence, contradiction.	Logic	Mendelson (1997), Chakraborty (2016)	6	Blackboard, Truth Table Charts	AB
Group D: Linear Programming Problems: Objective function, decision variables, constraints, formulation (e.g., carpenter problem, chemical mixtures, diet problems), graphical solution (bounded region). Game Theory: Two-person zero-sum games, strategy, payoff, saddle point, elementary problems.	LPP	Thie & Keough (2008), Bronson & Naadimuthu (1997), Chakraborty & Ghosh (2009)	8	Diagrams, Graphs, Games	AB
Group E: Time Value of Money: Simple and compound interest (fundamental formulae), interest payable monthly, quarterly, annually. Ordinary Simple Annuities: Accumulated and discounted value, loan repayment, simple problems (no formula derivation). Dividend calculation, income tax calculation (old and new regimes).	Financial Math	Zima & Brown (1996), Chandra (2008)	9	Examples, Practice Sheets	DP