Lesson Plan

Even Semester

Mathematics (Major/Hons.)

CCF + CBCS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM II (Major) MATH-H-CC2-2-TH **Basic Algebra**					

Group A **Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric, and hyperbolic functions of complex variable.**	**Complex Analysis**	**Titu Andreescu and DorinAndrica, Complex Numbers from A to Z,**	**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-Schwartz inequality.**	**Classical Algebra**	**Classical Algebra, S.K. Mapa**	**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 $B \subseteq Y$.**	**Algebra**	**David C. Lay, Linear Algebra and its Applications** **Higher Algebra, S.K. Mapa**	**5**	**Chalk and Talk, Notes, tutorial, class work**	**AB**

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.**	**Algebra**	**Higher Algebra, S.K. Mapa**	**6**	**Chalk and Talk, Notes, tutorial, class work**	**BS**

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)**	**6**	**Chalk and Talk, Notes, tutorial, class work**	**AB**

Group C **Vectors in $R\hat{}n$, 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**	**MH**

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
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**		**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**	**Russell / 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	**Artificial Intelligence**	**Russell / Norvig , ARTIFICIAL**	**6**	**Chalk and Talk, Notes, Hands on**	**DP**

• 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		INTELLIGENCE: A MODERN APPROACH		Experience, Research Work, Term Paper Submission	
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	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH	6	Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission	DP
Unit 5: Other Important Issues • Ethical guidelines and responsible AI practices • AI and Innovation	Artificial Intelligence	Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH	6	Chalk and Talk, Notes, Hands on Experience, Research Work, Term	DP

• Emerging trends and future directions in AI **• AI and creativity: Generative models and artistic applications**				**Paper Submission**	

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM IV (Major) MATH-H-CC5-4-Th Theory of Real Functions					
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 $x \to 0$. **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: $y = xx^a$ $(a = 2, 3, 1/2, -1)$, $\lvert x \rvert$, $[x]$, $\sin x$, $\cos x, \tan x, \log x, ee^x$.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,**	**15**	**Chalk and Talk, Notes**	**AB**

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**	**R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis.** **T. M. Apostol, Mathematical Analysis,**	**15**	**Chalk and Talk, Notes**	**AB**
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**	**R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis.** **T. M. Apostol, Mathematical Analysis,**	**10**	**Chalk and Talk, Notes**	**AB**

Review of Group A	**Limit and Continuity**	**R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis.** **T. M. Apostol, Mathematical Analysis,**	**5**	**Chalk and Talk, Notes, Interactive session**	**AB**
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**	**R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis.** **T. M. Apostol, Mathematical Analysis,**	**20**	**Chalk and Talk, Notes, Interactive session**	**PL**

Review of Group B	**Differentiability of Functions**	**R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis.** **T. M. Apostol, Mathematical Analysis,**	**4**	**Chalk and Talk, Notes, Interactive session**	**PL**

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
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**	**BS**

Review of Statics-I	**Statics**	**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).**	**01**	**Chalk and Talk, Google Classroom, Hand Notes**	**BS**
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**	**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).**	**06**	**Chalk and Talk, Google Classroom, Hand Notes**	**MH**
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**	**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).**	**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 cceleration, 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, 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**	**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**
Review of Paticle Dynamics-I	**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).**	**6**	**Chalk and Talk, Google Classroom, Hand Notes**	**MH**

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
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**	**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**

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**	**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,**	**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**	**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**

Review of Multivariate Calculus	**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,**	**05**	**Chalk and Talk, Google Classroom, Hand Notes**	**BS**

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**	**I. Sneddon, Elements of Partial Differential equations, McGraw-Hill International Edition** **W. A. Strauss, Partial Differential Equations** **L. C. Evans, Partial Differential equations**	**05**	**Chalk and Talk, Google Classroom, Hand Notes**	**BS**

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
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**	**D. S. Malik, J. M. Mordeson and M. K. Sen; Fundamentals of Abstract Algebra;**	**4**	**Chalk and Talk, Google Classroom, Hand Notes**	**PL**
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**	**D. S. Malik, J. M. Mordeson and M. K. Sen; Fundamentals of Abstract Algebra;** **S. K. Mapa, Higher Algebra (Abstract and Linear)**	**3**	**Chalk and Talk, Google Classroom, Hand Notes**	**PL**

CBCS

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SEM VI(H) CBCS CC-13 Metric Space & Complex Analysis					
UNIT I **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.**	**Metric Space**	**1) S. Kumaresan, Topology of Metric Spaces 2)P. K. Jain and K. Ahmad, Metric Spaces**	**15**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems**	**AB**
UNIT I **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.**	**Metric Space**	**1) S. Kumaresan, Topology of Metric Spaces 2)P. K. Jain and K. Ahmad, Metric Spaces**	**15**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems**	**AB**

UNIT I **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.**	**Metric Space**	**1) S. Kumaresan, Topology of Metric Spaces** **2)P. K. Jain and K. Ahmad, Metric Spaces**	**10**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems**	**AB**
UNIT II **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 functions. M¨obius transformation.**	**Complex Analysis**	**1) S. Kumaresan, Topology of Metric Spaces** **2)P. K. Jain and K. Ahmad, Metric Spaces**	**18**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems**	**PL**
UNIT II **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.**	**Complex Analysis**	**1) S. Kumaresan, Topology of Metric Spaces** **2) P. K. Jain and K. Ahmad, Metric Spaces**	**17**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems**	**PL**

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM VI(H) CBCS CC-14 Numerical Methods					
UNIT I **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**	**Numerical Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**5**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

UNIT II **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.**	**Numerical Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**15**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**
UNIT III **Numerical differentiation : Methods based on interpolations, methods based on finite differences.** **Numerical Integration : Newton Cotes formula, Trapezoidal rule, Simpson's 3 -rd rule, Simpson's 8 -th rule,** **Weddle's rule, Boole's Rule, midpoint rule. Composite trapezoidal rule, composite Simpson's 1 -rd rule,** **composite Weddle's rule. Gaussian quadrature formula.**	**Numerical Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**10**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

UNIT IV **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.**	**Numerical Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**10**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**
UNIT V **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. LU decomposition method (Crout's LU decomposition method).** **Matrix inversion : Gaussian elimination and LU decomposition method (Crout's LU decomposition method) (operational counts).** **• The algebraic eigenvalue problem : Power method.**	**Numerical Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**10**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

UNIT VI **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 Analysis**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**5**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

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SEM VI(H) CBCS CC-14 Practical Numerical Methods Lab					
Calculate the sum 1 + 1/2 + 1/3 + · · · + 1/N 2. Enter 100 integers into an array and sort them in an ascending order. 3.Solution of transcendental and algebraic equations by i) Bisection method ii) Newton Raphson method (Simple root, multiple roots, complex roots). iii) Secant method. iv) Regula Falsi method.	**Numerical Methods Lab**	**1) Atkinson, K. E., An Introduction to Numerical Analysis, 2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**10**	**Computer Lab, Chalk and Talk, ICT Classroom**	**DP**
4. Solution of system of linear equations i) LU decomposition method ii) Gaussian elimination method iii) Gauss-Jacobi method iv) Gauss-Seidel method	**Numerical Methods Lab**	**1) Atkinson, K. E., An Introduction to Numerical Analysis, 2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical**	**15**	**Computer Lab, Chalk and Talk, ICT Classroom**	**DP**

5. Interpolation **i) Lagrange Interpolation** **ii) Newton's forward, backward and divided difference interpolations**		**Methods for Scientific and Engineering**			
6. Numerical Integration **i) Trapezoidal Rule** **ii) Simpson's one third rule** **iii) Weddle's Rule** **iv) Gauss Quadrature** **7. Method of finding Eigenvalue by Power method (up to 4 × 4)**	**Numerical Methods Lab**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**15**	**Computer Lab, Chalk and Talk, ICT Classroom**	**DP**
8.Fitting a Polynomial Function (up to third degree) **9. Solution of ordinary differential equations** **i) Euler method** **ii) Modified Euler method** **iii) Runge Kutta method (order 4)** **iv) The method of successive approximations (Picard)**	**Numerical Methods Lab**	**1) Atkinson, K. E., An Introduction to Numerical Analysis,** **2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering**	**10**	**Computer Lab, Chalk and Talk, ICT Classroom**	**DP**

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Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM VI(H) CBCS DSE-A(2) Mathematical Modelling					
UNIT I Power series solution of Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.	**Mathematical Modelling**	**1) TynMyint-U and Lokenath Debnath, Linear Partial Differential Equation for Scientists and Engineers 2) Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling**	**20**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

UNIT II **Monte Carlo simulation modelling: simulating deterministic behavior (area under a curve, volume under a surface), generating random numbers: middle square method, linear congruence, queuing models: harbor system, morning rush hour, Overview of optimization modelling. Linear programming model: geometric solution algebraic solution, simplex method, sensitivity analysis**	**Mathematical Modelling**	**1) TynMyint-U and Lokenath Debnath, Linear Partial Differential Equation for Scientists and Engineers** **2) Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling**	**45**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**MH**

Graphical demonstration (Teaching aid **) [10 classes] **Plotting of Legendre polynomial for n = 1 to 5 in the interval [0,1]. Verifying graphically that all the roots of Pn(x) lie in the interval [0,1].** **• Automatic computation of coefficients in the series solution near ordinary points.** **• Plotting of the Bessel's function of first kind of order 0 to 3.** **• Automating the Frobenius Series Method.** **Random number generation and then use it for one of the following (a) Simulate area under a curve (b) Simulate volume under a surface.** **Programming of either one of the queuing model (a) Single server queue (e.g. Harbor system) (b) Multiple server queue (e.g. Rush hour).** **• Programming of the Simplex method for 2/3 variables.**	**Mathematical Modelling**	**1) TynMyint-U and Lokenath Debnath, Linear Partial Differential Equation for Scientists and Engineers** **2) Frank R. Giordano, Maurice D. Weir and William P. Fox, A First Course in Mathematical Modeling**	**10**	**Computer Lab, Chalk and Talk, ICT Classroom**	**MH**

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM VI(H) CBCS DSE-B(2) Advanced Mechanics					
UNIT I Degrees of freedom, reactions due to constraints. D' Alembert's principle; Lagranges first kind equations; Generalized coordinates; Generalized forces; Lagrangian; Second kind Lagrange's equations of motion; cyclic coordinates; velocity dependent potential; Principle of energy; Rayleigh's dissipation function.	**Mechanics**	**1) H. Goldstein, Classical Mechanics, Narosa Publ., New Delhi, 1998 2) E.C.G. Sudarshan and N. Mukunda, Classical Dynamics: A Modern Perspectives**	**20**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**BS**
UNIT II Action Integral; Hamilton's principle; Lagrange's equations by variational methods; Hamilton's principle for non-holonomic system; Symmetry properties and conservation laws; Noether's theorem. Canonically conjugate coordinates and momenta; Legendre transformation; Routhian approach; Hamiltonian.	**Mechanics**	**1) H. Goldstein, Classical Mechanics, Narosa Publ., New Delhi, 1998 2) E.C.G. Sudarshan and N. Mukunda, Classical Dynamics: A Modern Perspectives**	**20**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**BS**

UNIT III **Hamilton's equations from variational principle; Poincare-Cartan integral invariant; Principle of stationary action; Fermat's principle;**	**Mechanics**	**1) H. Goldstein, Classical Mechanics, Narosa Publ., New Delhi, 1998** **2) E.C.G. Sudarshan and N. Mukunda, Classical Dynamics: A Modern Perspectives**	**15**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**BS**
UNIT IV **Canonical transformation; Generating function; Poisson Bracket; Equations of motion; Action-angle vari- ables; Hamilton-Jacobi's equation; Hamilton's principal function; Hamilton's characteristics function; Li- ouville's theorem.**	**Mechanics**	**1) H. Goldstein, Classical Mechanics, Narosa Publ., New Delhi, 1998** **2) E.C.G. Sudarshan and N. Mukunda, Classical Dynamics: A Modern Perspectives**	**20**	**Chalk Blackboard, Class-Notes & Hand-written theory notes with problems,**	**BS**

Lesson Plan

Even Semester

Mathematics (MDC/General)

CCF + CBCS

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
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, nth roots of unity, De Moivre's theorem for rational indices and its applications. Exponential, logarithmic, trigonometric, and hyperbolic functions of complex variable.**	**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-Schwartz inequality.**	**Classical Algebra**		**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 $B \subseteq Y$.**			**5**	**Chalk and Talk, Notes, tutorial, class work**	**AB**
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.**			**6**	**Chalk and Talk, Notes, tutorial, class work**	**BS**

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)**	**6**	**Chalk and Talk, Notes, tutorial, class work**	**AB**
Group C **Vectors in 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**	**MH**

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM II (MDC) MATH-MD-SEC 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**		**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**	**Russell / 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**	**Russell / 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**	**Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH**	**6**	**Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission**	**DP**

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**	**Russell / Norvig , ARTIFICIAL INTELLIGENCE: A MODERN APPROACH**	**6**	**Chalk and Talk, Notes, Hands on Experience, Research Work, Term Paper Submission**	**DP**

Sem IV MDC Syllabus is not out yet

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM VI(G) CBCS DSE-B Advanced 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.	**Advanced Calculus**	**1. David Widder; Advance Calculus** **2. Angus E. Taylor and W. Robert Mann; Advanced Calculus**	**20**	**Chalk Blackboard Notes**	**BS**
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	**Advanced Calculus**	**1. David Widder; Advance Calculus** **2. Angus E. Taylor and W. Robert Mann; Advanced Calculus**	**40**	**Chalk Blackboard Notes**	**AB**

term differentiation of Power Series. Statements of Abel's Theorems on Power Series. Convergence of Power Series. **Expansions of elementary functions such as ex, 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 and its Inverse.** **Application to the solution of ordinary differential equation of second order with constant coefficients**					

Planned				After Implementation	
Unit / Group / Module / Article	**Topics**	**Reference Books**	**No of Lecture Planned**	**Content Delivery Technique**	**Remarks Comments**
SEM VI(G) CBCS SEC-B Boolean Algebra					
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.	**Boolean Algebra**	**1. A. Davey and H. A. Priestley, Introduction to Lattices and Order** **2. Rudolf Lidl and Gu¨nter Pilz, Applied Abstract Algebra**	**10**	**Chalk Blackboard Notes**	**PL**