Lesson Plan
Subject: Mathematics (Hons.)

Semester: I
BMH1CC01 (Calculus, Geometry an Differential Equations)
Total Lectures = 60

Unit- 1	**Total Lectures =12**
CONTENTS Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$ concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Brief discussion on continuity, differentiability: Definition, examples and some results.
Lecture 2	Hyperbolic functions, higher order derivatives.
Lecture 3	Statement and proof of Leibnitz rule, examples.
Lecture 4	Applications of Leibnitz rule to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$.
Lecture 5	Concavity and inflection points. Examples.
Lecture 6	Envelopes.
Lecture 7	Asymptotes.
Lecture 8	Curve tracing in Cartesian coordinates of standard curves.
Lecture 9	Curve tracing in polar coordinates of standard curves.
Lecture 10	L'Hospital's rule discussion.
Lecture 11	Applications of derivatives in real world problems
Lecture 12	Discussion of more problems.
Unit- 2	**Total Lectures =12**
CONTENTS Reduction formulae, derivations and illustrations of reduction formulae for the integration of $\sin nx$, $\cos nx$, $\tan nx$, $\sec nx$, $(\log x)^n$, $\sin^n x\ \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution .Techniques of sketching conics	
Lecture 13	General discussion on indefinite and definite integration and simple problems.
Lecture 14	Simple concept on reduction formula. Simple problems.
Lecture 15	Derivation and illustrations of reduction formulae for $\sin nx$, $\cos nx$ and applications.
Lecture 16	Derivation and illustrations of reduction formulae for $\sin nx$, $\cos nx$ and applications.
Lecture 17	Derivation and illustrations of reduction formulae for $\tan nx$, $\sec nx$ and applications.

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Lecture 18	Derivation and illustrations of reduction formulae $(\log x)^n$, $\sin^n x \sin^m x$ and applications.
Lecture 19	Parametric equations, parametrizing a curve. Examples
Lecture 20	Arc length, arc length of parametric curves and examples.
Lecture 21	Area of surface of revolution.
Lecture 22	More problems on area of surface of revolution.
Lecture 23	Techniques of sketching conics
Lecture 24	General discussion and dealing with different kinds of problems on content.
Unit- 3	**Total Lectures =12**
CONTENTS Reflection properties of conics, translation and rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics. Spheres.Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	
Lecture 25	Reflexion properties of conics, translation and rotation of axes with examples
Lecture 26	Invariants and some problems
Lecture 27	General equation of 2nd degree: Classification and canonical forms of conics
Lecture 28	Polar equation of conics : Equations of straight line, circle, conic
Lecture 29	Polar equation of conics : Some problems
Lecture 30	Spheres: Some basic properties and problems
Lecture 31	Some more problems on sphere
Lecture 32	Cylindrical surface and central conicoids, ellipsoid, hyperboloid and paraboloid
Lecture 33	Generating lines: Properties and problems
Lecture 34	General equation of 2nd degree in three variables
Lecture 35	Some more problems determining nature and canonical forms of conics in 3D
Lecture 36	Illustration of graphing standard quadratic surfaces: Cone, cylinder, ellipsoid etc.
Unit- 4	**Total Lectures =12**
CONTENTS Linear Differential equations and mathematical models. General, particular, explicit, implicit and singular. Solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.	
Lecture 37	Introduction of ODE, order, degree of differential equation, Example and solution of ODE,
Lecture 38	Particular, Complete, Explicit, Implicit, Singuler solution of ODE with example
Lecture 39	Family of curves represented by ODE, Geometrical interpretation
Lecture 40	Exact equation, Necessary and Sufficient condition for exactness, examples

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Lecture 41	Integrating factor(IF) of first order ODE, examples
Lecture 42	If $M\,dx + N\,dy = 0$ has one and only one solution then number of IF is infinite, Examples
Lecture 43	Equation solvable by separation of variable, substitution, homogeneous equation
Lecture 44	Rules to find an integrating factor, Examples
Lecture 45	Special Integrating Factors and Transformations
Lecture 46	Solution of first order Linear equation, Equation reducible to linear form, Examples
Lecture 47	Introduction of first order higher degree equations solvable for x, y, p, Clairaut's Equation, Examples
Lecture 48	Singular solution, P-discriminant, C-discriminant, Envelope, Nodal locus, Cuspidal locus, Examples
Graphical Demonstration (Teaching Aid)	**Total Lectures =12**
CONTENTS 1. Plotting of graphs of function e^{ax+b}, log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax + b| and to illustrate the effect of a and b on the graph 2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them. 3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid). 4. Obtaining surface of revolution of curves. 5. Tracing of conics in Cartesian coordinates/polar coordinates. 6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.	
Lecture 49	Plotting of graphs of $e^{ax+b}, \log(ax+b), \frac{1}{ax+b}$
Lecture 50	Plotting of graphs of $\sin(ax+b), \cos(ax+b), \lvert ax+b \rvert$
Lecture 51	Plotting the graph of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and comparing them
Lecture 52	Sketching parametric curves (Eg. Trochoid, cycloid).
Lecture 53	Sketching parametric curves (Eg. epicycloids, hypocycloid).
Lecture 54	Obtaining surface of revolution of curves
Lecture 55	Obtaining surface of revolution of curves.
Lecture 56	Tracing of conics in Cartesian coordinates
Lecture 57	Tracing of conics in polar coordinates.
Lecture 58	Sketching ellipsoid, hyperboloid of one and two sheets using Cartesian coordinates
Lecture 59	Sketching elliptic cone using Cartesian coordinates
Lecture 60	Sketching elliptic paraboloid and hyperbolic paraboloid using Cartesian coordinates.

Lesson Plan
Subject: Mathematics (Hons.)

Semester: I
BMH1CC02 (Algebra)
Total Lectures = 60

Unit- 1	**Total Lectures =17**
CONTENTS Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic and biquadratic equations. Reciprocal equation, separation of the roots of equations, Strum,s theorem. Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Introduction of Complex Numbers, Geometrical representation of complex numbers, Examples
Lecture 2	Modulus, Argument of complex numbers, Polar representation of complex numbers, Examples
Lecture 3	De Moivre's theorem for rational indices and its applications.
Lecture 4	Roots of complex number, n-th roots of unity
Lecture 5	Various problem and solution of complex number
Lecture 6	Algebraic Equation, Fundamental equation of Classical Algebra, Examples
Lecture 7	Rolle's Theorem to find position of root, Multiple root, Examples
Lecture 8	Descartes rule of signs, Examples
Lecture 9	Relation between roots and coefficients, Symmetric functions, Examples
Lecture 10	Transformation of equation, Cubic and biquadratic equations and its solution, Examples
Lecture 11	Reciprocal equation, Examples and its solution
Lecture 12	Separation of the roots of equations
Lecture 13	Location of roots, Strum,s theorem
Lecture 14	Introduction about Inequality, Examples
Lecture 15	Cauchy-Schwartz inequality, Problem and solution
Lecture 16	Arithmetic, Geometric and Harmonic Means, Examples
Lecture 17	$AM \geq GM \geq HM$, problems using these inequality

Lesson Plan
Subject: Mathematics (Hons.)

Unit- 2	Total Lectures =15
CONTENTS Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.	
Lecture 18	Equivalence relation with examples and equivalence class
Lecture 19	Partition and relation between equivalence relation and partition
Lecture 20	Bijective mapping and invertible mappings with examples
Lecture 21	Composition of functions and some problems
Lecture 22	One to one correspondence and cardinality of a set
Lecture 23	Well ordering property of +ve integers and Division algorithm
Lecture 24	Some theorems and problems
Lecture 25	Divisibility, gcd of two integers and some theorems on gcd
Lecture 26	Euclidean algorithm and some problems
Lecture 27	Congruence relation on $\mathbb{N}$ with examples
Lecture 28	Some theorems on congruence
Lecture 29	Some problems on congruence
Lecture 30	Principle of mathematical inductions
Lecture 31	Some problems on mathematical induction
Lecture 32	Fundamental theorem of Arithmetic and related problems
Unit- 3	**Total Lectures =10**
CONTENTS Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.	
Lecture 33	Introduction to systems of linear equations. m equations with n variables. Row reduction and echelon forms.
Lecture 34	What about existence of solution for system equations? Augmented matrix. The matrix equation Ax=b.
Lecture 35	To understand consistent and inconsistent system equations. Examples of consistent and inconsistent system equations.
Lecture 36	System of non-homogeneous and homogenous equations. Examples.
Lecture 37	Important theorems and results on existence of solutions for a system of homogeneous equations.
Lecture 38	Definition of vector space over a field. Solutions of a homogeneous system form a vector space.
Lecture 39	On existence of solutions of a non-homogeneous system.
Lecture 40	Few results and problems on non-homogeneous system.
Lecture 41	Applications of linear systems, linear independence.
Lecture 42	Dealing with more problems from the content.

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Unit- 4	**Total Lectures =18**
CONTENTS Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Vector Spaces of R^n, Subspaces of R^n, dimension of subspaces of R^n, rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.	
Lecture 43	Brief discussion on Real and Complex field. Binary composition, External composition. Definition of Vector space ***V*** over a field ***F***. Few examples of vector spaces.
Lecture 44	Definition of Vector space $\mathbf{R^n}$**.** Examples, some important properties of vector space, few useful theorems.
Lecture 45	**Definition:** Subspace of a vector space $\mathbf{R^n}$, Examples, Important results on subspace.
Lecture 46	Linear combination and linear independence of vectors. Discussion with various problems.
Lecture 47	Brief discussion on basis, dimension, finite dimensional vector spaces etc. Dimension of subspaces of $\mathbf{R^n}$**.**
Lecture 48	Introduction to Linear transformations. Definition of a linear transformation, examples.
Lecture 49	Matrix of a linear transformation.
Lecture 50	Problems on matrix of a linear transformation.
Lecture 51	Inverse of a matrix, characterizations of invertible matrices.
Lecture 52	Problems on inverse of a matrix and discussion.
Lecture 53	Matrix polynomials. Characteristic Equation of a matrix.
Lecture 54	Definition of eigen values and eigen vectors. To find the eigen value and the corresponding eigen vectors for a given matrix.
Lecture 55	**Multiplicity:** Algebraic and Geometric multiplicity, Important theorems and results.
Lecture 56	Theorem on existence and type of eigen values for a real symmetric and skew-symmetric matrix.
Lecture 57	More theorems on eigen value and eigen vectors. Some standard problems on eigen value and eigen vectors.
Lecture 58	Cayley-Hamilton theorem. Verification of Cayley-Hamilton theorem.
Lecture 59	Use of Cayley-Hamilton theorem in finding the inverse of a matrix.
Lecture 60	Dealing with more problems from the content.

Lesson Plan
Subject: Mathematics (Hons.)

Semester : II
Paper : BMH2CC03 (Real Analysis)
Total Lecture Hours = 60

Unit 1 (Real Number System)	**Total Lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 1	Review of algebraic and order properties of $\mathbb{R}$
Lecture 2	$\mathcal{E}$-neighbourhood of a point in $\mathbb{R}$
Lecture 3	Some theorems and problems on neighbourhood of a point in $\mathbb{R}$
Lecture 4	Idea of countable sets, some examples and theorems
Lecture 5	Example of uncountable sets and uncountability of $\mathbb{R}$
Lecture 6	Bounded above, Bounded below, Bounded sets and their examples
Lecture 7	Supremum, infimum of a subset of $\mathbb{R}$ with examples
Lecture 8	Completeness property of $\mathbb{R}$ and it's equivalent properties
Lecture 9	Archimedean property of $\mathbb{R}$ and it's examples
Lecture 10	Density property of rational and irrational numbers
Lecture 11	Open intervals , closed intervals and their properties
Lecture 12	Limit point and isolated point of a set in $\mathbb{R}$ and related theorems and problems
Lecture 13	Interior point of a set in $\mathbb{R}$ and concept of open sets with examples
Lecture 14	Theorems and problems related to open sets
Lecture 15	Introduction of closed sets and some examples of closed sets
Lecture 16	Theorems and problems on closed sets
Lecture 17	Derived set of a set in $\mathbb{R}$ and its properties
Lecture 18	Bolzano-Weierstrass property and it's verification with some examples
Lecture 19	Open cover of a set in $\mathbb{R}$ and concept of compactness in $\mathbb{R}$
Lecture 20	Heine-Borel theorem and some problems related to compactness.
Unit 2 (Sequence of real numbers)	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 21	Introduction of sequence of real numbers with various examples
Lecture 22	Concept of bounded above, bounded below and bounded sequence with examples
Lecture 23	Definition of convergent sequence and limit of a sequence with examples
Lecture 24	Relation between bounded and convergent sequences
Lecture 25	Limit superior and limit inferior, theorems and problems
Lecture 26	Limit theorems : Addition, subtraction and multiplication by a scalar with examples and counter examples
Lecture 27	Limit theorems: Multiplication, Division, Modulus with examples and counter examples
Lecture 28	Introduction of monotone sequences with examples
Lecture 29	Monotone convergence theorems and its applications
Lecture 30	Some more problems with monotone convergence theorems
Lecture 31	Introduction of sub sequence and divergence criterion
Lecture 32	Some problems with sub sequence theorem and Bolzano-Weierstrass

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	property for sequence
Lecture 33	Introduction of Cauchy sequence with examples
Lecture 34	The relation between convergence and Cauchy sequences and Cauchy criterion for convergence
Lecture 35	Some problems of determining convergence or divergence of a sequence with Cauchy criterion
Unit 3 (Series of real numbers)	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 36	Introduction of infinite series with examples and sequence of partial sums of a series
Lecture 37	Convergence and Divergence of a series with examples
Lecture 38	Cauchy criterion for convergence of an infinite series with applications.
Lecture 39	Comparison test and limit comparison test with applications
Lecture 40	Some more problems with Comparison tests
Lecture 41	D' Alembert's ratio test with applications
Lecture 42	Raabe's test with applications
Lecture 43	D' Morgan and Bertrand's test with applications
Lecture 44	Cauchy's integral test with applications
Lecture 45	Cauchy's n^{th} root test with applications
Lecture 46	Gauss' test with applications
Lecture 47	Some miscellaneous problems
Lecture 48	Alternating series and Leibnitz's test
Lecture 49	Some applications of Leibnitz's test
Lecture 50	Absolute and conditional convergence with some examples
Graphical Demonstration (Teaching Aid)	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 51	Plotting of recursive sequences
Lecture 52	Study the convergence of sequences through plotting
Lecture 53	Some more problems of convergence or divergence sequences through plotting
Lecture 54	Verify Bolzano-Weierstrass' theorem through plotting of sequence and hence identify convergent subsequences from the plot
Lecture 55	Some more problems related Bolzano-Weierstrass' theorem through plotting
Lecture 56	Study the convergence or divergence of infinite series by plotting their sequences of partial sums
Lecture 57	Some more problems of convergence or divergence of infinite series by plotting
Lecture 58	Cauchy's root test by plotting nth roots
Lecture 59	Ratio test by plotting the ratio of nth and (n+1)th terms
Lecture 60	Some more problems of ratio test by plotting

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Subject: Mathematics (Hons.)

Semester: II
Paper : BMH2CC04 (Differential Equation and Vector Calculus)
Total Lectures = 60

Unit 1 (Ordinary Differential Equation)	**Total Lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 1	Introduction of Lipschitz condition with various example
Lecture 2	Picard's existence and uniqueness Theorem with some example
Lecture 3	Initial Value Problems which has unique solution, many solution or no solution
Lecture 4	Linear ODE of nth order homogeneous and non-homogeneous, Auxiliary Equation
Lecture 5	General solution of homogeneous ODE equation of second order with constant coefficients related to roots of the Auxiliary Equation
Lecture 6	Various problem about general solution of homogeneous ODE with constant coefficient
Lecture 7	Principle of super position for homogeneous equation
Lecture 8	Definition of Wronskian of n functions, Linearly dependent and Linearly independent of functions and some example
Lecture 9	Theorem, properties and applications of Wronskian
Lecture 10	Particular Integral of non-homogeneous, higher order ODE with constant coefficients, some properties
Lecture 11	Problem solution about Particular Integral of higher order ODE with constant coefficients
Lecture 12	Complementary Function of non-homogeneous ODE, General solution of non-homogeneous higher order ODE with constant coefficients
Lecture 13	Problem solution about of non-homogeneous ODE with constant coefficients
Lecture 14	Introduction of Euler's Homogeneous Linear Equation or Cauchy-Euler equation
Lecture 15	Solution of Homogeneous Linear Equation using Cauchy-Euler Method
Lecture 16	Introduction for Method of Undetermined Coefficient to solve non-homogeneous ODE with constant coefficients
Lecture 17	Solution of non-homogeneous ODE using the Method of Undetermined Coefficient
Lecture 18	Introduction forMethod of Variation of Parametersto solve non-homogeneous ODE
Lecture 19	Solution of non-homogeneous ODE using the Method of Variation of Parameters
Lecture 20	Various problem solution of Linear homogeneous and non-homogeneous ODE

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Unit 2 (Systems of Linear Differential Equations)	**Total lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 21	Introduction of Systems of linear differential equations, Type of Liner Systems
Lecture 22	Definition of solution, normal form of Liner Systems, Example
Lecture 23	Some various example of Linear differential equation
Lecture 24	Differential operators with some example
Lecture 25	An Operator Method for Linear System with constant coefficients
Lecture 26	Solution of Linear System using Operator Method
Lecture 27	Various problem and solution by Operator Method
Lecture 28	Discuss about application of System Linear ODE, Eample
Lecture 29	Application to Mixture Problem, Example
Lecture 30	Basic Theory of Linear System in Normal form, some example
Lecture 31	Homogeneous Linear System with two equations in two unknown functions, some example
Lecture 32	Linear combination of solutions, Example
Lecture 33	Theorem: Any linear combination of two solutions of the homogeneous linear system is itself a solution of the system, Example
Lecture 34	Linearly independent solution of the Homogeneous Linear System, Example
Lecture 34	Theorem: There exist sets of two linearly independent solutions of the homogeneous linear system, Example
Lecture 35	Every solution of the Linear System can be written as a linear combination of any two linearly Independent solution of the Linear System, Example
Lecture 36	If W(t) be Wronskian of two solutions of homogeneous linear system on an interval $a \leq t \leq b$, then either W(t)=0 for all $t \epsilon [a, b]$ or W(t)=0 for no $t \epsilon [a, b]$, Example
Lecture 37	Nonhomogeneous Linear System, Example
Lecture 38	Characteristic Equation associated with the Homogeneous Linear System with constant coefficients, some example
Lecture 39	Introduction for solution of Homogeneous Linear System with constant coefficients two equations in two unknown functions
Lecture 40	Problem solution of Homogeneous Linear System with constant coefficients two equations in two unknown functions
Unit 3 (Phase plane, Power series solution)	**Total lectures =06**
Lecture Serial	**Topics of Discussion**
Lecture 41	Equilibrium points, Interpretation of the phase plane
Lecture 42	Definition of Power Series, Definition of regular point, singular point, regular singular point, some example
Lecture 43	Method of solution of series solution about ordinary point,
Lecture 44	Power series solution of a 2nd order linear ODE about ordinary point
Lecture 45	Series solution about Regular Singular points, The method of Frobenius
Lecture 46	Example, series solution about Regular Singular points

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Unit 4 (Vector Calculus)	**Total lectures =10**
CONTENTS Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions	
Lecture Serial	**Topics of Discussion**
Lecture 47	Preliminary idea about product of vectors, product of three and four vectors, geometrical interpretation of scalar and vector triple product.
Lecture 48	Discussion of some elementary geometrical problem by application of vector method, coplanarity of three vectors etc.
Lecture 49	Discussion of problems on triple product, application of vectors in mechanics.
Lecture 50	Introduction to vector functions, definition of vector function and example of different kinds of vector valued functions.
Lecture 51	Algebra of vector-valued functions, examples.
Lecture 52	Definition of limit for a vector valued function, algebra of limits and examples.
Lecture 53	Definition of continuity for a vector valued function, algebra of continuous vector functions and examples.
Lecture 54	Definition of differentiability for a vector valued function, algebra of differentiable vector functions and examples.
Lecture 55	Integration of vector functions: Definition, discussion of some properties and evaluation of integration of vector valued function.
Lecture 56	Discussion of problems.
Graphical Demonstration (Teaching Aid)	**Total lectures =04**
Lecture Serial	**Topics of Discussion**
Lecture 57	Plotting of family of curves which are solutions of first order differential equation.
Lecture 58	Plotting of family of curves which are solutions of second order homogeneous differential equation
Lecture 59	Plotting of family of curves which are solutions of second order non-homogeneous differential equation.
Lecture 60	Plotting of family of curves which are solutions of third order differential equation

Lesson Plan
Subject: Mathematics (Hons.)

Semester: III
Paper: BMH4CC05 (Theory of real functions and Introduction to metric space)
Total Lecture Hours = 60

Unit 1	**Total Lectures =25**
Lecture Serial	**Topics of Discussion**
Lecture 1	$\varepsilon - \delta$ definition of limit of a function with examples
Lecture 2	Uniqueness of limit and sequential criterion of limit
Lecture 3	Some problems of finding limits of functions
Lecture 4	Same sign property and some more examples and problems
Lecture 5	Limit theorems: Sum, difference and scalar multiplication of functions
Lecture 6	Limit theorems: product, ratio of functions
Lecture 7	Some more theorems and problems
Lecture 8	Sandwitch theorem with applications
Lecture 9	Cauchy's principle with examples
Lecture 10	Concept of one sided limits with examples
Lecture 11	Concept of infinite limits with examples
Lecture 12	Some theorems and problems
Lecture 13	Some miscellaneous problems
Lecture 14	Continuity of a function with examples and some theorems
Lecture 15	Sequential criterion of continuity and some other theorems
Lecture 16	Some applications of sequential criterion
Lecture 17	Continuity of sum, difference , product , ratio of two continuous functions
Lecture 18	Continuity in an interval with examples and problems
Lecture 19	Examples of some important continuous functions and composite functions
Lecture 20	Various type of discontinuity with examples
Lecture 21	Some miscellaneous problems
Lecture 22	Same sign property, the relation between continuity and boundedness, Intermediate value property
Lecture 23	Relation between monotone function and continuous function, some theorems related to open, closed sets and continuity
Lecture 24	Uniform continuity: Definition and theorems
Lecture 25	Some problems on continuity an uniform continuity
Unit 2	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 26	Differentiability of a function: Definition, theorems and examples
Lecture 27	Caratheodory's theorem and some problems
Lecture 28	Algebra of differentiable functions
Lecture 29	Relative extrema, interior extrema with examples
Lecture 30	Monotonicity of a function with sign of derivative with related problems
Lecture 31	Rolle's theorem in different forms with geometric interpretation
Lecture 32	Verification and application of Rolle's theorem with some examples

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Lecture 33	Lagrane’s MVT with geometric interpretation and different form of Lagrange’s MVT
Lecture 34	Verification and applications of Lagrange’s MVT with some examples
Lecture 35	Some theorems and related problems
Lecture 36	IVP for derivatives and Darboux theorem
Lecture 37	Application of Lagrange’s MVT to inequalities and approximation of polynomials
Lecture 38	Curvature and radius of curvature of a curve with intrinsic equation and cartesian equations
Lecture 39	Radius of curvature of a curve with parametric equation, polar equation, pedal equations
Lecture 40	Some miscellaneous problems on curvature
Unit 3	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 41	Cauchy’s MVT and it’s geometric interpretation
Lecture 42	Some problems
Lecture 43	Taylor’s theorem with Lagrange’s , Cauchy’s and Generalized form of remainder
Lecture 44	Maclaurin’s theorem with Lagrange’s , Cauchy’s and Generalized form of remainder
Lecture 45	Application of Taylor’s theorem to convex function and relative extrema
Lecture 46	Some problems and introduction of Taylor’s and Maclaurin’s infinite series
Lecture 47	Expansion of some functions: Exponential function, Trigonometric functions
Lecture 48	Expansion of some functions: $\log(1+x)$and some consequences
Lecture 49	Expansion of some functions: $\frac{1}{ax+b}$ and $(1+x)^n$
Lecture 50	Applications of Taylor’s theorem to inequalities
Unit 4	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 51	Metric space : Definition and examples
Lecture 52	Some examples of metric space: Usual metric on $\mathbb{R}^n$, $l_p - Space,\ p \geq 1$, Space of continuous functions $C[a,b]$
Lecture 53	Open ball, interior point and open set
Lecture 54	Some theorems on open set
Lecture 55	Closed ball and closed set and limit point
Lecture 56	Some theorems on closed sets
Lecture 57	Interior of a set and related theorems
Lecture 58	Derived and closure of a set and related theorems
Lecture 59	Diameter of a set and subspace of a metric space
Lecture 60	Dense sets and separable sets

Lesson Plan

Subject: Mathematics (Hons.)

Semester: III

Paper: BMH3CC06 (Group Theory–I)

Total Lectures = 60

Unit 1	**Total Lectures =10**
CONTENTS Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Finite groups, The permutation group S_n, Symmetric group S_3
Lecture 2	Symmetries of a equilateral triangle, Symmetries of a square
Lecture 3	Definition and examples of groups, Commutative group, non-commutative group, examples.
Lecture 4	Permutation groups and quaternion groups,
Lecture 5	Definition and examples Cycle, Even and odd permutation, alternating groups.
Lecture 6	Few important results on permutation group, interesting problems.
Lecture 7	A group contains only one identity element, examples.
Lecture 8	Inverse of an element in a group is unique, some problems, In a group$(G,\circ)$, $(a \circ b)^{-1} = b^{-1} \circ a^{-1} \quad \forall\ a, b \in G,$ some problems.
Lecture 9	Some Important Groups; $GL(2,\mathbb{R}) = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in M_2(\mathbb{R}) :\ ad - bc \neq 0 \right\}$ $SL(2,\mathbb{R}) = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in M_2(\mathbb{R}) :\ ad - bc = 1 \right\}$ Few important results and theorems.
Lecture 10	The group Z_n of integers under addition modulo n, Examples, The group U(n) of units under multiplication modulo n, Examples
Unit 2	**Total Lectures =05**
CONTENTS Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	
Lecture 11	Definition of Subgroup with examples. If$(G,\circ)$ be a group,a non-empty subset H of G forms a subgroup of G iff i) $a, b \in H \Rightarrow a \circ b \in H$, ii) $a \in H \Rightarrow a^{-1} \in H$
Lecture 12	If H be a non-empty subset of a group G. Then H is a subgroup of G iff $ab^{-1} \in H$ whenever $a, b \in H$. Intersection of a family of subgroup of a group G is a subgroup of G.
Lecture 13	Union of two subgroups of a group G may not be a subgroup of G, examples. If H, K be two subgroups of a group G. Then $H \cup K$ is a subgroup of G iff $H \subset K$ or $K \subset H$.
Lecture 14	Definition of Centre of a group, examples. Z(G) is a subgroup of G Definition of Centraliser of an element in a group, If G be a group and a ∈ G, then C(a) is a subgroup of G.

Lesson Plan
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Lecture 15	Product of two subgroups. Theorems and results.
Unit 3	**Total Lectures =20**
CONTENTS Properties of cyclic groups, classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	
Lecture 16	Integral power of an element, Definition of order of an element. Examples If a be an element of a group G. Then $o(a) = o(a^{-1})$. In a group G, let $a \in G$ and $o(a) = n$ then $o(a^m) = \frac{n}{(m,n)}$ where m is a non-zero integer.
Lecture 17	Definition of Cyclic groups, examples, If G is a cyclic group generated by a then a^{-1} is also a generator of G , Complex roots of unity, Klein's 4-group, example
Lecture 18	Few more theorems, results and problems.
Lecture 19	Classification of subgroups of cyclic groups.
Lecture 20	Every subgroup of a cyclic group is cyclic. Properties of finite cyclic group.
Lecture 21	If G be a cyclic group of order n. Then the total number of generators of G is $\phi(n)$. Application of this theorem to different type of problems
Lecture 22	More results on cyclic group. Solving problems.
Lecture 23	Definition and examples of Permutation. Permutation groups. Symmetric group S_n.
Lecture 24	Definition and examples Cycle. Theorems and results.
Lecture 25	Even and odd permutation. Theorems and results.
Lecture 26	The alternating groups. Theorems and results.
Lecture 27	Few important results on permutation group, interesting problems.
Lecture 28	Definition of Left Coset and Right Coset, Let H be a subgroup of a group G and $a \in G$ then $aH = H$ iff $a \in H$
Lecture 29	H be a subgroup of a group G and $a, b \in G$ then $aH = bH$ iff $a^{-1}b \in H$
Lecture 30	Any two left cosets or right cosets of a group have the same cardinality. More Theorems on coset.
Lecture 31	H be a subgroup of a group G, then $\bigcup_{a\in G} aH = G$ $a, b \in G$ then either $aH = bH$ or $aH \cap bH = \phi$ Let H be a subgroup of a group G then set of all left cosets (right costes) of H in G forms a partition of G, Index of subgroup
Lecture 32	Lagrange's theorem. The order of each element of a finite group G is a divisor of $o(G)$ [if Gbe a finite group then $o(a) \mid o(G)$ $\forall\, a \in G$].
Lecture 33	Group of prime order is cyclic. The order of each element in a finite group is a divisor of order of the group. Application of this result.
Lecture 34	More consequences of Lagrange's theorem, Fermat's Little theorem.

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Lecture 35	General discussion on whole content of this unit.
Unit 4	**Total Lectures =10**
CONTENTS External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.	
Lecture 36	External direct product of a finite number of groups.
Lecture 37	Few important result and problems on External direct product of a finite number of groups.
Lecture 38	Normal subgroups: their definition, examples, and characterizations
Lecture 39	Let H be a subgroup of G such that$[G : H] = 2$. Then H is a normal subgroup of G.
Lecture 40	Let H be a subgroup of a group G, then H is normal in G iff $x \in G, h \in H \Rightarrow xhx^{-1} \in H$ $[or\ xHx^{-1} \subset H\ \ \forall\, x \in G]$.
Lecture 41	Every subgroup of a commutative group G is a normal in G. Test for normality.
Lecture 42	More theorems, results and examples on normal subgroup.
Lecture 43	Quotient groups, Let H be a normal subgroup of G, letG/H denote the set of all left cosets of H in G. Define a binary operation $*$ on G/H as $aH * bH = abH \quad \forall\, aH, bH \in G/H.$ Then G/H is a group with respect to the operation.
Lecture 44	If H be a subgroup of a cyclic group G then G/H is cyclic. More results and examples.
Lecture 45	Finite abelian groups, Cauchy's theorem for finite abelian groups.
Unit 5	**Total Lectures =15**
CONTENTS Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.	
Lecture 46	Definition and examples of Group ***homomorphism***. Simple properties.
Lecture 47	Let $\emptyset: G \to G'$ be a homomorphism, then $\emptyset(e) = \emptyset(e')$, $\emptyset(a^{-1}) = \{\emptyset(a)\}^{-1}\ for\ all\ a \in G$ and many more results.
Lecture 48	Definition of homeomorphic image and its properties, examples.
Lecture 49	Definition and examples of ***epimorphism***. Let $\emptyset: G \to G'$ be a homomorphism, then if H is a subgroup of G, $\emptyset(H)$ is a subgroup of G'.
Lecture 50	Action of homomorphism on normal subgroup of a group. Few theorems and results.
Lecture 51	Definition and examples of ***kernel*** of a homomorphism. Theorems and results.
Lecture 52	Discussion of various problems on homomorphism.
Lecture 53	Definition and examples of Group ***isomorphism***. Simple properties.
Lecture 54	Important theorems and results on isomorphism.
Lecture 55	Action of isomorphism on a cyclic group. Theorems and results.
Lecture 56	Discussion of various problems on isomorphism.
Lecture 57	First isomorphism theorem and application.

Lecture 58	Second isomorphism theorems and application.
Lecture 59	Third isomorphism theorems and application.
Lecture 60	General discussion on whole content of this unit

Semester: III
Paper: BMH3CC07 (Numerical Methods and Numerical Methods Lab)
Total Lectures = 60

Unit 1 (Error)	**Total Lectures =02**
Lecture Serial	**Topics of Discussion**
Lecture 1	Exact number, Approximation number, Absolute error, Relative error, Relative percentage error, Significant digit, General formula for estimation of error, Examples
Lecture 2	Rounding off , Algorithms, Convergence, Truncation, Examples
Unit 2 (Method to find roots of Transcendental and Polynomial equations)	**Total Lectures =06**
Lecture Serial	**Topics of Discussion**
Lecture 3	Discuss about the roots and location of roots of Transcendental and Polynomial equations
Lecture 4	Method of bisection, Fixed point iteration method, Examples
Lecture 5	Convergence of these method, Order of convergence
Lecture 6	Newton-Raphson method, Condition for Convergence, Order of Convergence, Geometrical interpretation
Lecture 7	Regulafalsi method, Convergence, Geometrical interpretation
Lecture 8	Newton’s method, Secant method, Convergence
Unit 3 (Solution of System of Linear Algebraic Equation)	**Total Lectures =08**
Lecture Serial	**Topics of Discussion**
Lecture 9	Discuss about the solution of System of linear algebraic equations
Lecture 10	Gaussian Elimination, Examples
Lecture 11	Gauss Jordan methods. Examples
Lecture 12	Gauss Jacobi method, Examples
Lecture 13	Gauss Seidel method, Examples
Lecture 14	Gauss Seidel iteration method converges if the system of equation is diagonally dominate
Lecture 15	Their convergence analysis
Lecture 16	LU Decomposition
Unit 4 (Interpolation)	**Total Lectures =09**
Lecture Serial	**Topics of Discussion**
Lecture 17	Introduction about Interpolation, Error in Interpolation
Lecture 18	Difference, Operator, Difference of polynomial
Lecture 19	Newton’s forward and backward Interpolation, Examples
Lecture 20	Lagrange Interpolation, Properties, Inverse Interpolation, Examples
Lecture 21	Linear, Quadratic Interpolation and their accuracy
Lecture 22	Divided difference, Properties, Examples

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Lecture 23	Forward and backward difference interpolations.
Lecture 24	Numerical differentiation methods based on interpolations, Examples
Lecture 25	Numerical differentiation methods based on finite differences, Examples
Unit 5 (Numerical Integration)	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 26	Numerical Integration, General formula
Lecture 27	Degree of Precision, Examples
Lecture 28	Newton Cotes formula, Error in Newton Cotes formula
Lecture 29	Trapezoidal rule, Composite trapezoidal rule, Examples
Lecture 30	Simpson’s 1/3rd rule, Composite Simpson’s 1/3rd rule, Examples
Lecture 31	Simpson’s 3/8rd rule
Lecture 32	Weddle’s rule, Composite Weddle’s rule
Lecture 33	Boole’s rule.
Lecture 34	Midpoint rule
Lecture 34	Gauss quadrature Theory, Composite Gauss formula.
Lecture 35	The algebraic eigenvalue problem: Power method.
Unit 6 (Numerical Solution of Differential Equations)	**Total lectures =05**
Lecture Serial	**Topics of Discussion**
Lecture 36	Basic concepts, The method of successive approximations
Lecture 37	Euler’s method, Examples
Lecture 38	The modified Euler method, Examples
Lecture 39	Runge-Kutta methods of order two, Examples
Lecture 40	Runge-Kutta methods of order four, Examples
Unit 7 (Numerical Practical)	**Total lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 42	Introduction in C- Programming
Lecture 43	Sample program, Printing a message, adding of two number, Percentage, Interest calculation, Examples
Lecture 44	Sample program use of mathematical functions, Basic structure of C programs
Lecture 45	Discuss onNewton Raphson method,
Lecture 46	C- Programming onsolution of transcendental and algebraic equations byNewton Raphson method
Lecture 47	Discuss onRegula Falsi method
Lecture 48	C- Programming onsolution of transcendental and algebraic equations byRegula Falsi method
Lecture 49	Discuss onGaussian elimination method
Lecture 50	C- Programming onsolution of system of linear equations by Gaussian elimination method
Lecture 51	Discuss onGauss-Seidel method
Lecture 52	C- Programming onsolution of system of linear equations by Gauss-Seidel method
Lecture 53	Discuss onLagrange Interpolation, Examles
Lecture 54	C- Programming onLagrange Interpolation

Lecture 55	Discuss onTrapezoidal Rule and composite form
Lecture 56	C- Programming onNumerical Integration by Trapezoidal Rule
Lecture 57	Discuss on Simpson's one third rule and composite form
Lecture 58	C- Programming on Numerical Integration by Simpson's one third rule
Lecture 59	Discuss on RungeKutta method
Lecture 60	C- Programming onsolution of ordinary differential equations by Runge Kutta method

Semester : III
Paper : BMH3SEC11 (Logic & Sets)
Total Lecture Hours = 40

Unit 1	**Total Lectures =18**
Lecture Serial	**Topics of Discussion**
Lecture 1	Introduction, Proposition with examples
Lecture 2	Truth table, negation, conjunction and disjunction
Lecture 3	Some examples of truth tables of some logical expressions
Lecture 4	Implications with examples and it's truth table
Lecture 5	Biconditional properties with examples
Lecture 6	Converse of a logical statement
Lecture 7	Contrapositive and inverse of a proposition
Lecture 8	Precedence of logical operators with examples
Lecture 9	Tautology and Contradiction
Lecture 10	Some more examples o tautologies and contradictions
Lecture 11	Propositional equivalence and Logical equivalence
Lecture 12	Some examples of pair of Logically equivalent statements
Lecture 13	D' Morgan's laws
Lecture 14	Quantifiers: Introduction and examples
Lecture 15	Existence and universal quantifiers with examples
Lecture 16	Negation of quantified statements
Lecture 17	Binding variables and negations
Lecture 18	Miscellaneous problems
Unit 2	**Total lectures =07**
Lecture Serial	**Topics of Discussion**
Lecture 19	Sets and sub sets with examples
Lecture 20	Set operations and the laws of set theory and Venn diagrams
Lecture 21	Examples of finite and infinite sets
Lecture 22	Finite sets and counting principle
Lecture 23	Empty set, properties of empty set.
Lecture 24	Standard set operations.
Lecture 25	Classes of sets. Power set of a set.
Unit 3	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 26	Difference of two sets with examples

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Lecture 27	Symmetric difference of two sets with examples
Lecture 28	Set identities
Lecture 29	Generalized union and intersections
Lecture 30	Cartesian product and relation between two sets
Lecture 31	Relation on a set. Types of relations, equivalence relations
Lecture 32	Some examples of equivalence relations
Lecture 33	Equivalence class with examples
Lecture 34	Partitions of a set and relation between partition and equivalence relation
Lecture 35	Congruence relation with examples
Lecture 36	Some theorems on congruence relation
Lecture 37	Partial order relation with examples
Lecture 38	Poset and Latice with examples
Lecture 39	Covering diagram and some problems on Poset and Latice
Lecture 40	n- ary relations

Semester : IV
Paper : BMH4CC08 (Riemann Integrations and Series of functions)
Total Lecture Hours = 60

Unit 1(Riemann Integration)	**Total Lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 1	Introduction and definition of Riemann Integration
Lecture 2	Refinement of a partion Norm of a partion.Inequalities of Upper and Lower sums
Lecture 3	Finding of value of some integrals by Riemann’s definitions
Lecture 4	Some more problems related to upper and lower sums and refinement and finding integrals
Lecture 5	Condition of integrability and related problems
Lecture 6	Darboux theorem and another definition of integrability : $U(P,f) - L(P,f) < \varepsilon$
Lecture 7	Solving some problems using Darboux theorem and the another definition of integrability
Lecture 8	Riemann integrability of monotone and continuous functions
Lecture 9	Definition of piecewise continuity and integrability of piecewise continuous function with examples
Lecture 10	Integrability of a function f on $[a,b]$, where f has an infinite sub set S of $[a,b]$ as the points of discontinuity with limit points of S is finite with examples
Lecture 11	Some examples and problems related to the previous theorems
Lecture 12	Integrability of sum, difference of two integrable functions with examples and counter example . Integrability of scalar multiplication of an integrable function
Lecture 13	Integrability of product and ratio of two integrable functions with

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	examples and counter examples
Lecture 14	Integrability of modulus function of an integrable function and showing it's converse is not true with counter examples
Lecture 15	The theorems related to $\int_a^b f = \int_a^c f + \int_c^b f$ and some examples
Lecture 16	Some inequalities like $\int_a^b f \geq 0$, if $f(x) \geq 0$ on $[a,b]$; $\int_a^b f \geq \int_a^b g$, if $f(x) \geq g(x)$ on $[a,b]$; $\mid \int_a^b f \mid \leq \int_a^b \lvert f \rvert$
Lecture 17	Fundamental theorems of Integral Calculus and concept of antiderivatives of a function with examples
Lecture 18	The relation between integrability and existence of antiderivative with some examples
Lecture 19	1^{ST} MVT of integral calculus with some applications
Lecture 20	2^{ND} MVT of integral calculus with some applications
Unit 2 (Improper Integrals)	**Total lectures =07**
Lecture Serial	**Topics of Discussion**
Lecture 21	Introduction of Improper integrals and different types with examples
Lecture 22	Convergence of Improper integrals of type 1 when the interval of integration is bounded, but integrand is not bounded. Some theorems and problems
Lecture 23	Some more results and problems of type 1 improper integrals
Lecture 24	Improper integrals of type 2 when the interval of integrations is unbounded. Some theorems and problems
Lecture 25	Abel's and Dirichlet's test and their applications
Lecture 26	Introduction and convergence of Beta function and it's properties
Lecture 27	Introduction and convergence of Gamma function and it's properties. Applications of Beta and Gamma functions
Unit 3 (Sequence and Series of functions)	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 28	Introduction of Sequence of functions with some examples
Lecture 29	Pointwise and uniform convergence of sequence of functions with examples
Lecture 30	Some problems related to pointwise and uniform convergence of sequence of functions
Lecture 31	Cauchy criterion and some theorems and examples
Lecture 32	Some more problems on convergence of sequence of functions
Lecture 33	Boundedness and continuity of uniform limit functions of a sequence of bounded or continuous functions
Lecture 34	Some more explanations with examples related to previous topic
Lecture 35	Integrability and differentiability of limit function
Lecture 36	Some more explanations with examples related to term-by-term integrations and differentiations
Lecture 37	Introduction of series of functions and it's partial sum with examples
Lecture 38	Pointwise and uniform convergence of series of functions with some examples

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Lecture 39	Cauchy's principle and Weierstrass' M-test for uniform convergence with some examples
Lecture 40	Some problems for testing of uniform convergence by Cauchy's principle and Weierstrass' M-test
Lecture 41	Consequences of uniform convergence
Lecture 42	Abel's and Dirichlet's tests and their applications
Unit 4 (Fourier Series)	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 43	Introduction of Fourier Series of a periodic function of period 2π in $[-\pi,\pi]$ and determining the coefficients a_0, a_n, b_n
Lecture 44	Determining of Fourier series of some functions
Lecture 45	Determining of Fourier Series of odd and even functions with examples
Lecture 46	Dirichlet's conditions and the main theorem related to convergence of Fourier Series
Lecture 47	Some problems of finding Fourier Series and convergence of the series and some deductions
Lecture 48	The half range series in $[0,\pi]$: Expansion of a function in sine and cosine series in $[0,\pi]$
Lecture 49	Some more problems of finding Fourier series and their convergence and sine, cosine series
Lecture 50	Fourier Series of a function in $[0,2\pi]$ of period 2π with examples
Lecture 51	Fourier Series of a periodic function of period $2l$ in arbitrary interval $[-l,l]$ with examples
Lecture 52	Some miscellaneous problems on Fourier Series
Unit (Power Series)	**Total lectures =08**
Lecture Serial	**Topics of Discussion**
Lecture 53	Introduction of Power Series with examples
Lecture 54	Some theorems on convergence and divergence of Power series with examples
Lecture 55	Definition of radius of convergence and interval of convergence with some examples
Lecture 56	Cauchy-Hadamard theorem and Ratio test for finding radius of convergence
Lecture 57	Some problems of finding radius of convergence and interval of convergence
Lecture 58	Some properties of power series: Differentiation and Integration of power series
Lecture 59	Abel's Theorems and their applications
Lecture 60	Weierstrass' approximation theorem and it's applications

Lesson Plan
Subject: Mathematics (Hons.)

Semester : IV
Paper : BMH4CC09 (Multivariate Calculus)
Total Lecture Hours = 60

Unit 1	Total Lectures =25
Lecture Serial	**Topics of Discussion**
Lecture 1	Functions of several variables: Introduction with some examples
Lecture 2	Limit of a function with n variables with some examples
Lecture 3	Some examples of non-existence of limit
Lecture 4	Concept of repeated limit and simultaneous limit with examples
Lecture 5	Continuity of a function of several variables with examples
Lecture 6	Some more examples and problems related to continuity
Lecture 7	Definition of partial derivatives of a function of several variables with examples
Lecture 8	Some problems on partial derivatives
Lecture 9	Some more problems on partial derivatives
Lecture 10	Concept of directional derivatives and gradient with examples
Lecture 11	Some examples related to partial derivatives and directional derivatives
Lecture 12	Concept of total differential with examples
Lecture 13	Some theorems and problems on total differentiability
Lecture 14	Sufficient condition for differentiability with some illustrated examples
Lecture 15	Chain rules: Results and some problems
Lecture 16	Some more problems using chain rules
Lecture 17	Definition of homogeneous function and Euler's theorem
Lecture 18	Some problems using Euler's theorem
Lecture 19	The converse of Euler's theorem and related problems
Lecture 20	Schwartz theorem and some related problems
Lecture 21	Jacobian : Some results and problems
Lecture 22	Some more problems on Jacobian
Lecture 23	Maximal and normal property of gradients and tangent planes
Lecture 24	Extrema of a function of n variables with some examples
Lecture 25	Method of Lagrange multipliers with some related problems
Unit 2	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 26	Introduction of Double integration with examples
Lecture 27	Double integration over rectangular region with some examples
Lecture 28	Double integration over non rectangular region with some examples
Lecture 29	Some miscellaneous problems on Double integration
Lecture 30	Some more problems on double integration
Lecture 31	Double integration in polar co-ordinates with some illustrated examples
Lecture 32	Some more problems on double integration in polar co-ordinates
Lecture 33	Introduction of Triple integrals with examples
Lecture 34	Triple integrals over a parallelopiped with some illustrated examples
Lecture 35	Triple integrals over a solid region with some illustrated examples

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Lecture 36	Volume of a solid by triple integrals with some examples
Lecture 37	Cylindrica and spherical polar co-ordinate system in three dimensions
Lecture 38	Some problems in cylindrical and spherical polar co-ordinate system
Lecture 39	Change of variables in double and triple integration with some illustrative examples
Lecture 40	Some miscellaneous problems on multiple integrals
Unit 3	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 41	Gradient of a scalar function with examples
Lecture42	Directional derivatives with examples
Lecture 43	Divergence and curl of a vector function with examples
Lecture 44	Some theorems on divergence and curl of a vector function
Lecture 45	Some problems on divergence and curl
Lecture 46	Solenoidal and irrotational vector fields with examples
Lecture 47	The concept of line integrals, fundamental theorem of line integrals
Lecture 48	Some problems on line integrals
Lecture 49	Definition of conservative field with examples
Lecture 50	Application of line integrals to work done
Unit 4	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 51	Concept of surface integrals with some illustrated examples
Lecture 52	Some more problems on surface integrals
Lecture 53	Green's theorem with examples
Lecture 54	Applications and verifications of Green's theorem with some illustrative examples
Lecture 55	Some more problems on Green's theorem
Lecture 56	The concept of volume integrals with examples
Lecture 57	Gauss's divergence theorem with examples
Lecture 58	Verifications and applications of divergence theorem with some illustrated examples
Lecture 59	Stoke's theorem , verifications of Stoke's theorem with some examples
Lecture 60	Some application of Stoke's theorem

Lesson Plan
Subject: Mathematics (Hons.)

Semester: IV
Paper: BMH4CC10 (Ring Theory and Linear Algebra I)
Total Lectures = 60

Unit- 1	**Total Lectures =15**
CONTENTS Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Definition of ring, simple examples. **Definition**: Commutative ring, ring with unity; examples of commutative ring, non-commutative rings and ring with unity. **Trivial** and **non-trivial** rings, ring of **real matrices**, ring of **integers** and ring of **integer modulo** ***n***. Ring of **Gaussian** integers, ring of **Gaussian** numbers and ring of **Quaternions**.
Lecture 2	**Polynomial** rings and ring of **continuous function**. **Theorem:** Multiplicative identity in a ring is unique. Other important properties of ring. **Theorem: In a** $\boldsymbol{R, a.0 = 0.a = 0, \forall a \in R; a.(-b) = (-a).b = -(a.b), \forall a, b \in R; (-a).(-b) = a.b, \forall a, b \in R}$. Discussion on simple properties of rings.
Lecture 3	**Definition**: Left and right **Divisor of zero** and examples. Examples of rings with and without **Divisor of zero.** **Theorem:** Cancellation Law holds in a ring. Verification of cancellation law with some examples. **Theorem:** A non-trivial finite ring having no divisor of zero is a ring with unity. Verification of this theorem with some examples of integration of vector valued function. **Definition**: **Units**. To find the units in the ring $(\boldsymbol{Z}, +, .), (\boldsymbol{R}, +, .), (\boldsymbol{Q}, +, .), (\boldsymbol{Z_n}, +, .)$ etc.
Lecture 4	Few theorems on unit of a ring and discussing some important problems. **Definition**: **Characteristic** of a ring. **Theorem:** Let ***R*** be a ring with unity ***I***. If ***n*** be the least positive integer for which ***nI*=0**, then *char* ***R*=*n***. If There does not exist a positive integer ***n*** for which ***nI*=0** holds, then *char* ***R***=0. Some more problems.
Lecture 5	**Definition**: Subring, Discussion on subring with examples. Definition and examples of **trivial**, **non-trivial** and **improper** subrings**.** Condition that a non empty subset ***S***, of a ring ***R*** to be a subring of ***R*** and discussing with examples. Theorem and important properties of subring. Problems. Definition of **factor ring** with examples.
Lecture 6	Definition of **Integral domain** with examples. Realizing Z_n is an integral domain when n is prime. Discussion on simple properties of an integral domain. Considering more examples for clear understanding the integral

	domain.
Lecture 7	**Theorem:** The characteristic of an integral domain is either zero or a prime number. **Definition**: Skew field, examples of skew field. Few theorems and discussing some important problems.
Lecture 8	Definition of **Field** with examples. Understanding the field of **Real, Rational** and **Complex** numbers. To understand that "**A field is an integral domain**" but an integral domain may not be a field.
Lecture 9	Discussing that a **finite integral domain** is a field. $\boldsymbol{Z_p}$ is a field when $\boldsymbol{p}$ is prime. **Theorem:** The characteristic of a field domain is either zero or a prime number. Problem discussion.
Lecture 10	**Theorem:** A finite division ring is a field. **Theorem:** If $\boldsymbol{p}$ is a prime number then $\boldsymbol{p}$ is divisor of ($\boldsymbol{p}$-1)! +1. **Theorem:** If n is a positive integer and a is any integer prime to n, then $a^{\varphi(n)} \equiv 1\ (mod\ n)$, where $\varphi(n)$is the number of positive integers less than n and prime to n.
Lecture 11	**Definition**: Ideals. Examples of Ideals. Definition and examples of **trivial**, **non-trivial** and **improper** Ideals**.** Condition that a non empty subset $\boldsymbol{S}$, of a ring $\boldsymbol{R}$ to be an Ideals of $\boldsymbol{R}$ and discussing with examples. **Operations on Ideals:** Sums and products of ideals; Intersections of ideals.
Lecture 12	Theorems and simple properties of ideal. Ideal generated by a subset of a ring.
Lecture 13	Definition of **Principal** ideals with examples, definition of **Principal** ideal ring and **Principal** ideal of the ring ***Z.*** Problem discussion.
Lecture 14	Definition of **Prime** ideals with examples, definition of **Prime** ideal ring and **Prime** ideal of the ring ***Z.*** Problem discussion.
Lecture 15	Definition of **Maximal** ideals with examples, definition of **Maximal** ideal ring and **Maximal** ideal of the ring ***Z.*** Problem discussion.
Unit- 2	**Total Lectures =10**
CONTENTS Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.	
Lecture 16	Brief discussion on group homomorphisms, monomorphism, epimorphism and isomorphism. **Definition:** Ring homomorphisms. Examples.
Lecture 17	**Definition:** Ring monomorphism, epimorphism and isomorphism. Examples of monomorphism, epimorphism and isomorphism.
Lecture 18	Few important theorems and some properties of ring homomorphism.
Lecture 19	Definition of ***kernel*** and examples. **Theorem:** Let R and R'be two rings and $\varphi: R \to R'$be a homomorphism. Then *ker* φ is an ideal of R. **Theorem:** Let R and R' be two rings and $\varphi: R \to R'$ be an onto

	homomorphism. Then φ is an isomorphism if and only if $ker\ \varphi=\{0\}$.
Lecture 20	Some more useful theorems and properties. Important problems.
Lecture 21	**First Isomorphism Theorem:** Let R and R' be two rings and $\varphi: R \to R'$ be a homomorphism. Then $R/\ker\varphi \cong Im(\varphi)$. Solving problems by application of First Isomorphism Theorem.
Lecture 22	**Second Isomorphism Theorem**: Let R be a ring, let S ⊂ R be a subring, and let I be an ideal of R. Then: (1) S + I = {s + a : s ∈ S, a ∈ I} is a subring of R, (2) S ∩ I is an ideal of S, and (3) (S + I)/I is isomorphic to S/(S ∩ I). Solving problems by application of Second Isomorphism Theorem.
Lecture 23	**Theorem:** Let R and R' be two rings and $\varphi: R \to R'$ be an onto homomorphism. Let I be an ideal of R such that $\ker\varphi \leq I, \sigma$ and σ' are natural homomorphisms of R onto R/I and R' onto $R'/f(I)$, respectively. Then there exists a unique isomorphism θ of R/I onto $R'/f(I)$ such that $\sigma' o\varphi = ho\sigma$. **Third Isomorphism Theorem:** Let I_1, I_2 be ideals of a ring R such that $I_1 \leq I_2$. Then $(R/I_1)/(I_2/I_1) \cong R/I_2$.
Lecture 24	Solving problems by application of Third Isomorphism Theorem. Discussing more problems. **Embedding** of rings, understanding extension of a ring. **Theorem:** A ring R can be embedded in a ring S with unity.
Lecture 25	**Theorem:** An integral domain can be embedded in a field. **Field of quotients.** **Theorem:** The field of quotients F of an integral domain D is the smallest field containing D. **Example:** Finding the field of quotients of the integral domain Z. More problems.
Unit- 3	**Total Lectures =12**
CONTENTS Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, extension, deletion and replacement theorems.	
Lecture 26	Brief discussion on Real and Complex field. Binary composition, External composition. Definition of Vector space $\boldsymbol{V}$ over a field $\boldsymbol{F}$. Examples of different vector spaces, some important properties of vector space, few useful theorems.
Lecture 27	**Definition:** Subspace of a vector space, Examples, Few theorems on subspace. **Theorem:** The intersection of a family of subspaces of a vector space is a subspace of that vector space. **Theorem:** The union of two subspaces of a vector space is not, in general a subspace of that space.

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	Algebra of subspaces: Linear sum of subspaces. Theorems and examples.
Lecture 28	**Definition:** *Linear combination, linear span, spanning set*. Examples for clear understanding of these definitions. **Theorem:** Let V be a vector space over a field F and let S be a non-empty subset of V. Then the set W of all linear combinations of the vectors in S forms a subspace of V and this is the smallest subspace containing the set S. Problem discussion.
Lecture 29	*Linear dependence* and *linear independence*, verification with examples. **Theorem:** If the set of vectors $\{\alpha_1, \alpha_2, \ldots\ldots, \alpha_n\}$ in a vector space V over a field F be linearly dependent, then at least one of the vectors of the set can be expressed as a linear combination of the remaining others. **Deletion Theorem**.
Lecture 30	Proof of **Deletion Theorem**. Solving problems by applying **Deletion Theorem**. *Basis and Dimension*. Example of *bases* for a vector space and the corresponding dimension of the vector space.
Lecture 31	Finite and infinite dimensional vector spaces. Example of finite and infinite dimensional vector spaces. Proof of **Replacement Theorem.** Solving problems by applying **Replacement Theorem.**
Lecture 32	Important theorem on basis and dimension. Discussing more problems.
Lecture 33	Proof of **Extension Theorem**. Application of **Extension Theorem** to solve various problems. **Coordinates of vectors**.
Lecture 34	Complement of a subspace. **Theorem:** If U and W be two subspace of a finite dimensional vector space V over a field F. Then $\dim(U+W) = \dim U + \dim W - \dim(U \cap W)$. Examples.
Lecture 35	Definition of complement. Direct sum. **Theorem:** If V be a finite dimensional vector space and U and W are complements to each other in V, then $\dim V = \dim U + \dim W$. Problem discussion.
Lecture 36	**Quotient Space** definition and properties of quotient space. Theorem: Let V be a vector space over a field F and W be a subspace of V. Then $\dim V = \dim U + \dim W$.
Lecture 37	Student’s feedback. General discussion on miscellaneous problem following the content of this unit 3.

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Unit- 4	**Total Lectures =23**
CONTENTS Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations, Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.	
Lecture 38	Brief discussion on basis, dimension, finite dimensional vector spaces etc. Introduction to Linear transformations.
Lecture 39	Definition of linear transformation. Example of various type of linear transformation.
Lecture 40	**Proof:** 1.Let F be a field and let V be the space of polynomial functions f from F into F, given by $f(x) = c_0 + c_1x + \cdots + c_kx^k$ Let $Df(x) = c_1 + \cdots + kc_kx^{k-1}$. Then D is a linear transformation from V into V. 2. Let R be the field of real numbers and let V be the space of all functions from R into R which are continuous. Define T by $(Tf)(x) = \int_0^x f(t)dt$. Then T is linear transformation from V into V. More examples.
Lecture 41	Theorem on existence of unique linear transformation for two given vector space over a same field. Application of this theorem on different problems.
Lecture 42	Problem discussion.
Lecture 43	Definition of *kernel* of a linear transformation, examples, few important theorems on *kernel* of a linear transformation.
Lecture 44	Problem discussion.
Lecture 45	*Null space*, *Range space*: Definition and examples; *Nullity* and *Rank* of a linear transformation.
Lecture 46	Problem Discussion.
Lecture 47	**Proof :** Let V and W be vector space over the field F and let T be a linear transformation from V into W. Suppose that V is finite-dimensional. Then rank (T) + nullity (T)=dim V. Application of this theorem.
Lecture 48	Problem discussion.
Lecture 49	**Theorem:** If A is an $m \times n$ matrix with entries in the field F, then Row rank (A) = Column rank (A). Problem discussion.
Lecture 50	**Algebra of Linear Transformation:** Addition of two linear transformations, multiplication of linear transformations. Important properties and theorems.
Lecture 51	Problem discussion.
Lecture 52	Invertibility of linear transformation, non-singular linear transformation, theorem and properties.

Lecture 53	Problem discussion.
Lecture 54	**Theorem:** Let V and W be finite-dimensional vector space over the field F such that dim (V) =dim (W).If T is linear transformation from V into W, the following are equivalent: i. T is invertible ii. T is non-singular iii. T is onto.
Lecture 55	**Isomorphism:** Definition and examples. **Theorem:** Let V and W be finite-dimensional vector space over the field F .Now V and W will be isomorphic *iff* dim (V) =dim (W). Few more theorem and properties.
Lecture 56	Problem discussion.
Lecture 57	**Theorem:** Let V be an n dimensional vector space over the field F. Then V is isomorphic to F^n. More theorem and properties.
Lecture 58	Matrix representation of a linear transformation. Results and properties. Algorithm for finding matrix for a given linear transformation.
Lecture 59	Dealing with few interesting Problem.
Lecture 60	Student's feedback. General discussion on miscellaneous problem following the content of this unit 4.

Semester: IV
Paper: BMH4SEC21 (Graph Theory)
Total Lecture Hours = 40

Unit 1	**Total Lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 1	Some basic definitions like vertex, edges etc. with examples
Lecture 2	Some basic properties related to vertices and edges of graph and their examples
Lecture 3	Concept of Pseudo graph and examples
Lecture 4	Some problems on graph and pseudo graph
Lecture 5	The idea of complete graph and examples
Lecture 6	Some theorems, examples and problems of complete graph
Lecture 7	Connected and Bi-partite graphs : Definition and some examples and some theorems
Lecture 8	Some more theorems and problems on bi-partite graphs
Lecture 9	The concept of isomorphism between two graphs with examples
Lecture 10	Some more examples of isomorphic and non-isomorphic graphs
Unit 2	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 11	Definitions of path, circuit, cycles, closed path and their examples
Lecture 12	The introduction of Konigsberg's bridge problem and the origin of graph theory

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Lecture 13	Definition of Eulerian circuits and Eulerian graphs with examples
Lecture 14	Some theorems and problems on Eulerian graph and the conclusion of the Konigsberg’s bridge problem.
Lecture 15	Semi-Eulerian graph and related theorems
Lecture 16	Some more problems on Eulerian and Semi-Eulerian graphs.
Lecture 17	Definition of Hamiltonian cycles and Hamiltonian graph with examples
Lecture 18	Some theorems and examples of Hamiltonian graph
Lecture 19	Some more theorems and problems on Hamiltonian graph
Lecture 20	The relation and comparing between Eulerian graph and Hamiltonian graph with examples
Lecture 21	The adjacence matrix with examples and some properties
Lecture 22	Some problems of finding adjacence matrix of a graph and making the diagram of a graph from it’s adjacence matrix
Lecture 23	The incidence matrix of a graph with examples and some properties
Lecture 24	Some problems of finding incidence matrix of a graph and making the diagram of a graph from it’s incidence matrix
Lecture 25	Concept of weighted graph with some examples
Unit 3	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 26	Definitions and examples of Tree
Lecture 27	Some more definitions, theorems on Tree
Lecture 28	Some results and problems on Tree
Lecture 29	Definition of spanning tree and examples
Lecture 30	Some theorems and examples of tree and spanning tree
Lecture 31	Some more theorems and problems on tree and spanning tree
Lecture 32	The definition of contracted graph with some examples
Lecture 33	Some theorems and problems related to contracted graph
Lecture 34	Cayley’s theorem
Lecture 35	Definitions of chord, fundamental cycle, o-chain, 1-chain, the boundary operator , the co-boundary operator with examples
Lecture 36	Definitions of cycle vector, cycle rank, cut-set, cotree , cocycle with examples .
Lecture 37	The concept of Travelling sale’s man problem of shortest path
Lecture 38	Dijkstra’s algorithm and it’s application to find shortest path
Lecture 39	Some more problems of finding shortest path
Lecture 40	Warshall algorithm for finding shortest path between all the pair of vertices in a weighted graph

Lesson Plan
Subject: Mathematics (Hons.)

Semester: V
Paper: BMH5CC11 (Partial differential equations)
Total Lecture Hours = 60

Unit 1	**Total Lectures =22**
Lecture Serial	**Topics of Discussion**
Lecture 1	PDE: Basic concepts and definitions
Lecture 2	The compare among complete solution, general solution, particular solution and singular solution with examples
Lecture 3	Mathematical problems
Lecture 4	1^{ST} order PDE: Classifications and geometric interpretation
Lecture 5	Constructions of PDE
Lecture 6	More problems on constructing PDE
Lecture 7	Order and degree of PDE
Lecture 8	Lagrange's method of solving 1^{ST} order PDE
Lecture 9	Some problems by Lagrange's method
Lecture 10	Some more problems by Lagrange's method
Lecture 11	Method of Characteristics for obtaining General Solution of Quasi Linear Equations
Lecture 12	More problems by characteristic method
Lecture 13	Canonical Forms of First-order Linear Equations
Lecture 14	Some more problems on canonical forms
Lecture 15	Cauchy problems of 1^{ST} order PDE
Lecture 16	More problems of Cauchy problem
Lecture 17	Method of Separation of Variables for solving first order partial differential equations
Lecture 18	Some problems by method of separation of variables
Lecture 19	More problems on method of separation of variables
Lecture 20	Charpit's method for solving 1^{ST} order PDE
Lecture 21	Different particular forms of Charpit's method
Lecture 22	Some more problems on Charpit's method
Unit2	**Total lectures =12**
Lecture Serial	**Topics of Discussion**
Lecture 23	Derivation of Heat equation
Lecture 24	Derivation of wave equation
Lecture 25	Derivation of Laplace's equation
Lecture 26	Introduction of 2^{nd} order PDE with examples
Lecture 27	Classification of second order linear equations as hyperbolic, parabolic, elliptic
Lecture 28	Reduction of second order hyperbolic Linear Equations to canonical forms.
Lecture 29	Reduction of second order parabolic Linear Equations to canonical forms.
Lecture 30	Reduction of second order elliptic Linear Equations to canonical forms.
Lecture 31	Some problems for finding nature and canonical form of 2^{nd} order linear equations
Lecture 32	Some problems for finding nature and canonical form of 2^{nd} order linear equations

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Lecture 33	Some more problems for finding nature and canonical form of 2nd order linear equations
Lecture 34	Some miscellaneous problems on 2nd order PDE
Unit 3	**Total lectures =17**
Lecture Serial	**Topics of Discussion**
Lecture 35	The Cauchy problem of 2nd order partial differential equation
Lecture 36	Cauchy-Kowalewskaya theorem with examples
Lecture 37	Cauchy problem of an infinite string
Lecture 38	Some problems on infinite string
Lecture 39	Initial and Boundary Value Problems.
Lecture 40	Semi-Infinite String with a fixed end
Lecture 41	Some problems on semi-infinite string with a fixed end
Lecture 42	Semi-infinite String with a Free end.
Lecture 43	Some problmes on semi- infinite string with a free end
Lecture 44	Finite string problems
Lecture 45	Some more problems on string
Lecture 46	Equations with non-homogeneous boundary conditions of wave equation
Lecture 47	Non-Homogeneous Wave Equation.
Lecture 48	Method of separation of variables: Solving the Vibrating String problem
Lecture 49	More problems using method of separation of variables
Lecture 50	Solving the Heat Conduction problem
Lecture 51	More problems on Heat conduction equation
Graphical Demonstration (Teaching Aid)	**Total lectures =09**
Lecture Serial	**Topics of Discussion**
Lecture 52	Solution of Cauchy problem for first order PDE.
Lecture 53	More problems on solving Cauchy problems
Lecture 54	Finding the characteristics for the first order PDE.
Lecture 55	Plotting the integral surfaces of a given first order PDE with initial data.
Lecture 56	More problems on plotting the integral surface
Lecture 57	Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: $u(x,0) = \phi(x), \quad u_x(x,0) = \psi(x), x \in R, \quad t > 0$
Lecture 58	Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: $u(x,0) = \phi(x), \quad u_x(x,0) = \psi(x), \quad u(0,t) = 0, x \in (0,\infty) \quad t > 0$
Lecture 59	Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: u(x,0) =φ(x), u (0, t) =a,u (l, t) =b, 0 < x < l, t >0.
Lecture 60	Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions: u(x,0) =φ(x), x∈R, 0 < t < T.

Lesson Plan
Subject: Mathematics (Hons.)

Semester : V
Paper :BMH5CC12 (Mechanics I)
Total Lectures = 60

Unit 1 (Analytical Statics)	**Total Lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 1	Co-planar forces, Reduction of a system of Co-planar forces
Lecture 2	Conditions equilibrium of a system of Co-planar forces
Lecture 3	Astatic equilibrium, Astatic centre, Examples
Lecture 4	Vector treatment of 2D system, Problems
Lecture 5	Problems and solution about Co-planar forces
Lecture 6	Friction, Laws of Friction, Angle of Friction, Cone of Friction, Examples
Lecture 7	Coefficient of Friction, Problems
Lecture 8	Equilibrium of a particle on a rough curve, Problems
Lecture 9	Principle of Virtual work, Virtual work a single particle
Lecture 10	The condition of equilibrium of a particle under coplanar forces from the principle of Virtual work
Lecture 11	The principle of Virtual work for a free rigid body, Application of the principle of Virtual work
Lecture 12	Problems on the principle of Virtual work
Lecture 13	Forces in three dimensions, Moment of a force about a line, Problems
Lecture 14	Equation of central axis of a given system of forces, Problems
Lecture 15	General conditions of equilibrium
Lecture 16	Stable and unstable equilibrium, The energy test of stability
Lecture 17	A perfectly rough heavy body rests in equilibrium on a fixed body, whether the equilibrium is Stable or unstable, Problems
Lecture 18	Centre of gravity(CG) of some elementary bodies, Problems
Lecture 19	CG of continuous distribution of matter, CG of any arc of a plane curve, Problems
Lecture 20	Equilibrium of flexible string, Problems
Unit 2 (Dynamics of a particle)	**Total lectures =25**
Lecture Serial	**Topics of Discussion**
Lecture 21	Fundamental concept in particle dynamics
Lecture 22	Simple harmonic motion, Problems
Lecture 23	Damped Harmonic motion
Lecture 24	Force Oscillation, Damped and forced oscillation, Problems
Lecture 25	Radial and cross radial components of velocity and acceleration,Problems
Lecture 26	Motion in 2D, Examples
Lecture 27	Equations of motion referred to a set of rotating axes
Lecture 28	Projectile motion, Problems
Lecture 29	Motion of a projectile in a resisting medium, Problems
Lecture 30	Central Orbit, Differential equation of Central Orbit,

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Lecture 31	Differential Equation of Central orbit in Pedal form, Significant of 'h', Angular momentum,
Lecture 32	Apse, Apsidal distance, Apsidal angle, Problems
Lecture 33	Some problem and solution on Central Orbit
Lecture 34	Stability of nearly circular orbits
Lecture 34	Motion under the inverse square law, Problems
Lecture 35	Kepler's laws of planetary motion, Modification of Kepler's 3rd law
Lecture 36	Verification of Kepler's Laws from Newton's Gravitational law, Verification of Newton's Gravitational law from Kepler's Laws, Planet has only radial acceleration towards the sun, Time of describing, Problems
Lecture 37	Slightly disturbed orbits
Lecture 38	Motion of artificial satellites
Lecture 39	Tangent and normal Velocity and acceleration , Examples
Lecture 40	Tangent and normal equation of motion of particles, Examples
Lecture 42	Motion Varying mass
Lecture 43	Motion of a particle in three dimensions.
Lecture 44	Motion on a smooth sphere, cone of revolution
Lecture 45	Motion on a smooth any surface of revolution, Problems
Unit 3 (Rigid Dynamics)	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 46	Moment of Inertia(MI), MI of a system of particle, Rigid body, MI of aa rigid body, MI and Product of Inertia(PI) about rectangular axes
Lecture 47	MI of rod, rectangular plate, circular plate, Circular were, Right circular cylinder, cone
Lecture 48	Some problem related to MI and PI
Lecture 49	Theorem of parallel axes
Lecture 50	Inertial Matrix, Momental Ellipsoid
Lecture 51	Momental Ellipsoid of an elliptic plate, solide ellipsoid
Lecture 52	Some other problem related to Momental Ellipsoid
Lecture 53	Principal axes, Principal Moment
Lecture 54	Some problem on principal axes
Lecture 55	D'Alembert's Principle, Problems
Lecture 56	Motion about a fixed axis, Compound pendulum
Lecture 57	Centre of mass of a system of particles, Equation of motion of a system of particles, K.E of a system of particles
Lecture 58	Linear momentum, angular momentum of a system of particles, Principal of conservation of linear and angular momentum
Lecture 59	Motion of a rigid body in two dimensions under finite and impulsive forces, K.E of a rigid body moving in 2D is $\frac{1}{2}Mv^2 + \frac{1}{2}MK^2\dot{v}^2$
Lecture 60	Conservation of momentum and energy

Lesson Plan
Subject: Mathematics (Hons.)

Semester: V
Paper: BMH5DSE11 (Linear Programming)
Total Lectures = 60

Unit 1	**Total Lectures =22**
CONTENTS Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.	
Lecture Serial	**Topics of Discussion**
Lecture 1	Preliminary Discussions (Relating to Application)
Lecture 2	Problems of Linear Programming, Formulation of L.P.P
Lecture 3	Graphical method of solution of LPP, Nature of Solutions, Application to real world problems.
Lecture 4	Mathematical preliminaries: Basic concept of vector spaces. Subspaces, linear combination.
Lecture 5	Linear dependence and linear independence, basis, dimension and explanation with examples. Rank of matrices, Inverse of matrices and method of finding them.
Lecture 6	Definition and examples of BFS, Convex combination, convex set and few important results.
Lecture 7	Definition and examples of extreme point, convex hull, convex polyhedron. Standard form of LPP, examples.
Lecture 8	**Theory of simplex method:** Fundamental theorem of LPP, reduction of feasible solution to a BFS. Standard examples.
Lecture 9	Improving a BFS, Optimality condition and few important theorems and results.
Lecture 10	Unboundedness, Alternative optima and few important theorems and results.
Lecture 11	Discussion of Degeneracy in set of Solutions (Through Simplex Method).
Lecture 12	Discussing various problems on simplex method.
Lecture 13	**The simplex algorithm:** Procedural Techniques for finding BFS, Systematic rule for computation.
Lecture 14	Initial BFS, Simplex tableau.
Lecture 15	Computational procedure in simplex method.
Lecture 16	Introduction to artificial variables, Removal of artificial variables.
Lecture 17	Inconsistency and redundancy in LPP.
Lecture 18	Minimizing the number of artificial variables, examples.
Lecture 19	Introduction to two phase method: Discussion and examples.
Lecture 20	Solution of simultaneous linear equations or inequations.
Lecture 21	Big-M method: Discussion and examples.
Lecture 22	Comparison between various method for solving LPP.

Lesson Plan
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Unit 2	**Total Lectures =08**
CONTENTS Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual, Dual Simplex method.	
Lecture 23	Concept of duality, Mathematical formulation duals. Examples.
Lecture 24	Construction of duals, examples.
Lecture 25	Few theorems on duality, complementary slackness. Examples.
Lecture 26	Duality and Simplex method.
Lecture 27	Economic interpretation of duality and examples.
Lecture 28	Introduction to Dual Simplex method.
Lecture 29	Computational algorithm of Dual Simplex method, examples.
Lecture 30	Initial basic solution and examples.
Unit 3	**Total Lectures =15**
CONTENTS Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem, Travelling salesman problem.	
Lecture 31	Introduction to TPP. Mathematical formulation.
Lecture 32	The transportation type problem in LP form. Special feature of TPP.
Lecture 33	Few theorems on no. of basic variables or existence of feasible solution of a TPP. Solution of TPP is never unbounded.
Lecture 34	**Initial BFS:** Northwest-corner method, examples and results.
Lecture 35	Least cost method, examples and results.
Lecture 36	Vogel approximation method, examples and results.
Lecture 37	Optimality test of the BFS. Examples.
Lecture 38	Computational procedure and examples
Lecture 39	Degeneracy in TPP. Results, theorems and examples.
Lecture 40	Variations in transportation problem, examples.
Lecture 41	Typical problems.
Lecture 42	Introduction to assignment problem. Mathematical formulation.
Lecture 43	Important theorems and application.
Lecture 44	Hungarian method for solving assignment problem.
Lecture 45	Travelling salesman problem.
Unit 4	**Total Lectures =15**
CONTENTS Game theory: Formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.	
Lecture 46	Introduction to Game theory.
Lecture 47	Formulation of two person zero sum games, strategies.
Lecture 48	The maxmin and minmax criterion. Existence of saddle point. Examples.
Lecture 49	Game without saddle point. Further consideration of mixed strategies.

	Solution of 2 x 2 games (mixed strategies).
Lecture 50	Solution of rectangular game with mixed strategies. Examples
Lecture 51	Important theorems.
Lecture 52	Symmetric games. Concept of dominance. Examples.
Lecture 53	Theorems on dominance.
Lecture 54	General rule for dominance. Two-person, zero sum 2 x n or n x 2 games.
Lecture 55	Graphical method of solution. Examples.
Lecture 56	Algebraic method of solution. Examples.
Lecture 57	Transformation of game problem to an LPP. Examples.
Lecture 58	Fundamental theorem. Solution of a game by simplex method.
Lecture 59	Summary of the method of solution. Examples.
Lecture 60	General discussion on whole content of this unit. Solution of Problems.

Semester : VI
Paper :BMH5DSE21(Probability and Statistics)
Total Lectures = 60

Unit 1 (Probability distributions, Expectation)	**Total Lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 1	Random experiment, Trial, Event space, Event, Event point, Mutually exclusive events, Mutually exhaustive events, Classical definition of probability, Weakness of Classical definition of probability, Examples
Lecture 2	Frequency definition of probability, $0 \leq P(A) \leq 1$., for any event A **I)** $P(S) = 1, P(\emptyset) = 0, P(A \cup B) = P(A) + P(B) - P(A \cap B)$, for any events A, B. **II)** $P(\bar{A}) = 1 - P(A)$, for any event A. Conditional Probability, Random variable, Examples,
Lecture 3	Axiomatic definition of probability, Some Deductions, Independent events, Repeated independent trials, Bernoulli trials, Binomial law, Poisson approximation
Lecture 4	Cumulative distribution function (c.d.f.) or simply distribution function (d.f.), Some properties, Examples
Lecture 5	Discrete random variable, Probability mass function, Examples
Lecture 6	Discrete uniform distribution, Degenerate Distribution, Binomial Distribution, Bernoulli Distribution, some problems
Lecture 7	Negative Binomial Distribution, Poisson Distribution, Geometric Distribution, Problems
Lecture 8	Continuous Random Variables, Examples $P(X = a) = 0 \quad \forall\, a \in \mathbb{R}$. $P(a < X \leq b) = P(a \leq X \leq b) = P(a < X < b) = \int_a^b f(x)dx$ where $f(x) = F'(x)$
Lecture 9	Probability density function(f(x)), Examples, $f(x) \geq 0 \quad \forall\, x \in \mathbb{R}$. $F(x) = \int_{-\infty}^{x} f(t)dt \quad \forall\, x \in \mathbb{R}. \int_{-\infty}^{\infty} f(x)dx = 1, P(x < X \leq x + dx) = f(x)dx$

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Lecture 10	Uniform or Rectangular Distribution, Normal Distribution, Gamma Distribution, Problms
Lecture 11	Exponential Distribution,Beta Distribution of 1st kind, Beta Distribution of 2nd kind, Cauchy Distribution, Problems
Lecture 12	Transformation of random variables, Examples
Lecture 13	Mathematical Expectations, Mean of some well-known distributions
Lecture 14	Moments, Central moment, Variance, Standard deviation, S.D. of Some well-known distributions
Lecture 15	Moment generating function, Characteristic function, M.g.f. and c.f. of, some important distributions, Skewness, Kurtosis, Median, QuantileMode
Unit 2 (Two Dimensional Distribution)	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 16	Joint cumulative distribution function, $F(x,y)$ is monotonic non-decreasing in both variables x and y If $a < b,\ c < d$ then $P(a < X \leq b, c < Y \leq d) = F(b,d) + F(a,c) - F(a,d) - F(b,c)$, Examples
Lecture 17	$F(x,y)$is monotonic non-decreasing in both variables x and y. If $a < b,\ c < d$ then, $P(a < X \leq b, c < Y \leq d) = F(b,d) + F(a,c) - F(a,d) - F(b,c)$, Problems
Lecture 18	Marginal Distributions, Two random variables X and Y are independent iff their joint d.f. $F(x,y)$can be written as the product of a function of x alone and a function of y alone. If X and Y are independent then $P(a < X \leq b, c < Y \leq d) = P(a < X \leq b)P(c < Y \leq d)$
Lecture 19	Joint probability density function, Continuous distribution, Some properties of continuous distribution
Lecture 20	The variables X and Y are independent iff $f(x,y) = f_X(x)f_Y(y)$, Uniform Distribution or Rectangular Distribution, Bivariate Normal Distribution
Lecture 21	Conditional Distributions, Transformation of two random variables
Lecture 22	Expectations of bivariate, If (X,Y) be a two-dimensional random variable such that $E(X)$ and $E(Y)$ exist. Then $E(X+Y) = E(X) + E(Y)$.
Lecture 23	If (X,Y)be a two-dimensional random variable such that $E(X)$ and $E(Y)$ exist. If X and Y are independent then $E(XY) = E(X)E(Y)$, Examples
Lecture 24	Moments, Covariance, Correlation coefficient in bivariate
Lecture 25	**I)** $\mathrm{Cov}(aX+b, cY+d) = ac\,\mathrm{Cov}(X,Y)$ **II)** $\rho(aX+b, cY+d) = \frac{ac}{\lvert a\rvert\lvert c\rvert}\rho(X,Y)$, $a \neq 0,\ c \neq 0$ **III)** $-1 \leq \rho \leq 1$ Uncorrelated variables
Lecture 26	Joint Moment generating function, Problems
Lecture 27	Characteristic function,The random variables $X_1, X_2, \ldots, X_n$ are mutually independent iff their joint characteristic function is given by$\chi(t_1, t_2, \ldots, t_n) = \chi_1(t_1)\chi_2(t_2)\cdots\chi_n(t_n)$, Some problems
Lecture 28	Cauchy-Schwarz Inequality, Some Problems
Lecture 29	Conditional Expectation(Discrete and Continuous cases), Examples

Lesson Plan
Subject: Mathematics (Hons.)

Lecture 30	Regression Curves, Regression Lines, Problems
Unit 3 (Convergence and limit theorems)	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 31	Chebysheve's inequality
Lecture 32	Converge in probability , Asymptotically normal
Lecture 33	Chebysheve's Theorem
Lecture 34	Bernoulli's Theorem, Problems
Lecture 35	Statement and interpretation of (weak) law of large numbers and strong law of large numbers.
Lecture 36	Central Limit theorem for independent and identically distributed random variables with finite variance
Lecture 37	Markov Chains, Problems
Lecture 38	Infinite sequence of Markov trials
Lecture 39	Chapman-Kolmogorov equations, Problems
Lecture 40	Classification of states
Unit 4 (Statistics)	**Total lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 41	Collection of Data, Frequency distribution table
Lecture 42	Cumulative Frequency curve, Histogram
Lecture 43	Masures of Central Tendency, Mean, Median, Mode, Examples
Lecture 44	Some Problem related to Mean, Median, Mode
Lecture 45	Measures of Dispersion, Range, Quartile Deviation, Absolute Mean Deviation, Standard Deviation, Problems
Lecture 46	Coefficient of Variation, Problems
Lecture 47	Moments, Skewness, kurtosis , Problems
Lecture 48	Sampling Distribution, Population, Random Sample, Some Problems
Lecture 49	If $X_1, X_2 \ \dots . X_n$ be a random sample drawn from the population of X , then $E\left(\frac{n}{n-1}S^2\right) = E(s^2) = \sigma_X^2$
Lecture 50	Chi-square Distribution, Problems
Lecture 51	Some Properties of Chi-square Distribution
Lecture 52	Students t-distribution, Problems
Lecture 53	Theory of Estimation, Examples
Lecture 54	Point Estimation, Consistent Estimation, Unbiased Estimator, Minimum Variance Estimator, Efficient Estimator
Lecture 55	The sample mean $\bar{X}$ is an unbiased and consistent Estimator of population mean.
Lecture 56	Sample variance is a consistent estimator of population variance, Problems
Lecture 57	Likelihood function, Maximum Likelihood Estimator, Problems
Lecture 58	Interval Estimation, Confident interval for mean of $N(\mu, \sigma^2)$ population
Lecture 59	Confident interval for SD of $N(\mu, \sigma^2)$ population, Problems
Lecture 60	Testing of hypothesis, Problems

Lesson Plan
Subject: Mathematics (Hons.)

Semester: VI
Paper: BMH6CC13 (Metric spaces & Complex analysis)
Total Lecture Hours = 60

Unit 1	**Total Lectures =05**
Lecture Serial	**Topics of Discussion**
Lecture 1	Sequences in metric spaces, convergence of sequence in metric space and some theorems
Lecture 2	Cauchy sequence in a metric space with examples and some theorems
Lecture 3	Completeness of a metric space with examples
Lecture 4	Examples of incomplete metric spaces
Lecture 5	Cantor's theorem and some problems
Unit 2	**Total lectures =25**
Lecture Serial	**Topics of Discussion**
Lecture 6	Limit and continuity of a function in a metric space with examples
Lecture 7	Some theorems on limit and continuity in a metric space
Lecture 8	Sequential criterion of continuity of a function with examples
Lecture 9	Some problems related to previous topics
Lecture 10	Some more theorems on continuity
Lecture 11	Homeomorphism and homeomorphic spaces with examples
Lecture 12	Uniform continuity of a function with some examples and related theorems
Lecture 13	Connectedness in metric spaces: Definitions and some examples
Lecture 14	Some theorems on connectedness
Lecture 15	Connectedness in real line
Lecture 16	Some more theorems on connectedness
Lecture 17	$\varepsilon-$chanin and related theorems
Lecture 18	Some theorems related to continuity and connectedness
Lecture 19	Components in a metric space and related theorems
Lecture 20	Some problems on connectedness of metric spaces
Lecture 21	Compactness: cover and sub cover, open cover, compact metric space with some examples
Lecture 22	Some more examples of compact and non-compact spaces
Lecture 23	Finite intersection property and some theorems on compactness
Lecture 24	Heine-Borel theorem and some other theorems
Lecture 25	Total boundedness and some related theorems and examples defining relation between boundedness, total boundedness
Lecture 26	Sequential and B-W compactness and theorems defining mutual relation

	between total boundedness, completeness, sequential compactness, B-W compactness and compactness
Lecture 27	Theorems on continuity and compactness and some problems
Lecture 28	Definitions: weak contraction, contraction mapping and Lipschitz condition with examples
Lecture 29	Fixed point of an operator and Banach's Fixed point theorem
Lecture 30	Some applications of Banach's fixed point theorem
Unit 3	**Total lectures =07**
Lecture Serial	**Topics of Discussion**
Lecture 31	Some Historical aspects of complex numbers
Lecture 32	Properties of complex numbers
Lecture 33	Limit of a complex function with some theorems and examples
Lecture 34	Continuity of a complex function with some theorems and examples
Lecture 35	Regions in the complex plane
Lecture 36	Differentiation of complex function with examples
Lecture 37	Cauchy-Riemann equation and sufficient condition for differentiability
Unit 4	**Total lectures =13**
Lecture Serial	**Topics of Discussion**
Lecture 38	Analytic functions with examples
Lecture 39	Some more examples of analytic functions: exponential function, Logarithmic function, trigonometric functions
Lecture 40	Definite integrals of complex function with some simple problems
Lecture 41	Contour and contour integrals with some examples
Lecture 42	Some more problems on contour integrals
Lecture 43	ML formula with examples
Lecture 44	Some more problems on previous topics
Lecture 45	Cauchy-Goursat theorem and it's consequences
Lecture 46	The important result $\int_{\gamma}\frac{1}{(z-z_0)^n}dz=\begin{cases}2\pi i, & n=1\\ 0, & n\neq 1\end{cases}$ and some problems
Lecture 47	Cauchy integral formula and it's applications
Lecture 48	The derivative formula and it's applications
Lecture 49	The higher derivative formula and it's applications
Lecture 50	Some miscellaneous problems
Unit 5	**Total lectures =06**
Lecture Serial	**Topics of Discussion**
Lecture 51	Cauchy' inequality and Liouville's theorem
Lecture 52	Fundamental theorem of algebra
Lecture 53	Maximum modulus theorem and it's applications
Lecture 54	Convergence of sequence and series of functions in complex space
Lecture 55	Taylor's series expansion of complex functions
Lecture 56	Some problems on Taylor's series expansion
Unit 6	**Total lectures =04**

Lesson Plan
Subject: Mathematics (Hons.)

Lecture Serial	Topics of Discussion
Lecture 57	Laurent series expansion of complex functions
Lecture 58	Some problems on Laurent series expansion
Lecture 59	Power series and radius of convergence of power series
Lecture 60	Convergence and uniform convergence of Power series, Cauchy Hadamard theorem and it's applications

Semester: VI
Paper: BMH6CC14 (Ring Theory and Linear Algebra II)
Total Lectures = 60

Unit- 1(Rings and Field)	**Total Lectures =20**
CONTENTS Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z[x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.	
Lecture Serial	**Topics of Discussion**
Lecture 01	Few preliminary definitions and examples on integral domain.
Lecture 02	Definition and few properties of **divisibility**. Definition and examples of **units** and **associates** in an integral domain. Some theorems.
Lecture 03	Finding units in the integral domain ***Z*[*i*]** and ***Z*[*x*]**. Multiplicative norm function on an integral domain. Definition and examples of **greatest common divisor** (*gcd*), **least common multiple** (*lcm*) and **irreducible element** on an integral domain.
Lecture 04	Introduction to ***UFD*** (Unique Factorization Domain). Definition and examples. Definition and examples of **prime element** in an integral domain. **Theorem:** In an integral domain, every prime element is an irreducible element
Lecture 05	Some more theorems on ***UFD***.
Lecture 06	Discussion of some interesting problems on ***UFD.***
Lecture 07	A very short discussion on some interesting results of ideals and examples.
Lecture 08	Introduction to ***PID*** (Principal Ideal Domain). Definition and examples. Discussing ***Z***[*x*] is an integral domain but not ***PID.***
Lecture 09	Discussing theorems and results on ***PID.***
Lecture 10	**Theorem**: A ***PID*** is an ***UFD***. **Theorem**: In a ***PID*** an irreducible element is a prime element.
Lecture 11	Discussion of some interesting problems on ***PID.***
Lecture 12	Introduction to ***Euclidean Domain***. Definition and examples. Discussing a field is a ***Euclidean Domain.***
Lecture 13	**Theorem**: Every ***Euclidean Domain*** is a ***PID.*** Few more theorems and results.
Lecture 14	***Euclidean algorithm*** and discussing various problems on ***Euclidean***

Lesson Plan
Subject: Mathematics (Hons.)

	Domain.
Lecture 15	Basic discussion on commutative ring. Definition of Polynomial rings over commutative rings, few examples.
Lecture 16	**Theorem**: Let R be an integral domain. Then deg (fg) = deg(f) + deg(g). **Theorem**: Let R be an integral domain. (a) Then $R[x]$ is an integral domain. (b) The units in $R[x]$ are precisely the constant polynomials that are also units in R.
Lecture 17	More theorem and problems on polynomial ring.
Lecture 18	***Division algorithm*** and consequences. **Theorem**: If F be a field, then $F[x]$ is a Euclidean domain.
Lecture 19	Definition of **reducible polynomial**, **irreducible polynomial** and **zero of a polynomial** $f(x)$ in $F[x]$. Few theorems and examples.
Lecture 20	***Eisenstein criterion.*** Discussion of some interesting problems.
Unit- 2	**Total Lectures =20**
CONTENTS Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.	
Lecture 21	Brief discussion on Linear transformations, Linear Operators.
Lecture 22	Linear **functional, Dual** space and **Dual** basis, few theorems.
Lecture 23	Few more important theorems on **Dual** basis and examples.
Lecture 24	**Annihilators** **Theorem:** Let V be a finite-dimensional vector space over a field F, and let W be a subspace of V. Then dim W + dim W^0 = dim V.
Lecture 25	Problem discussion on linear functional, dual basis and annihilators.
Lecture 26	The **double dual**, theorems and problems.
Lecture 27	The transpose of a linear transformation, theorems and problems.
Lecture 28	Matrix representation of the **transpose of a linear transformation** in dual basis, examples.
Lecture 29	Polynomials Applied to Operators, algebra of polynomials.
Lecture 30	**Eigen spaces of a linear operator:** Definition and examples of Eigen values, eigen vectors, few important theorems.
Lecture 31	**Multiplicity:** Algebraic and Geometric multiplicity, Important theorems and results.
Lecture 32	Characteristic value of a linear operator, Theorems, Examples.
Lecture 33	**Diagonalizability**, Theorems and examples.
Lecture 34	The **minimal polynomial** for a linear operator, Theorems and examples.
Lecture 35	**Cayley-Hamilton theorem** and its applications.
Lecture 36	**Invariant Subspaces**, Invariant Subspaces on Real Vector Spaces, Theorems and examples.
Lecture 37	Problem discussion on Diagonalizability, Invariant Subspaces etc.
Lecture 38	**Canonical forms**
Lecture 39	Problems and solution.

Lesson Plan
Subject: Mathematics (Hons.)

Lecture 40	Student's feedback. General discussion on miscellaneous problem following the content of this unit 3.
Unit- 3	**Total Lectures =20**
CONTENTS Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.	
Lecture 41	Definition and examples of Real Inner Products, and Complex Inner Products. Standard inner product.
Lecture 42	Few deductions. **Euclidean** and **Unitary** space.
Lecture 43	Definition of **Norm** of a vector. Few Theorems. **Schwarz's** inequality.
Lecture 44	**Unit** vector, **Triangular** inequality, **Pythagoras** theorem and **Parallelogram** law.
Lecture 45	Definition and examples of **orthogonal** and **orthonormal** basis in a Euclidean space. Few theorems and properties.
Lecture 46	**Gram-Schmidt** orthogonalisation process and few related theorms.
Lecture 47	Application of Gram-Schmidt orthogonalisation process.
Lecture 48	**Bessel's** inequality, **Parseval's** theorem.
Lecture 49	**Orthogonal complements** of a subspace, few standard theorems.
Lecture 50	Dealing with various problems of inner product space.
Lecture 51	Linear Functionals and Adjoints, adjoint of a linear operator.
Lecture 52	Few Theorems and examples.
Lecture 53	Method of **Least Squares Approximation** with applications.
Lecture 54	On **minimal solutions** of systems of linear equations with applications.
Lecture 55	Orthogonal Projections and Minimization Problems.
Lecture 56	Normal and self-adjoint operators-I.
Lecture 57	Normal and self-adjoint operators-II.
Lecture 58	The **Spectral Theorem** with applications.
Lecture 59	Normal Operators on Real Inner-Product Spaces.
Lecture 60	Student's feedback. General discussion on miscellaneous problem following the content of this unit 3.

Lesson Plan

Subject: Mathematics (Hons.)

Semester : VI

Paper : BMH6DSE33 (Group Theory II)

Total Lecture Hours = 60

Unit 1	**Total Lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 1	Automorphism and inner automorphism with some examples
Lecture 2	Some theorems on automorphism
Lecture 3	Automorphism groups of finite cyclic groups with examples
Lecture 4	Some theorems on previous topic
Lecture 5	Automorphism groups of infinite cyclic groups with examples
Lecture 6	Some theorems on previous topic
Lecture 7	Factor groups with examples
Lecture 8	Factor groups to automorphism groups and some theorems
Lecture 9	Applications of factor groups to automorphism groups
Lecture 10	Some problems related to previous topics
Lecture 11	Some more problems on automorphism
Lecture 12	Commutator subgroups with examples
Lecture 13	Some properties of commutator subgroup
Lecture 14	Some more theorems on commutator subgroup
Lecture 15	Some problems on commutator subgroup
Unit 2	**Total lectures =10**
Lecture Serial	**Topics of Discussion**
Lecture 16	External direct product of groups: Definition and examples
Lecture 17	Some theorems and concept of internal direct product
Lecture 18	Some theorems on direct product
Lecture 19	Some problems on direct product
Lecture 20	Some more problems on direct product
Lecture 21	The group of units modulo n as an external direct product
Lecture 22	Direct sum of subgroups, direct summand and some examples
Lecture 23	Some theorems on direct sum
Lecture 24	p-group and The fundamental theorem of finite Abelian groups
Lecture 25	Some problems on Finitely generated Abelian groups
Unit 3	**Total lectures =15**
Lecture Serial	**Topics of Discussion**
Lecture 26	Group action: Definition and examples
Lecture 27	Definitions: Orbit, Stabilizer, Centalizer, normalizer with examples
Lecture 28	Some theorems including orbit-stabilizer theorem
Lecture 29	Permutation representation associated with a given group action
Lecture 30	Some problems related to previous topics
Lecture 31	The Burnside theorem with some examples
Lecture 32	The theorem S=a∈AG:Ga with examples
Lecture 33	The theorem |S|≡|S0|mod p and some applications
Lecture 34	The theorem G:HNH:Hmod p with some applications
Lecture 35	Cayley’s theorem and extended Cayley’s theorem

Lesson Plan
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Lecture 36	Some examples on Group actions and problems
Lecture 37	Some more theorems and examples on Group actions and normalizer
Lecture 38	Some related problems
Lecture 39	Some related problems
Lecture 40	Some more related problems
Unit 4	**Total lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 41	Conjugacy relation and class equation
Lecture 42	Some examples of class equation
Lecture 43	Some theorems and examples
Lecture 44	Some theorems including Cauchy theorem
Lecture 45	Some more theorems and examples
Lecture 46	Some problems on Class equation
Lecture 47	Some more problems on class equation
Lecture 48	p-groups , Sylow's first theorem and Sylow p-subgroup with examples
Lecture 49	Sylow's second theorem and normality of unique Sylow p-subgroup with examples
Lecture 50	Sylow's third theorem with examples
Lecture 51	Some more theorems and results
Lecture 52	Some problems related to Sylow's theorems
Lecture 53	Some problems of determining normal sub groups applying Sylow's theorems
Lecture 54	Some more applications of Sylow's theorems
Lecture 55	Some more problems
Lecture 56	Simple group: Definition and examples
Lecture 57	The theorem : G is a simple group iff $G \cong \mathbb{Z}p$ and examples
Lecture 58	Some more theorems and problems
Lecture 59	Simplicity of An for $n \geq 5$ and other problems
Lecture 60	Non-simplicity tests by Sylow's theorems

Lesson Plan
Subject: Mathematics (Hons.)

Semester : VI
Paper :BMH6DSE43 (Mechanics-II)
Total Lectures = 60

Unit 1 (Newton's Laws of Motion, Galilean Transformation)	**Total Lectures=15**
Lecture Serial	**Topics of Discussion**
Lecture 1	Introduction about Newton's Laws of Motion
Lecture 2	Inertia, Force, Measurement of force
Lecture 3	If (X, Y) be the component of forces acting in 2 dimension on a particles of unit mass, then the Newton's equation can be written as $\frac{d}{dx}\left[\frac{Y-X\frac{dy}{dx}}{\frac{d^2y}{dx^2}}\right]-2X=0.$
Lecture 4	Conservative force field, Example
Lecture 5	Mechanics of a Particle, some problem
Lecture 6	Conservation of angular momentum
Lecture 7	Conservation of energy
Lecture 8	Equation of motion, Examples
Lecture 9	Introduction about Relativistic Mechanics
Lecture 10	Inertial frame of reference, Newtonian relativity
Lecture 11	Discuss about Galilean transformation
Lecture 12	Galilean invariance, Invariance of space, Invariance of Time interval, Invariance of Velocity, Invariance of acceleration
Lecture 13	Invariance of Newton's Law, Conservation law of linear momentum, Conservation law of Energy,
Lecture 14	Special Theory of Relativity, Length contraction,Time dilation
Lecture 15	Limitations of Newton's laws in solving problems
Unit 2 (Fluid)	**Total lectures =25**
Lecture Serial	**Topics of Discussion**
Lecture 16	Introduction about fluid, Stress Matrix, Compressible fluid, Homogeneous fluid, intensity offluid, line of force, Examples
Lecture 17	Pressure in a heavy homogeneous liquid
Lecture 18	Equilibrium of fluid in a given field of force,Pressure derivative in terms of force,
	Necessary condition for Equilibrium, Surface of qui-pressure, Problems
Lecture 19	Line of force are intercepted by the surface of equi-pressure at right angles, problems
Lecture 20	Differential equation of the equi-pressure and equi-density surfaces, Problems
Lecture 21	If a fluid be in equilibrium under conservative field of force (X, Y, Z) *per unit mass then the surface of equi − pressue*, surface of equi-density and surface of equi-potential coincide
Lecture 22	Some problem and solution using the pressure equation
Lecture 23	Thrust on Plane Surface, Examples
Lecture 24	Whole pressure
Lecture 25	Problem and solution related to Thrust on Plane Surface
Lecture 26	A vessel having a plane vertical sides, contains two liquids which do not mix, to fond the resultant thrust on one of the sides

Lesson Plan
Subject: Mathematics (Hons.)

Lecture 27	Discuss about Centre of Pressure(CP), Examples
Lecture 28	Position of the CP of a plane Lamina, Examples
Lecture 29	Depth of the CP of a plane area, Depth of the CP of a rectangle, triangle with a side(vertex) in the effective surface
Lecture 30	Some problems and solution related to CP
Lecture 31	Effect of additional depth
Lecture 32	CP of a triangular area, depths of whose vertices are given, Problem and solution
Lecture 33	CP of a circular area, depths of whose centre is given
Lecture 34	CP of a composite plane area, Examples
Lecture 34	Equilibrium of floating bodies, Examples
Lecture 35	Problem and solution about Equilibrium of floating bodies
Lecture 36	Discuss about Gas, Examples
Lecture 37	Relation between Pressure, Volume and temperature, Boyle’s Law, Charle’s Law
Lecture 38	Absolute zero, Ideal as equation/ equation of state, Isothermal and adiabatic changes in Gases
Lecture 39	Equilibrium of an isothermal atmosphere, Convective equilibrium
Lecture 40	Stress in continuum body, Stress quadric
Unit 3 (Constraints, Lagrange’s Equation)	**Total lectures =20**
Lecture Serial	**Topics of Discussion**
Lecture 41	Introduction about Generalised Co-ordinates,
Lecture 42	Discuss about Constraints,Examples
Lecture 43	Holonomic Constraints, Examples
Lecture 44	The constraint $q_1\dot{q}_1 + q_2\dot{q}_2 + q_1\dot{q}_2 + q_2\dot{q}_1 = k,\ k$ =constant, is holonomic.
Lecture 45	Non-Holonomic Constraints, Examples
Lecture 46	Scleronomic Constraints, Rheonomic Constraints, Bilateral Constraints, Unilateral Constraints
Lecture 47	Conservative Constraints, Examples; Dissipative Constraints, Examples
Lecture 48	Lagrange's equation of motion, Examples
Lecture 49	D’Alembert’s Principle
Lecture 50	Lagrange equation of the form $\frac{d}{dx}\left(\frac{\partial L}{\partial \dot{q}_j}\right) - \frac{\partial L}{\partial q_j} = 0$
Lecture 51	Lagrangian of a function, $L^{'}(q,\dot{q},t) = L(q,\dot{q},t) + \frac{dF}{dx}$
Lecture 52	Velocity-dpendentPotentialand the Dissipation function
Lecture 53	Expression for total energy, Examples
Lecture 54	Potential energy, Examples
Lecture 55	Integrals of motion
Lecture 56	Kepler's problem,
Lecture 57	Gibbs-Appell’s principle of least constraint
Lecture 58	Discuss about Work, Power, Energy
Lecture 59	Measurement Energy, The Principle of Energy
Lecture 60	Work energy relation for constraint forces of shielding friction.