



AKKAMAHADEVI WOMEN'S UNIVERSITY
Vijayapura
Department of Mathematics

M.Sc. Mathematics
Syllabus
(under CBCS and CAGP)

With effect from
2018-2019



Akkamahadevi Women's University, Vijayapura
M.Sc. Mathematics Choice Based Credit System (CBCS) Syllabus

Course code	Course name	Credits L:T:P	Instruction Hrs./week	Duration of Exam Hrs	Marks		
					IA	Exam	Total
Semester I							
MHT-1.1	Real Analysis	5:0:0	5	3	30	70	100
MHT-1.2	Discrete Mathematics	5:0:0	5	3	30	70	100
MHT-1.3	Algebra-I	5:0:0	5	3	30	70	100
MHT-1.4	Ordinary Differential Equations	5:0:0	5	3	30	70	100
MST-1.5	(Any one to be selected) a) Classical Mechanics b) Number Theory c) Computer Aided Geometric Design-I	4:0:0	4	3	30	70	100
O.E	Offered by Dept. of Women's Studies	4:0:0	4	3	30	70	100
	Total	28					600
Semester II							
MHT-2.1	Complex Analysis	5:0:0	5	3	30	70	100
MHT-2.2	Programming in C	5:0:0	5	3	30	70	100
MHT-2.3	Algebra-II	5:0:0	5	3	30	70	100
MHT-2.4	Partial Differential Equations	5:0:0	5	3	30	70	100
MST-2.5	(Any one to be selected) a) Topology b) Relativity c) Computer Aided Geometric Design-II	4:0:0	4	3	30	70	100
OE	Offered by dept. of Women's Studies	4:0:0	4	3	30	70	100
	Total	28					600
Semester III							
MHT-3.1	Functional Analysis	4:0:0	4	3	30	70	100
MHT-3.2	Numerical Methods-I	4:0:0	4	3	30	70	100
MHT-3.3	Differential Geometry	4:0:0	4	3	30	70	100
MHP-3.4	Numerical Methods using C Programming Lab	0:0:4	8	4	30		
MST-3.5	(Any one to be selected) a) Graph Theory-I	4:0:0	4	3	30	70	100

	b) Fluid Dynamics-I c) Fuzzy Sets and Fuzzy System-I						
OE	Offered by other department	4:0:0	4	3	30	70	100
MOE-3.6	Foundation of Mathematics	4:0:0	4	3	30	70	100
	Total	24					600
Semester IV							
MHT-4.1	Measure Theory	4:0:0	04	3	30	70	100
MHT-4.2	Numerical Methods- II	4:0:0	04	3	30	70	100
MHP-4.3	Project Work*	0:0:4			30	70	100
MST-4.4	(Any one to be selected) a) Graph Theory- II b) Fluid Dynamics- II c) Fuzzy Sets and Fuzzy Systems- II	4:0:0	04	3	30	70	100
OE	Offered by other department	4:0:0	04	3	30	70	100
MOE-4.5	Business Mathematics	4:0:0	04	3	30	70	100
	Total	20					500
	Programme Total						2300

L- Lecture, T- Tutorial, P- Practical.

MHT- Mathematics Hard Core Theory, MST- Mathematics Soft Core Theory, OE- Open Elective, MCP- Mathematics Hard Core Practical, MOE- Mathematics Open Elective course offered to students of other department.

*The project evaluation marks 100 are a total of 50 marks for dissertation, 20 marks for presentation and viva voce and 30 marks for internal assessment.

SEMESTER-I

MHT-1.1: REAL ANALYSIS

UNIT I

15 Hours

The Riemann-Stieltjes Integral: Definition and existence of integral, Properties of the integral, function of bounded variation. Integral and differentiation, First and Second mean value theorems, Change of variables.

UNIT II

10 Hours

Sequence and Series of Functions: Uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, uniform convergence and bounded variations, equicontinuous families of function, The Stone-Weierstrass theorem.

UNIT III

10 Hours

Some Special Functions: power series, exponential and logarithmic functions, trigonometric functions, algebraic completeness of the complex field.

UNIT IV

25 Hours

Functions of Several Variables: Maxima and minima of functions of several variables, Linear transformations, differentiation, the contraction principle, the inverse function theorem, the implicit function theorem and the rank theorem

Text Books:

1. W.Rudin. Principle of Mathematical Analysis, 3rd ed. McGrawHill Book Co. New York(1986)
2. T.M.Apostol. Mathematical Analysis, 2nd ed. Addison-Wesley, Narosa, New Delhi

Reference Books:

1. H.L.Raydon. Real Analysis (second edition), The McMillan Co. New York(1986)
2. R.R.Goldberg.Method of Real Analysis,Oxford & IBH Publishing Co. New Delhi(1970)
3. R.G.Bartle. The Elements of Real Analysis, 2nd ed. Wiley,International Edition, New York
4. W.H.Flemming.Functions of several variables,Addison-Wesley,Narosa,New Delhi

MHT-1.2: DISCRETE MATHEMATICS

UNIT I

25 Hours

Mathematical Logic: Statements and notations, Connectiveness. Well-Formed Formulas, Tautologies. Implications, Normal Forms, Statement Calculus and predicate calculus.

Lattices and Boolean Algebra: Partially ordered sets, Lattices, Distributive and complement lattices. Boolean lattices and algebra. Uniqueness of finite Boolean algebra. Boolean functions and Boolean expressions. Propositional calculus. Design and implementation of digital network, switching circuits.

UNIT II

10 Hours

Combinatorics: Basic counting principles, permutations and combinations, Principle of Inclusion and Exclusion, Recurrence Relations, Generating Functions, applications.

UNIT III

15 Hours

Graph: Basic terminology with related result, Four color problems, Multigraphs and Weighted Graphs, Paths and Circuits, Eulerian and Hamiltonian Paths and Circuits, Adjacency and Incidence matrices, Transport Networks.

UNIT IV

10 Hours

Coding Theory: Semigroups, Monoids and Groups, Codes and Group Codes, Coding of Binary Information and Error Detection, Decoding and Error Correction.

Reference Books:

1. Trembley J.P. and Manohar R. Discrete Mathematical Structure with Application to Computer Science, TME(1997)
2. Liu C.L. Elements of Discrete Mathematics, McGraw Hill,(1995)
3. Kolman B. and Busy R.C. Discrete Mathematical Structures for Computer Science, PHI(1988)
4. Narasingh Deo, Graph Theory with Application to Engineering and Computer Science PHI(1984)

MHT-1.3: ALGEBRA-I

UNIT I

10 Hours

Introduction to Groups, Symmetries of a square, Dihedral Groups, Examples and properties of Groups, Finite Groups, Subgroups Cyclic Groups.

UNIT II

15 Hours

permutation Groups and its properties, a check-digit scheme based on D_5 , Isomorphisms, Cayley's Theorems, Cosets and Lagrange's Theorem, Application of Cosets and Permutation Groups, Rotation Group of a cube and Soccer.

UNIT III

25 Hours

External Direct Products with Applications, Normal subgroups and Factor Groups and Applications.

Group Homomorphisms, First Isomorphism Theorem, Fundamental Theorem of Finite Abelian Groups.

Sylow Theorems, Applications of Sylow Theorems.

UNIT IV

10 Hours

Introduction to Rings, Integral Domains, Fields, Ideals, Ring Homomorphisms, Polynomial Rings, Factorisation of Polynomials, Divisibility in Integral Domains.

Text Books:

Joseph Gallian - Contemporary Abstract Algebra (Narosa Publishing House).
Chapters:-2 to 18 and 24.

Reference Books:-

- 1.I.S. Luthar and I.B.S. Passi: Algebra(Volume 1) Groups (Narosa Publishing House)
2. I.N. Herstein : Topics in Algebra(Wiley – Eastern Ltd)
3. M. Artin: Algebra (Prentice Hall)
- 4.N.S. Gopalkrishna: University Algebra
5. Fraleigh : A First Course In Abstract Algebra
6. Herstein : Topics in Algebra (Wiley – Eastern Ltd)

MHT-1.4: ORDINARY DIFFERENTIAL EQUATIONS

UNIT I

15 Hours

Linear differential equations of nth order, fundamental sets of solutions, Wronskian - Abel's identity, theorems on linear dependence of solutions, adjoint - self - adjoint linear operator, Green's formula, Adjoint equations, the nth order nonhomogeneous linear equations - Variation of parameters - zeros of solutions - comparison and separation theorems.

UNIT II

15 Hours

Fundamental existence and uniqueness theorem. Dependence of solutions on initial conditions, existence and uniqueness theorem for higher order and system of differential equations - Eigenvalue problems - Sturm-Liouville problems - Orthogonality of eigenfunctions - Eigenfunction expansion in a series of orthonormal functions- Green's function method.

UNIT III

15 Hours

Power series solution of linear differential equations - ordinary and singular points of differential equations, Classification into regular and irregular singular points; Series solution about an ordinary point and a regular singular point - Frobenius method- Hermite, Laguerre, Chebyshev and Gauss Hypergeometric equations and their general solutions. Generating function, Recurrence relations, Rodrigue's formula Orthogonality properties. Behaviour of solution at irregular singular points and the point at infinity.

UNIT IV

15 Hours

Linear system of homogeneous and non-homogeneous equations (matrix method) Linear and Non-linear autonomous system of equations - Phase plane - Critical points - stability - Liapunov direct method - Limit cycle and periodic solutions-Bifurcation of plane autonomous systems.

Text Books:

1. G.F. Simmons: Differential Equations, TMH Edition, New Delhi, 1974.
2. M.S.P. Eastham: Theory of ordinary differential equations, Van Nostrand, London, 1970.
3. S.L. Ross: Differential equations (3rd edition), John Wiley & Sons, New York, 1984.

Reference Books

1. E.D. Rainville and P.E. Bedient: Elementary Differential Equations, McGraw Hill, NewYork, 1969.
2. E.A. Coddington and N. Levinson: Theory of ordinary differential equations, McGraw Hill, 1955.
3. A.C. King, J. Billingham & S.R. Otto: Differential equations, Cambridge University Press, 2006.

MST-1.5 (a): CLASSICAL MECHANICS

UNIT I

20 Hours

Analytical dynamics: Generalized Co-ordinates, Holonomic and non- Holonomic systems. Scleronomic and Rheonomic systems. D'Alembert's principle and Lagrange's equation from D'Alembert's principle. Velocity dependent potentials and the dissipation function. Energy equation for conservative field. Generalized momenta and Hamilton's canonical equations. Rigid body and Eulerian angles, infinitesimal rotations. Coriolis theorem. Motion relative to rotating earth. Euler's dynamics equations of Motion of a symmetrical top.

UNIT II

15 Hours

Hamilton's principle of least action. Deduction of Lagrange and Hamilton equation from Hamilton's principle. Hamilton's variational principle. Poincare integral invariants. Whittaker's equation, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation and its complete integral. Solution of Harmonic oscillator problem by Hamilton-Jacobi method.

UNIT III

15 Hours

Cyclic Co-ordinates, Routh's equation, Poisson's identity, Lagrange's Bracket condition of canonical character of transformation in term of Lagrange's Bracket. Poisson's bracket. Invariance of Lagrange's brackets and Poisson brackets under canonical transformations.

UNIT IV

10 Hours

Motivation problems of calculus of variations. Shortest distance. Maximum surface of revolution. Brachistochrome problem, Geodesic. Fundamental lemma of calculus of variations. Euler's equation for one independent function and its generalization to (a) 'n' independent function (b) higher order derivatives. Conditional extremum under geometry constraints and under integral constraints.

Reference Books:

1. A.S.RAMSEY, Dynamics Part II, The English Language Book society and Cambridge University Press, (1972)
2. F.Gantmacher, Lectures in Analytical Mechanics, MIR PUBLISHER, Moscow, 1975
3. H.Goldstein, Classical Mechanics (2nd edition), Narosa Publishing house, New Delhi.
4. I.M.Gelfand and S.V.Fomin, Calculus of Variations, Prentice Hall.
5. Narayan Chandra Rana and Sharad Chandra Joag. Classical Mechanics, Tata McGraw Hill. 1991
6. Louis N.Hand and Janet D.Finch, Analytical Mechanics, Cambridge University Press. 1998

MST-1.5 (b): NUMBER THEORY

UNIT I

15 Hours

Congruences: Basic properties, Residue Systems, Linear congruences, The Theorem of Fermat and Wilson (Rearsited). The Chinese Remainder Theorem, Polynomial congruences, Diophantine equations. Arithmetic Functions – $\phi(n)$, $d(n)$ and $\sigma(n)$, their multiplicative properties, mobius Inversion formulas.

UNIT II

15 Hours

Primitive root - Properties of reduced residue systems, primitive root modulo P. Prime numbers – Elementary properties of $T(x)$, Tchebychev's Theorem, some unsolved problems.

UNIT III

15 Hours

Quadratic congruences - Eulers Criterion, the Legendre symbol, the quadratic reciprocity law and its applications.

UNIT IV

15 Hours

Partition theory- Euler's partition theorem, generating functions, Identities between infinite series and products.

Geometric Number Theory - Lattice points, Gauss's circle problem, Dirchelets Division Problem.

Reference Books:

1. George E. Andrews: Number Theory, Hindustan publishing Corporation (India) (1989)
2. G.H. Hardy and Little wood: Number Theory, CUP.

MST-1.5 (c): COMPUTER AIDED GEOMETRIC DESIGN-I

Points and vectors, Affine maps, barycentric co-ordinates, linear and piecewise linear interpolation, Menelaos theorem, function spaces, curves and surfaces in Euclidean spaces, parametric curves and arc length, Frenet frame, Oscillating circles, Bezier curves, the de Casteljau algorithm, properties of Bezier curve, the blossom, Bernstein form of Bezier curve, the derivative of Bezier curve, sub division, blossom and the polar.

(20 Hours)

Degree elevation, repeated degree elevation, variation diminishing property, degree reduction, non-parametric curves, cross plots, different forms of Bezier curves, Weierstrass approximation theorem, formulae for Bernstein polynomials, interpolation by polynomial curves, Aitkin's Algorithm, limits of Lagrange interpolation, cubic and quintic Hermite interpolation, the Newton form and forward difference scheme. Spline curves in Bezier form, smoothness conditions, C^1 piecewise cubic interpolation.

(20 Hours)

Cubic Spline Interpolation: The B-spline form, Hermite form, end conditions, parametrization, the minimum property, B-splines: knot insertion, the de Boor algorithm, smoothness of B-spline curves, the B-spline basis, recursion formula, repeated knot insertion, B-spline blossoms, B-spline basics.

(20 Hours)

Text Book:

1. Gerald Farin, Curves and Surfaces for CAGD, Academic press, 3ED.1993

Reference Books:

1. B.A. Barsky – Computer Graphics and Geometric modeling using Beta-Splines Springer Verlag, Berlin 1988.
2. C De Boor – A practical guide to splines , Springer Verlag 1978.
3. G. Farin (Ed)- NURBS for curves and surfaces design SIAM, Philadelphia, 1991
4. L. Schumaker- Spline functions: Basic theory, John Wiley, 1991
5. Famaguchi- Surves and Surfaces in computer aided Geometric design, Springer, 1998

SEMESTER-II

MHT-2.1: COMPLEX ANALYSIS

UNIT I

Line Integration

15 Hrs

Power Series: Convergence of sequences and series, power series and analytic functions, Taylor series, Laurent's series, absolute and uniform convergence, integration and differentiation of power series, uniqueness of series representation, zeros of an analytic function, classification of singularities, behavior of analytic function at an essential singular point.

UNIT II

15 Hours

Residues and Poles: Residues, Cauchy-Residue theorem, residues at poles, evaluation of improper integrals, evaluation of definite integrals, the argument principle, Rouché's theorem, Schwartz lemma, maximum modulus principles.

UNIT III

15 Hours

Spaces of analytic functions, spaces of meromorphic functions, the Riemann mappings theorem, Weierstrass factorization theorem, Schwarz reflection principle, Hadamard's product representation, Jensen's theorem, Phragmén–Lindelöf theorem, Hadamard's three circle theorem.

UNIT IV

15 Hours

Conformal Transformation, Critical points and inverse mappings. Schwarz–Christoffel transformation, Bilinear transformation, conformal mappings.

Reference Books:

1. R.V. Churchill. J.W. Brown-complex variables and Applications, 5th ed. McGraw Hill Series.
2. B. Choudary. The elements of complex Analysis, (second edition)-Wiley eastern ltd.
3. L.V. Ahlfors. Complex Analysis, McGraw Hill, Kogakusha (1979).
4. J.S. Conway. Functions of one complex variable, Springer Verlag, NEW YORK (1973).
5. R.V. Churchill. J.W. Brown and R.F. Verhey-Complex Variables and Applications. 3rd Ed. McGraw Hill. Kogakusha (1968).

MHT-2.2: PROGRAMMING IN C

UNIT I

10 Hours

Introduction: Introduction to Computers, Characteristics of Computers, Application areas of computer, Classification of computers, Overview of Programming, types of programming languages (Classification),

UNIT II

20 Hours

C Fundamental: Introduction to C, features of C, program structure, characteristics of programs, concepts of header file, preprocessor directives, Character Set, identifiers, keywords, constants and variables, Data type, type modifiers, types of statements, Declaration and Initialization, comments.

I/O Operation: Types of I/O statement: formatted and unformatted, getchar(), putchar(), printf(), scanf(), escape sequences and format specifiers(%d,%f,%c...)

UNIT III

20 Hours

Operator and expressions: Types of operators (unary, binary and ternary), Classification of operators: assignment, arithmetic, relational, logical, comma operator, size of operator, operator hierarchy and associativity, type conversion (explicit and implicit), library functions.

Control statements: Conditional statements,(if, if else, switch case), looping Statement (for, while, do while,). Nested Loops, Infinite Looping, break and continue.

Arrays and strings.

UNIT IV

10 Hours

Functions: Defining function, function arguments and passing, returning values from functions.

Text Books:

1. Gottlrid: Programming in C, Schism's series
2. P.B.Kotur- Programming in C
3. Balaguruswamy: Programming in C

MHT-2.3: ALGEBRA-II

UNIT I

15 Hours

Recapitulation of Matrices, Determinants, Polynomials, Vector Spaces, subspaces, Basis and dimension, Linear Transformation, Quotient spaces, Direct sum, The matrix of a linear transformation, Duality.

UNIT II

15 Hours

Canonical Forms, Eigen values and eigen vectors, the minimal polynomial, Diagonalizable and triangulable operators, The Jordan Form.

UNIT III

15 Hours

Inner Product Spaces, Inner Product Spaces, Orthogonality, The adjoint of a linear transformation, Unitary operators, Self adjoint and normal operators, Polar and singular value decomposition.

UNIT IV

15 Hours

Bilinear Forms, Definition and examples, the matrix of a bilinear form, Orthogonality, Classification of Bilinear forms.

Text Books:

Vivek Sahi, Vivek Bist: Linear Algebra (Narosa Publishing House).

MHT-2.4: PARTIAL DIFFERENTIAL EQUATIONS

UNIT I

15 Hours

First Order Partial Differential Equations: Basic definitions, Origin of PDEs, Classification, Geometrical interpretation. The Cauchy problem, the method of characteristics for Semi linear, quasi linear and Non-linear equations, complete integrals, Examples of equations to analytical dynamics, discontinuous solution and shockwaves.

UNIT II

15 Hours

Second Order Partial Differential Equations: Definitions of Linear and Non-Linear equations, Linear Superposition principle, Classification of second-order linear partial differential equations into hyperbolic, parabolic and elliptic PDEs, Reduction to canonical forms, solution of linear Homogeneous and non-homogeneous with constant coefficients, Variable coefficients, Monge's method.

UNIT III

15 Hours

Wave equation: Solution by the method of separation of variables and integral transforms The Cauchy problem, Wave equation in cylindrical and spherical polar coordinates. Laplace equation: Solution by the method of separation of variables and transforms. Dirichlet's, Neumann's and Churchills problems, Dirichlet's problem for a rectangle, half plane and circle, Solution of Laplace equation in cylindrical and spherical polar coordinates 7 Hrs.

UNIT IV

15 Hours

Diffusion Equation: Fundamental solution by the method of variables and integral transforms, Duhamel's principle, Solution of the equation in cylindrical and spherical polar coordinates. 7 Hrs. Solution of boundary value problems: Green's function method for Hyperbolic, Parabolic and Elliptic equations.

15 Hours

Text Books:

1. N. Sneddon, Elements of PDE's, McGraw Hill Book company Inc., 2006.
2. L Debnath, Nonlinear PDE's for Scientists and Engineers, Birkhauser, Boston, 2007.
3. F. John, Partial differential equations, Springer, 1971.

Reference Books:

1. F. Trèves: Basic linear partial differential equations, Academic Press, 1975.
2. M.G. Smith: Introduction to the theory of partial differential equations, Van Nostrand, 1967.
3. Shankar Rao: Partial Differential Equations, PHI

MST-2.5 (a): TOPOLOGY

UNIT I

20 Hours

Definition of topologies in terms of open sets, Closed sets. Closure operations and their equivalence, Neighbourhood systems. Limit points, interior, exterior and boundary points. Base and Sub-bases of a topology. Continuity, convergence, compactness.

UNIT II

15 Hours

Separation and continuity axioms. Separable and Lindelof spaces. Connectedness, path connectedness, Local connectedness.

UNIT III

15 Hours

Compact spaces, Local compactness and one-point compactification, Urysohn's metrization theorem and Tietze extension theorem.

UNIT IV

10 Hours

Equivalence of countability and separated axioms in metric spaces. Lindelof property, Equivalence of compactness.

Reference:

1. J.T. Munkers. Topology, PHI, New Delhi (1998)
2. J.Dugundagi. Topology, UBS Pub, New Delhi (1997)
3. Willard .General Topology, Hocking & Young Pub.
4. Maunder C.F. Algebraic Topology, Academic Press.
5. W.Massey. Introduction to Algebraic Topology, PHI, New Delhi.

MST-2.5 (b): RELATIVITY

UNIT I

15 Hours

Special Theory of relativity, Lorentz transformations. Representation of Lorentz group. Time dilation. Space contraction. Relativistic mechanics and particle dynamics.

UNIT II

15 Hours

Covariant, contravariant vectors and tensors. Tensor algebra. Transformation laws. Contraction Symmetric and Skew symmetric tensors.

UNIT III

15 Hours

Space-time as a differentiable manifold Tensor algebra and calculus in curved space-time. Parallel transport, covariant derivative, Connection coefficient. Geodesics, geodesic deviation. Riemann curvature tensor. The Bianchi identities.

UNIT IV

15 Hours

The general Theory of Relativity. Principle of equivalence. The Newtonian limit. Derivation of Einstein field equation.

References:

1. S. Weinberg: Gravitation on Cosmology, Principles and applications of the general theory of Relativity. John Wiley and Sons, Inc. (1972)
2. J. V. Narlikar: Introduction to cosmology Cambridge University Press (1993)
3. L. D. Landau & E. M. Lifshitz: The classical theory of fields, Pergamon Press (1980)
4. R. K. Sachs & H. Wu: General Relativity for Mathematicians (1977)

MST-2.5 (c): COMPUTER AIDED GEOMETRIC DESIGN-II

UNIT I

20 Hours

Parametric curves and arc length, Frenet frame, moving the frame, osculating circle, non parametric curves, composite curves. Geometric Continuity: characterization of G^2 Curves, Nu-Splines, G^2 –piecewise Bezier curve, direct G cubic splines, gamma and beta splines, local basis functions for G^2 Splines, Rational Bezier curves. The de Casteljau algorithm, derivatives, reparametrization and degree elevation, rational B-spline of arbitrary degree.

UNIT II

10 Hours

Tensor Product Bezier Surfaces: Bilinear interpolation, direct de Casteljau algorithm, tensor product approach, properties, degree elevation, derivatives, normal vectors, twists, smoothness and subdivision, bi-cubic B-spline surfaces, twist estimation, tensor product interpolants, parametrization, bicubic Hermite patches, surfaces of revolution.

UNIT III

15 Hours

Bezier Triangles: Barycentric coordinates and linear interpolation, de Casteljau algorithm, triangular blossoms, Bernstein polynomials, derivatives, sub-division, differentiability, degree elevation, non-parametric patches, rational Bezier triangles, quadrics.

UNIT IV

10 Hours

Geometric Continuity for Surfaces: triangle-triangle, rectangle-rectangle, rectangle-triangle, filling in rectangular patches, filling in triangular patches, theoretical aspects.

Text Book:

1. Gerald Farin. Curves and Surfaces for CAGD, Academic press. 3Ed. 1993

Reference:

1. B.A.Barsky. Computer Graphics and Geometric modeling using Beta-splines Springer Verlag, Berlin 1988.
2. C De Boor-A practical guide to splines, Springer Verlag, 1978
3. G.Parin(Cd) .NURBS for curves and surfaces design SIAM, Philadelphia, 1991.
4. L.L.Schumaker. Spline functions: Basic theory, John Wiley,1991
5. F.Yamaguchi.Curves and Surfaces in computer aided Geometric design, Springer Verlag. Berlin, 1998.

SEMESTER-III

MHT-3.1: FUNCTIONAL ANALYSIS

Metric Space: Open sets, Closed sets, Bounded sets, Convergence, Continuity, Compactness, Connectedness, Completeness and Bair's theorem, Cantor's intersection theorem, Weierstrass, approximation theorem, spaces of Continuous function.

(16 Hours)

Banach Spaces: Continuous linear transformation, dual spaces, Hahn-Banach theorem, The natural embedding of normed linear space into its second conjugate spaces, The open mapping theorem, Closed graph theorem, The conjugate operator, Banach-Steinhaus theorem, Application of partial differential equation.

(24 Hours)

Hilbert Space: Orthogonal complements, orthonormal sets, Conjugate spaces, Gram-Schmidt orthonormalization process, Riesz-representation theorem, the adjoint of an operator, self-adjoint operators, normal and unitary operators, projection.

(20 Hours)

Reference Books:

1. Simmons G.F. Introduction to Topology and Modern Analysis, McGraw Hill.(1986)
2. Limaye B.V. Functional Analysis, Wiley Easter Ltd., (1981)
3. Taylor A.E. Introduction to Functional Analysis, John Wiley & Sons, Inc., New York.(1958)
4. Brown A.L. and Page A. Elements of Functional Analysis, Van Nostred.,London.(1970)
5. Krcyszizg E. introduction to Functional Analysis with application, John Wiley, New York.(1978)
6. Goffman and Pedricl, Functional Analysis, PHI.

MHT-3.2: NUMERICAL METHODS-I

UNIT I

20 Hours

Examples from algebraic and transcendental equations where analytical methods fail. Examples from system of linear and non-linear algebraic equations where analytical solutions are difficult or impossible. Floating-point number and round-off, absolute and relative errors. Solution of nonlinear equation in one variable Fixed point iterative method - convergence and acceleration by Aitken's 2nd -process. Newton Raphson methods for multiple roots and their convergence criteria, Ramanujan method, Bairstow's method, Sturm sequence for identifying the number of real roots of the polynomial functions, complex roots-Muller's method. Homotopy and continuation methods.

UNIT II

15 Hours

Solving system of equations Review of matrix algebra. Gauss-elimination with pivotal strategy. Factorization methods (Crout's, Doolittle and Cholesky). Tri-diagonal systems-Thomas algorithm. Iterative methods: Matrix norms, error analysis and ill-conditioned systems- Jacobi and Gauss-Seidel methods, Chebyshev acceleration. Introduction to steepest descent and conjugate gradient methods. Solutions of nonlinear equations: Newton-Raphson method, Quasilinearization (quasi-Newton's) method, successive over relaxation method.

UNIT III

15 Hours

Interpolation Review of interpolations basics, Lagrange, Hermite methods and error analyses, Splines-linear, quadratic and cubic (natural, Not a knot and clamped), Bivariate interpolation, Least-squares, Chebyshev and rational approximations.

UNIT IV

10 Hours

Numerical integration Review of integrations. Gaussian quadrature - Gauss-Legendre, Gauss-Chebyshev, Gauss-Laguerre, Gauss-Hermite and error analyses, adaptive quadratures, multiple integration with constant and variable limits.

Text Books:

1. S.D. Conte & C de Boor: Elementary numerical analysis, Tata-Mc Graw-Hill, 1980 3rd edition.
2. R.L. Burden and J.D. Faires: Numerical Analysis, Thomson-Brooks/Cole, 1989, 7th edition.
3. D. Kincaid and W Cheney: Numerical analysis, American Mathematical Society, 2002, 3rd edition.

Reference Books:

A Iserles: A first course in the numerical analysis of differential equations, Cambridge texts in applied mathematics, 2008, 2nd edition

MHT-3.3: DIFFERENTIAL GEOMETRY

Calculus on Euclidean Spaces: Euclidean spaces, tangent vectors, directional derivatives, curves in E^3 , 1-Forms, differential Forms, mappings.

(10 Hours)

Frame Fields: Dot product, curves, the Frenet formulas, arbitrary- speed curves, covariant derivatives, Frame fields, connection forms.

(15 Hours)

Euclidean Geometry: Isometrics of E^3 , the derivative map of an isometry, orientation, Euclidean geometry, convergence of curves.

(10 Hours)

Calculus on a surface: Surface in E^3 , differentiable Functions and tangent vectors, differential forms on a surface, mappings, Integration of Forms, Topological properties of surfaces, Manifolds.

(10 Hours)

Shape Operators: Normal Section and Normal Curvature, Gaussian and Mean Curvatures, Patch Computations, Formulae for K and H, Umbilic Points, Asymptotic and Geodesic Curves.

(15 Hours)

Text Book:

1. Barrett O'Neil. Elementary Differential Geometry, Academic press, New York(1966) (chapters I to VI)
2. C.E. Weatherburn. An Introduction to Differential Geometry, Cambridge University Press

References Books:

1. T.J. Wilmore. Introduction to Differential Geometry, Oxford Clarendon press(1969)
2. Langwitz D, Differential and Riemann Geometry, Academic press, New York(1965)
3. W. KHngenber. A course in Differential Geometry. Springer(1978)
4. Elementary topic in Differential Geometry, Springer Verlag, NEW-YORK(1979)

MHP-3.4: NUMERICAL METHODS USING C PROGRAMMING LAB

1. Finding smallest and largest of three numbers
2. Searching for the smallest in a list
3. Sorting a list of integers in ascending/descending order
4. Finding the roots of quadratic equation
5. Difference table
6. Interpolation
7. Finding whether a year is leap year or not?
8. To find whether a number is positive, negative or zero.
9. Bisection method
10. Newton-Raphson method
11. Gauss elimination method
12. Gauss –Seidal iteration method
13. Computation of eigen values, eigen vector & inverse of matrices
14. Difference tables
15. Interpolation for equal and unequal intervals
16. Curve fitting, Least square method

Note: Any new Programs can be introduced by the staff member.

MST-3.5 (a): GRAPH THEORY-I

Graphs, degree of vertex, spanning subgraph, induced subgraph, walk, trail, path, cycle, connects grith, component, isomorphism, cut vertex, bridge, regular graphs, complement of a graph, self-complementary graph, complete graphs, bipartite graphs, complete bipartite graphs.

20 Hours

Trees, Characterisation of trees, distance in a graph, Radius of graph, Diameter of a graph, central vertex, branch of tree, rank and nullity, cuset. Fundamental cut-set, fundamental circuit, conservation equation, network flow, f-unsaturated, f-augmenting semipath. Max-Flow Eulerian Path, Eulerian trail, Eulerian circuit, Eulerian graphs, total, graph, block graph, cut-vertex graph.

30 Hours

Directed graphs: Digraph, Eulerian digraph, kinds of digraphs, Strong and week digraphs, condensation of a digraph, tournaments.

10 Hours

References:

1. F.Harary. Graph Theory. Addison—Wesley, Reading Mass(1969)
2. N.Deo. Graph Theory, Prentice hall of India Pri Ltd, New Delhi(1990)
3. M. Behzndal, G,Chartran.Intrduction to theory of graphs. All Ally and Bacon In.Mass(1971)
4. O. Ore. Theory of Graphs. Amer.math.soc.coolq.publ.38 Providence(1962)

MST-3.5 (b): FLUID DYNAMICS-I

UNIT I

15 Hours

Coordinate transformations: Cartesian tensors - Basic Properties – Transpose - Symmetric and Skew tensors - Isotropic tensors - Deviatoric Tensors - Gradient, Divergence and Curl of a tensor field- Integral Theorems. 7Hrs. Continuum Hypothesis: Configuration of a continuum - Mass and density - Description of motion - Material and spatial coordinates - Material and Local time derivatives- Stream lines - Path lines - Vorticity and Circulation - Examples. Transport formulas - Strain tensors - Principal strains, Strainrate tensor- Stress components and Stress tensor - Normal and shear stresses - Principal stresses.

UNIT II

15 Hours

Fundamental basic physical laws: Law of conservation of mass - Principles of linear and angular momenta - Balance of energy - Examples. 6Hrs. Motion of non-viscous fluids: Stress tensor- Euler equation-Bernoulli's equation- simple consequences-Helmholtz vorticity equation - Permanence of vorticity and circulation - Dimensional analysis - Nondimensional numbers.

UNIT III

15 Hours

Motion of Viscous fluids: Stress tensor - Navier-Stokes equation - Energy equation -Simple exact solutions of Navier-Stokes equation: (i) Plane Poiseuille and Hagen-Poiseuille flows (ii) Generalized plane Couette flow (iii) Steady flow between two rotating concentric circular cylinders (iv) Stokes's first and second problems. Diffusion of vorticity - Energy dissipation due to viscosity.

UNIT IV

15 Hours

Two dimensional flows of inviscid fluids: Meaning of two-dimensional flow -Stream function - Complex potential - Line sources and sinks - Line doublets and vortices - Images - MilneThomson circle theorem and applications - Blasius theorem and applications.

Text Books:

1. D.S. Chandrasekharaiah and L. Debnath: Continuum Mechanics, Academic Press, 1994.
2. A.J.M. Spencer: Continuum Mechanics, Longman, 1980.
3. S. W. Yuan: Foundations of Fluid Mechanics, Prentice Hall, 1976.

Reference Books:

1. P. Chadwick : Continuum Mechanics, Allen and Unwin, 1976.
2. L.E. Malvern : Introduction to the Mechanics of a Continuous Media, Prentice Hall, 1969.
Y.C. Fung, A First course in Continuum Mechanics, Prentice Hall (2nd edition), 1977.
3. Pijush K. Kundu, Ira M. Cohen and David R. Dowling, Fluid Mechanics, Fifth Edition, 2010.
4. C.S. Yih : Fluid Mechanics, McGraw-Hill, 1969.

MST-3.5 (c): FUZZY SETS AND FUZZY SYSTEM-I

UNIT I

12 Hours

Brief History of Mathematics, Set theory, Logic, Fuzzy set theory, Life history of World famous Mathematicians and their works and contributions.

UNIT II

12 Hours

Set Theory Union, intersection, Complementation, functions, characteristics functions, Mathematical Logic, Logical connectives, two valued & three valued logics, Applications.

UNIT III

12 Hours

Boolean Algebra, Fuzzy set theory & Fuzzy logic, Operations on fuzzy sets, Functions on fuzzy sets, Image and inverse image properties, α - cuts.

UNIT III

24 Hours

Quantitative Aptitude & Mental / logic ability and data interpretation – Arithmetic Ability, Percentage, Profit and Loss, Ratio and Proportion, Partnership, Numbers GCD & LCM, Time and Work, Simple and Compound Interest, Volume surface and area, Races & Games of skills, Stocks and Shares, Bankers Discount, Heights and distance, odd man outseries, Tabulation, Bar graph, Pie graph, Line graphs.

Reference Books:

1. A Text book of Mathematics I & II – B.G. and P.G. Umarani
2. A Text book of Mathematics I & II – B. M. Sreenivas Rao, Excellent Publication
3. Discrete Mathematics – Rajendra Akerkar & Rupali Akerkar, Pearson Publication
4. Fuzzy Sets & Fuzzy Logic – Klir and Yuan, PHI
5. Computer Fundamentals – Rajaraman
6. Quantitative Aptitude – R. S. Agarawala, S. Chand & Co.

MOE-3.6: FOUNDATIONS OF MATHEMATICS

UNIT I

10 Hours

Brief history of Mathematics. Life history of world known Mathematicians and their works and contributions.

UNIT II

15 Hours

Set Theory and Functions, Number Theory Partial fractions, Co-ordinate Geometry, Trigonometry and Calculus.

UNIT III

15 Hours

Matrices and determinants, Roots of equations, Vectors, Algebraic systems, Groups, Mathematical Logic, Counting Principles, Algorithms, Interpolation, Numerical Calculus.

UNIT IV

12 Hours

Quantitative Aptitude and Data interpretation, Percentage, Profit and Loss, Ratio and Proportion partnership, Time and Work, Simple and Compound Interest, Races and Game skills, Socks and Shares, Bankers Discount, Heights and distance, Odd man out Tabulation, Bar graph, Pie graph, Line graphs.

Reference Books:

1. Foundations of Mathematics – N. Vijayarangan, Scitech Pub. (India) Pvt. Ltd.
2. A Text book of Mathematics I & II – B.G. and P.G. Umarani
3. A Text book of Mathematics I & II – B. M. Sreenivas Rao, Excellent Publication
4. Discrete Mathematics – Kolman and Busby, PHI.
5. Computer Fundamentals – Rajaraman
6. Quantitative Aptitude – R. S. Agarawala, S. Chand & Co.

SEMESTER-IV

MHT-4.1: MEASURE THEORY

Measure and outer measure: Ring of a set, σ – ring of sets, algebra of sets, σ – algebra of sets, measure space, Caratheodory's postulates for outer measure, measurable sets, problems related to measure function. Ring of sets, σ – algebra of sets and lebesgue measure of set, Exterior and Interior measure, Vitali's covering theorem, Borel measurable set.

(20 Hours)

Measurable Functions: Measurable functions, Almost everywhere, equivalent functions, characteristic function, Borel measurability of functions, Little wood's three principles, Lebesgue integral of a function, first mean value theorem, convergence in measure, Reisz's theorem, D.F.Egoroff's theorem Lebesgue, bounded convergence theorem, Fatou's lemma, Absolute continuous function, indefinite and differentiation.

(20 Hours)

Signed Measure: Signed measure, positive and negative sets, Hahn decomposition theorem singular measure. Jordan decomposition, Absolutely continuous measure function, Randon Nikodym theorem, Lebesgue decomposition theorem, Product measure, Fubini's theorem.

(20 Hours)

Reference Books:

1. Poul R. Halmos. Measure theory, D. van. Nostrand co.Inc, New York and Affiliated East-west presses Pvt., Ltd, New Delhi(1966)
2. I.K.Rana. An measure and Integration and Integration, narosa publishing House (1977)
3. K.P. Gupta. Measure theory, Krishna Prakashan Media (P) Ltd., II, Shivaji Road, Meerut (U.P) India.
4. Harold Widom- Lectures on measure and Integration, Van Nostrand Reinhold company, New York.
5. J.F.C Kingmam and S.J.Taylor- introduction measure and probability, Cambridge University press.

MHT-4.2: NUMERICAL METHODS-II

Numerical solution of Ordinary Differential Equation:

Single Step Methods: Runge-Kutta methods, R-K methods for simultaneous & higher order differential equations. **Multi Step Methods:** Adam Bash fourth's & Milne's Predictor-Corrector methods

(20 Hours)

Numerical Solution of Partial Differential Equation: Introduction: 1) Classification of P.D.E. 2) Classification of physical problems. Finite difference approximations to derivatives.

Parabolic P.D.E: Non-dimensional form of heat equation, explicit finite difference scheme, Crank-Nicholson method. Gauss- seidal iterative scheme for Crank-Nicholson method. Successive over relaxation, parabolic equation with derivative boundary condition, ADI method, parabolic equation in cylindrical & spherical co-ordinates, Von-Neumann stability of parabolic differential equation.

(20 Hours)

Elliptic P.D.E: Laplace equation, Poisson equation, explicit finite difference method, implicit method. Derivative boundary condition. Iterative method.

Hyperbolic P.D.E: Solution of hyperbolic equation by characteristics, Finite difference methods and explicit finite difference method, implicit method.

(20 Hours)

Reference Books:

1. Jain, Iyengar and Jain: Numerical method for Scientific and Engineering Computation, Wiley Eastern, (1983)
2. Atkinson K.E: An introduction to Numerical Analysis, 3rd Ed John Weiley and Sons(1989)
3. Carnahan, Luther and Wiles: Applied Numerical Methods, John Weiley (1969).
4. Hilderband F.B: Introduction to Numerical Analysis, Ed 5 Tata McGraw Hill, New Delhi,(1986)
5. Conte S. D. and De Boor, Introduction to Numerical Analysis, McGraw Hill.

MHP-4.3: Project Work

Project work can be carried out in industries/R&D Organization/IITs/IISc/Any Universities. Project shall be conceptualized soon after the completion of the II Semester; Students shall work for the project during the mid-term vacation of III semester examinations and IV Semester.

MST-4.4 (a): GRAPH THEORY-II

Planar Graph: Operations on graphs, Combinatorial and Geometric graph, planar graph, plane graph, Maximal planar graph, Detection of planarity, subdivision of graph, inner vertex set, inner vertex number, outer planar, minimally nonouter planar graph, Geometric dual and its properties, crossing number and thickness of a graph.

(20 Hours)

Colouring, Covering and Independence: Coloring, Colour class, Chromatic number of graph, Bichromatic graph, Vertex coloring algorithm, Simple sequential algorithm, Welsh and Powell Algorithm, The smallest-last sequential algorithm, edge-coloring, n-edge coloring graph of graph, coloring of plane map, uniquely colorable graphs, four colour problem, edge covering number, vertex covering number, edge covering number, vertex independence number, edge independence number.

(20 Hours)

Factorization: Factor of G, n-factorization, 2- factorization.

NP-Completeness: Representing graph in a computer. Adjacency matrix of graph,

Domination: Dominating Numbers, Dominating sets, and total dominating sets, total dominating numbers, winner index, hyper winner index graph labeling, graceful labeling.

(20 Hours)

Reference Books:

1. F. Harary. Graph Theory. Addison-Wesley, Reading Mass. (1969)
2. M. Behzndal, C. Chajrtran. Introduction to theory of graphs. All Allyn and Bacon inc. Mass. (1971)
3. G. Chartrand and O.R. Ollermann. Applied and algorithmic graph theory, Mc. Graw-Hill, Inc. (1993)
4. L.W. Beineke and R.J. Wilson, Selected topics in Graph theory 3 Academic press Ltd. (1988)
5. E.J. Henley and R.A. Williams, Graph theory in Modern Engineering, Academic press, New York and London (1973)

MST-4.4 (b): FLUID DYNAMICS-II

Basic Equations of Fluid Dynamics: Continuity equation; Momentum equation; Energy equation ; Main Non-dimensional groups- Reynolds number, Froude number, Prandtl number, Mach number, Specific heat ratio etc.; Equations expressed in conservative form. Inviscid Flows. Incompressible potential flows; Flows due to Sources and Sinks; Inverse method-I Von Karman's method for approximating flow past bodies of revolution; Inverse method-II : Conformal mapping; Panel method; Elliptic equations - Potential flows in ducts or around bodies –Circular cylinder inside a channel; Propagation of a finite amplitude wave and formation of a shock-Method of characteristics.

(30 Hours)

Viscous Fluid flows: Governing equations for viscous flows; Structure of a plane shock wave; self similar laminar Boundary layer flows; flat plate thermometer problem; Ordinary boundary value problems involving derivative boundary conditions- pipe and open channel flows; Explicit method for solving generalized Rayleigh problem; Implicit method for solving starting flow in a channel problem; Numerical solution of a bi-harmonic equations-Stokes flows.

(30 Hours)

Reference Book:

1. An introduction to computational Fluid Mechanics, Chuen-Yen-Chow
2. Computational Fluid Dynamics - Tarit Kumar Bose, Wiley Eastern Ltd.
3. Computational Techniques for fluid Dynamics Vol. II C.A.J. Fletcher, Springer-Verlag.

MST-4.4 (c): FUZZY SETS AND FUZZY SYSTEM-II

UNIT I

15 Hours

Fuzzy relations: Fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy ordering relations, Fuzzy morphisms, Sup-I compositions of fuzzy relations, Inf- w_i compositions of fuzzy relations.

UNIT II

15 Hours

Fuzzy relation equations: Introduction, problem partitioning, Solution method, Fuzzy relation

Equations based on Sup-I compositions and Inf- w_i compositions, approximate solutions.

UNIT III

15 Hours

Fuzzy Logic: Classical Logic an overview, multi valued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistics hedges, inferences from conditional Fuzzy propositions, Qualified propositions and quantified propositions.

UNIT IV

15 Hours

Applications of Fuzzy Sets and Logic: Signal processing, image processing, hand written character recognition and visual image Recognition, communication systems, intelligent controller, other applications.

Reference Book:

1. George J. Klir and Yuan. Fuzzy sets and fuzzy logic, Theory and Applications, PHI
2. George J. Klir and Tina A. Folger. Fuzzy sets' Uncertainty and information, PHI (1994)
3. Kaufmann, A. Introduction to the theory of fuzzy subsets- Vol I Academic press (1975)
4. Driankov D. and others. An Introduction to fuzzy control, Narosa Pub. Co

MOE-4.5: BUSINESS MATHEMATICS

UNIT I

16 Hours

Linear Equations: algebra, graphs of linear equations, intersection of linear equations, modeling of supply and demand analysis, national income determination.

Non Linear Equations: quadratic, exponential and logarithmic equations, modeling of revenue, cost and profit.

UNIT II

08 Hours

Mathematics of Finance: percentages and interests, compound interest, investment appraisal.

UNIT III

16 Hours

Differentiation: rules of differentiation, marginal functions and elasticity, optimization of economic functions.

Partial Differentiation: functions of several variables, partial marginal functions and elasticity, Lagrange multipliers.

UNIT IV

12 Hours

Integration: indefinite integration, definite integration.

Reference Book:

Mathematics for Economics and Business by Ian Jacques, Financial Times/Prentice Hall.