7. Repeated degree elevation
8. Degree reduction
9. Numerical Verification of Weirstrass approximation theorem for several functions.

ADVANCED TOPOLOGY -1 (ELECTIVE A)

Fitters And Product, Spaces: Fitters, convergence, ultra and Cauchy Fitters arbitrary product spaces. **(15 Hours)**

Para Compact Spaces: Locally finite and point finite covers. Perfectly and totally Normal spaces, Meta compact (weakly Para compact) and strongly Para compact spaces. Perfect mapping. **(20 Hours)**

Metric And Metrizable Spaces: Locally metrizable spaces, Nagata-smirrnov metrization theorems. Seperation, compactness and convergence in metric spaces. Ascol's theorem and Baires theorems. **(25 Hours)**

REFERENCES:

1. J.Dugundgi - Topology, UBS Pub. New Delhi (1998)
2. J.T. Munker - Topology, PFII Pub.
3. Hocking and Young - Topology, Mc. Pub.

FUZZY SETS AND FUZZY SYSTEM - I (ELECTIVE A)

Basic Concepts of Fuzzy Sets: Introduction. Crisp set, Fuzzy sets, types of Fuzzy sets, basic, concepts, properties of a - cuts, representation of Fuzzy sets, extension principle of Fuzzy sets. **(20 Hours)**

Operations on Fuzzy'Sets: Types of operations Fuzzy complements, Fuzzy intersections, t-norms. fuzzy unions; t-co-norms, combinations of operations, aggregation operations. **(20 Hours)**

Fuzzy Arithmetic: Fuzzy numbers. Linguistic variables. Arithmetic operations on intervals. Arithmetic operations on fuzzy numbers. Lattice of fuzzy numbers, Fuzzy equations. **(10 Hours)**

Fuzzy Relations: Crisp versus fuzzy relations. Projections and cylindrical extensions, Binary fuzzy relations, binar\ relation on a single set. **(10 Hours)**

REFERENCES:

1.George J.Klir,and Yuan. Fuzzy sets and fuzzy logic, Theory and Applications, PHI.
2.George J.Klir and Tina A.Fotger. Fuzzy sets uncertainity and information,PHI (1994)
3.Kaufmamn,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.

ATMOSPHERIC SCIENCE - I (ELECTIVE A)

Fundamentals of General Fluid Dynamics: Continuum hypothesis, stress and strain analysis, concept of vorticity and circulation, Standard theorems like Kelvin's circulation theorem, permanence of vorticity and circulation, Equations of continuity, momentum and energy for a general continuum, Euler's and Bernoulli's equation for non-viscous fluid flow, Helmholtz theorem,

Navier-Stokes' equation for viscous fluid. Thermal Wind, Geostrophic motion, Hydrostatic approximation, Taylor-Proudman theorem, Geostrophic Degeneracy, Dimensional Analysis, and nondimensional numbers. **(15 Hours)**

Physical Meteorology: Atmospheric composition, Laws of thermodynamics of the atmosphere. Adiabatic process, potential temperature, The Clausis Clapyeron equation, Laws of black body radiation, Solar and terrestrial radiation. Solar constant, Albedoi, Green house effect, Heat balance of earth-atmosphere system.Stability and instability of atmosphere by parcel and slice method. Role of radioactive convective processes in creating the vertical thermal structure of the atmosphere. **(15 Hours)**

Atmospheric Dynamics: Basic equation for conservation of mass, momentum and energy fo rotating earth, Thermodynamic energy equation, equation of state, equation of angular momentum.Hydrostatic approximation and modified equations of horizontal motion, Geostrophi approximation, Boussinesq approximation, Pressure as vertical coordinate, modified continuity equation, Balance of forces.Non-dimensional number: Rossby, Richordson, Froude, Ekman etc.

(20 Hours)

General Circulation and Atmosphere: Definition of the general circulation, Various components of the general circulation-zonal and eddy-angular momentum balance of the atmosphere, meridional circulation, Hadley Ferrel and Polar cejls in summer and winter.
Dynamics of monsoon disturbances, mid-tropospherc cyclones, monsoon instability./ Intraseasonal variability of monsoon, interannual variability of the monsoon, Decadal and Century scale variability of monsoon, middle latitudinal effects on the monsoon, air-sea interaction and the monsoon, Arabian sea cooling. (10 Hours)

REFERENCES:

1. F. Chorlton- Text book of Fluid Dynamics, CBS publishers, New Delhi, 1985.
2. G.K. Batchelor- An Introduction to Fluid mechanics, Foundation Books, New Delhi, 1994.
3. J.R.Holton-An introduction to Dynamic Meteorology, Academic Press, 3^{ld} Edition, 1992.
4. R.Ananthakrishnan-Meteorology, Madras Science Foundation, 1991.
5. Y.P.Rao-Southwest Monsoon, I.M.D. Publication, 1976.
6. R.N.Kcshavamurthy and M.Shankar Rao-The Physics of Monsoon, Allied Publishers, 1992.
7. G.J.Haltiner and R.T.Williams-Numerical Weather Prediction, John Wiley and Sons, 1980.
8. R.A.Dobbins-Atmospheric Motion and Pollution.
9. Ghill and Childress , Topics in Geophysical Fluid Dynamics, Applied Mathematical Science, W
60, Springer verlag (1987).
10. Joseph Pedlosky , Geophysical Fluid Dynamics', Springer- verlag,Berlin and New York (1979).
11. Raudkivi, A.J. and Callander, R.A., Advanced Fluid Mechanics, An IntroductioTTTEtfWard Arnold, (U.K.) (1975).
12. Adrian E. Gill, Atmosphere-Ocean Dynamics,Academic Press, International Geophysics serial, vol. 30.
13. Edited by P.Motel, Dynamical Meteorology, Reidel Publ. Dordrecht, Netherland (Chapter: Planetary Fluid Mechanics, by Charney J.G, (1973).

MAGNETOHYDRODYNAMICS-I (Elective A)

Electrodynamics: Introduction to Maxwell's equations, invariance of Maxwell's equations under Lorentz transformation-Electromagnetic boundary conditions. **(15 Hours)**

Basic equations of MHO: Basic concept of MD-Derivations of momentum and energy equations for viscous, finitely electrical conducting fluids-Magnetic induction equation and decay time-Interpreting Lorentz-force as a sum of magnetic pressure and tension-MHD approximations and non- dimensional numbers. **(25 Hours)**

Magnetostatics: Force-free magnetic field and its basic equations-Chandrashekar's theorem, compatibility conditions-properties of abnormal parameter-problems of force free magnetic field-pinch effect-stability of Bennet pinch. **(20 Hours)**

REFERENCES:

1. V.C.A.Ferraro and Plumpton-Magnetohydrodynamics-Part I.
2. P.H.Roberts-An Introduction to Magneto hydro dynamics, Longman, London.
3. Allen Jeffrey-Ma'gnetohydrodynamics.
4. G.W.Sutton and A-Sherman-Engineering Magnetohydrodynamics.
5. W.F.Flughes and F.J.Young-Electromagnetodynamics of fluids, John Wiley and Sons, Inc.,

2. J.T. Munker. Topology, PHI Pub.
3. Hocking and Young. Topology. Me. Pub.

FUZZY SETS AND FUZZY SYSTEM - II (ELECTIVE B)

Fuzzy relations; fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy ordering relations, Fuzzy morphisms, Sup-I compositions of fuzzy relations, Inf- w_i compositions of Fuzzyrelations **(10 Hours)**

Fuzzy relation equations: Introduction, problem partitioning, Solution method, Fuzzy relation equations based on Sup-I compositions and Inf- w_i compositions, approximate solutions. **(10 Hours)**

Fuzzy Logic: Classical logic, an overview, multi valued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic hedges, inferences from conditional fuzzy propositions, Qualified propositions and quantified propositions. **(20 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. **(25 Hours)**

REFERENCES:

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 (19994).
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

ATMOSPHERIC SCIENCE - II (ELECTIVE B)

Atmospheric Waves and Instability: Wave motion in general, concept of wave packet, phase velocity and group velocity, Momentum and Energy transports by waves in the horizontal and vertical directions, Kelvjn and Mixed Rossby Gravity Waves, Stationary Planetary Waves.Linear barotropic (Rayleigh-Kuo type) and baroclinic (Charney, Eady and Green type) instability, Necessary condition of instability analysis-eigenvalue and initial value approach. **(20 Hours.)**

Numerical Methods for Atmospheric Models: Filtering for sound and gravity waves, filtered forecast equations, Basic concepts of quasi-geostrophic and primitive equation models, one-level and multi-level models, Basic concepts of initialization and objective analysis for wave equation, advection equation and diffusion equation.

Various numerical integration schemes, various space and time difference schemes, with reference to stability and accuracy of solution. **(10 Hours)**

Atmospheric Pollution: Basic concepts of atmospheric pollution; classification of atmospheric pollution, primary and (Secondary pollutants, photochemical and thermal reactions, gaseous and particulate pollutants, sources of pollution, fugitive emissions, pollution from single elevated stack, multiple-sources-urban pollution. Regional pollution. Global pollution. Ozone depletion, Global warming, Effects of air pollutants.

Dispersion of air pollutants; Eulerian description of turbulent dispersion, physical nature ol the atmospheric boundary layer, the properties of surface layer, stability of atmosphere, Pasquill and Monin-Obukhov's stability classifications. Eddy-diffusivity and gradient transfer approach, Reynold's equations far atmospheric flows, velocity distribution in surface stress layer following semi-empirical approach, wind profile, properties of planetary boundary layer as a whole. Similarity theon applied to neuthrf barotropic boundary layer, **(15 Hours)**

Mathematical Modelling of Air Pollution: Mathematical modelling of air pollution, Air quality models, temporal and spatial resolution of models, the Gaussian plume model, analytical

20

COMPUTER AIDED GEOMETRIC DESIGN - II (ELECTIVE B)

THEORY:

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 Casteliju algorithm, derivates, reparametrization and degree elevation, rational B-spline of arbitrary degree. **(20 Hours)**

Tensor Product Bezier Surfaces: Bilinear interpolation, direct de Casteliju 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. **(15 Hours)**

Bezier Triangles: Barycentric coordinates and linear interpolation, de Casteliju algorithm, triangular blossoms, Berstein polynomials, derivates, sub-division, differentiability, degree elevation, non-parametric patches, rational Bezier triangles, quadrics. (15 Hours)

Geometric Continuity for Surfaces: triangle-triangle, rectangle-rectangle, rectangle-triangle, filling in rectangular patches, filing in triangular patches, theoretical aspects. **(10 Hours)**

TEXTBOOK:

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

REFERENCE:

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

PRACTICALS:

1. Generation of Bezier curves passing through the given control points using Aitkufs algorithm.
2. Generation of Bezier curve passing through given control points using Lagrange polynomial
3. To construct cubic,and Quintic Hermite interpolants.
4. To construct C and C Spline curves.
5. To evaluate n^{th} degree B-spline at a parameter using knot insertion algorithm and de Boor algorithm.
6. To construct rational cubic B-spline for a given polygon.
7. Tensor product Bezier surfaces and Bezier triangles
8. To verify the degree elevation process and sub-division for tensor product Bezier surfaces and Bezier triangles.

ADVANCED TOPOLOGY -II (ELECTIVE - B)

Fundamental Groups And Homotopy Theory: Homotopy paths and mappings, the fundamental group and contractible spaces, Essential and inessential maps. Fundamental group theorem of algebra. Homotopically equivalent spaces. **(25 Hours)**

Covering Spaces: Properties of covering spaces, relation between fundamental group of covering spaces and its base. Tower correspondence and closure — preserving covers. **(15 Hours)**

Dimension Theory: M.JI. stone - Gclfard - Silvo's approximation theorem Lebsgue covering, dimension of normal spaces. Large and small inductive dimension function. The sum and subset theorem and Lemmas to Su theorem. **(20 Hours)**

REFERENCES:

1. J.Dugundgi. Topology, UBS Pub. New Delhi (1998)

properties of Gaussian plume equation, stability of plume rise and dispersion parameters, The Gaussian puff model for instantaneous release. Line source, Area source and point source models. The K-theory model for infinite line sources, the K-theory model for the infinite area source, Models for primary and secondary air-pollutants. Different removal phenomena, Modelling of accidental release of air pollutant. Long range transport models, modeling of acid rain problems (15 Hours.)

List of Assignments:

1. Solve Poisson equation of Barotropic vorticity equation using finite difference scheme.,
2. Compute geostrophic wind and mixing length.
3. Solve a simple unsteady state advection-diffusion model with chemical reaction term.
4. Compute effective stack height using Holland's formula.
5. Compute dispersion parameters er , cr_z at various atmospheric stability situations.
6. Solve an infinite line source diffusion model-using power law eddy-diffusivity and velocity profiles.
7. Compute concentration due to an area source using Gaussian plume model.
8. Compute concentration distribution due to a point source using Gaussian plume model
9. Solve a simple K-theory model for accidental release of air pollutant.
10. Solve a simple K-theory model for acid rain problems.
11. Construct and solve a simple K-theory model to obtain the effects of different removal phenomena
12. Compute concentration using solution of a K-theory model for semi-infinite area source.

REFERENCES:

1. J.R.Holton-An introduction to Dynamic Meteorology, Academic Press, 3rd Edition, 1992 (Chapters 1-3., 4.1-4.5, 5.1-5.3, 7,8.1-8.2,10.1-10.4, 13.1-13.4 & 13.6).
2. R.Ananthakrishnan-Meteorology, Madras Science Foundation, 1991 (Chapters 2.2-2.6, 3.2-3.3, 3.5,3,7,5, 7.1-7.8,8.1 & 8.2)
3. F.Pasquill and F.B.Sniith-Atmospheric Diffusion, Ellis Horwood Ltd.
4. A,C.Stern-Air Pollution , 3rd Edition, Academic Press.
5. R.A.Dobbins-Atmospheric Motion and Pollution.
6. Ghill and Childress, Topics in Geophysical Fluid Dynamics, Applied Mathematical Science, Springer veriag (1987).
7. 'Geophysical Fluid Dynamics', by Joseph Pedlosky, Springer - veriag, Berlin and New York 1979).
8. E.E.Gossard and W.H.Hooke , Waves in the Atmosphere , Elseveir, Amsterdam (1975).
9. Raudkivi, AJ. and Callander, R.A., Advanced Fluid MechanicsiAn Introduction, Edward Arnold,(U.K.)(1975).
10. Adrian E. Gill, Atmosphere-Ocean Dynamics,Aeademic Press, International "GeopEysics serial, vol. 30
11. Edited by P.Morel, Dynamical Meteorology, Reidel Publ. Dordrecht, Netherland (Chapter: Planetary Fluid Mechanics, by Charney J.G, 1973)

MAGNETOHYDRODYNAMICS-II (Elective B)

Classical MHD: Alfve'n theorem and some consequences, Bernoulli's equation and problems counter parts of Helmoltz'voticity theorem and Kelvin's circulation theorem in MHD-Ferraro's law of isorotation and some examples. (15 Hours)

Exact solutions for MHD channel flows: Poiseuiile-Hartmann and Couelte-Hartmann flows including temperature distributions-MHD flow in rectangular ducts-Applications of Hartmann flow. (10 Hours)

Waves: Alfven waves in compressible and incompressible fluids-Dispersion relation-Dissipation of Alfeven's waves-Reflection of Alfeven's waves at a discontinuity-Internal Alfeven's gravity waves- shockwaves-General shock relations-Rankines Hugoinol equation in MHD-Entropy_4umps- Friedrichs shock equations-Fast and slow shocks. (20 Hours)

MHD Stability and Convection: Meaning of stability-Methods of solving stability problems examples to illustrate the conditions using nornial mode methods-Magnetoconvection Marginal stability of fluids between parallel plates for free-free and rigid-rigid boundaries. (15 Hours)

REFERENCES:

1. V.C.A.Ferraro and Plumpton-Magnetohydrodynamics-Part I.
2. P.H.Roberts-An Introduction to Magnetohydrodynamics, Longman, London.
3. Allen Jeffrey-Magnetohydrodynamics.
4. G.W.Sutton and y^.Sherman-Engineering Magnetohydrodynamics.
5. W.F.Hughes and P.J.Young-Hlectromagnetodynamics of fluids, John Wiley and Sons, Inc., New York, (1966}.
6. T.G.Cowling-Magnctohydrodynamics.
7. L.Dragos-Magnetofluid Dynamics.
8. S.I.Pai-Magnetogas Dynamics and Plasma Dynamics, Springer-Verlag, NewYork, (1962).
9. S.Chandrashekar-Hydrodynamics and Hydromagnetic Stability of Flows.
10. M.M.Denn-stability of Reaction and Transport Processes.
11. Stratton-Electromagnetic Theory.
12. K.R.Cramer and* S.I.Pai-Magnetofluid Dynamics for Engineers and Physicists, Scripta publishing company, Washington D.C., (1973).
13. J.A.Shercliff-Magnetohydrodynamics. Pergamon press, London, (1965).
14. David J.Griffiths-Introduction to Electrodynamics, 2nd Edition, Prentice Hall of India Private Limited, New DcflhL (1989).

Computational fluid Dynamics –II

Iterative Methods-Stationary Methods. Krylov Subspace Methods. Multigrid Methods. Fast Poison Solvers. Iterative Methods for Incompressible NS Equations. (15 hours)

Shallow water Equations-One and Two Dimensional Cases. Scalar Conservation Laws-Godunov's Order Barrier Theorem, Linear schemes. (15 hours)

Euler Equation in One space Dimension-Analytic Aspects, Approximate Riemann Solver Osher Scheme. Flux Splitting Schemes. Stability. (10 hours)

James-Schmidt-Turkel Scheme. Higher Order schemes. Discretization in General Domains-Boundary Fitted Grids. Equations of Motion in General Coordinates. (10 hours)

Numerical Solution of Euler Equation in General Coordinates. Numerical Solution of NS Equations in General Domains. Unified Methods for Computing Compressible and Incompressible Flow. (10 hours)

Text Book:

1. P. Wesseling: Principles of Computational Fluid Dynamics, Springer-Verlag, 2000.

Reference Books:

1. J. F. Wendt, J.D. Anderson, G Degrez and E. Dick: Computational Fluid Dynamics An Introduction, Springer -Verlarg 1996.
2. J.D. Anderson: Computational Fluid Dynamics The Basics with Applications, McGraw-Hill, 1995.

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MHT-1.2: DISCRETE MATHEMATICS

UNIT I **25 Hours**

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

Lattices and Boolean Algebra: Partially ordered sets, Latticess, Distributive and compliment lattices. Boolean lattices and algebra. Uniqueness of finite Boolean algebra. Boolean functions and Boolean expressions. Prepositional 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)

SEMESTER-I

MHT-1.1: REAL ANALYSIS

UNIT I **15 Hours**

The Riemann-Stietje's 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-Weiestrass 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.Apoostol. 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

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

Points and vectors, Affine maps, barycdentric co-ordinates, linear and piecewise liner interpolation, Menelaos theorem, function spaces, curves and surfaces in Euclidean spaces, parametric curves and arc length, I'renet frame, Oscillating circles, Bezier curves, the dp Casleljau algorithm, properties of-Bezicr curve, the blossom, Berstcin form of Bezier curve, the derivative of Bezier curve, sub division, blossom and the polar.

(20 Hours)

Degree elevation, repeated degree elevation, variation demising properly, degree reduction, non-parametric curves, cross plots, different forms of Bezier curves, Weirstrass 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, Berline 1988.

2. C De Boor – A practical guide to splines , Springer Verlag 1978.
3. G.Farin (Ed)- N'URBS for curves and surfacdes design SIAM, Philadelphia, 1991
4. L.Schumakef- Spline functions: Basic theory, John Wiely, 1991
5. Famaguchi-Surves and Surfaces in computer aided Geometric design, Springer, 1998

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

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 Cures, 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 Casteliju algorithm, derivates, reparametrization and degree elevation, rational B-spline of arbitrary degree.

UNIT II **10 Hours**

Tensor Product Bezier Surfaces: Bilinear interpolation, direct de Casteliju 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 coordinats and linear interpolation, de Casteliju algorithm, triangular blossoms, Berstein polynomials, derivates, 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, filing in triangular patches, theoretical aspects.

Text Book:

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

Reference:

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

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 2 -process. Newton Raphson methods formultiple 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-Lagaurre, Gauss-Hermite and error analyses, adaptive quadratures, multiple integration with constant and variable limits.

Text Books:

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

Reference Books:

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

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 (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 theoremand 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.

1.1.2 Mathematics

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, cusets. 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)

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: Oprations on graphs, Combinatorial and Geometric graph, planna graph, plane graph, Maximal planar graph, Detection of planarity, subdivision of graph, inner vertex set, inner vertex number, outer plannar, minimally nonouter plannar graph, Geometric dual and its properties, crossing number and thichness 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, uniqyely 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)

REFFRENCE 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 BOOKS:

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.

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.