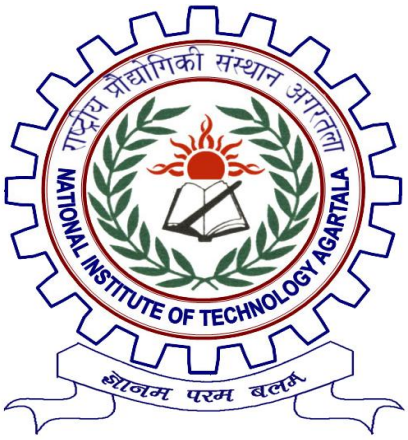
National Institute of Technology, Agartala

Department of Mathematics



Mathematics and computing Syllabus of

Integrated BS-MS Dual Degree

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

TRIPURA

Proposed Integrated BS (4-year) / MS (5-year) programme for Mathematics and computing

Semester-I

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Physics-I	DSPH11B01	3	1	0	4
2	Chemistry-I	DSCY21B01	3	1	0	4
3	Mathematics-I	DSMA31B01	3	1	0	4
4	Language and Technical Writing	DSHU41B01	2	0	1	3
5	Physics Lab-I	DSPH11P01	0	0	3	2
6	Chemistry Lab-I	DSCY21P01	0	0	3	2
Total Contact hrs per week =			**Total Credit = 19**			

Semester-II

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Physics-II	DSPH12B02	3	1	0	4
2	Chemistry-II	DSCY22B02	3	1	0	4
3	Mathematics-II	DSMA32B02	3	1	0	4
4	Basic environmental and atmospheric science	DSCY22B03	3	0	0	3
5	Physics Lab-II	DSPH12P02	0	0	3	2
6	Chemistry Lab-II	DSCY22P02	0	0	3	2
Total Contact hrs per week =			**Total Credit = 19**			

Semester-III

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Ordinary Differential Equation	DSMA33B03	3	1	0	4
2	Abstract Algebra-1	DSMA33B04	3	1	0	4
3	Probality & Statistics	DSMA33B05	3	1	0	4
4	Programming	DSMA33B06	3	1	0	4
5	Programming Lab	DSMA33P01	0	0	3	2
6	Statistics Lab	DSMA33P02	0	0	3	2
Total Contact hrs per week			**Total Credit = 20**			

Semester-IV

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Real Analysis	DSMA34B07	3	1	0	4
2	Linear Algebra	DSMA34B08	3	1	0	4
3	Partial Differential Equation	DSMA34B09	3	1	0	4
4	Numerical Analysis	DSMA34B10	3	1	0	4
5	Data Structure & Algrithm	DSMA34B11	3	1	0	4
6	Numerical Methods lab	DSMA34P03	0	0	3	2
Total Contact hrs per week			**Total Credit = 22**			

Semester-V

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Linear Programing and Game Theory	DSMA35B12	3	1	0	4
2	Statics & Dynamics	DSMA35B13	3	1	0	4
3	Integral Transforms & Applications	DSMA35B14	3	1	0	4
4	Fuzzy Set, Rough Set and Applications	DSMA35B15	3	1	0	4
5	Lab Work on Data Structure & Algorithm	DSMA35P04	0	0	3	2
Total Contact hrs per week			**Total Credit = 18**			

Semester-VI

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Complex Analysis	DSMA36B16	3	1	0	4
2	Discreate Mathematics	DSMA36B17	3	1	0	4
3	Stochastic Processes	DSMA36B18	3	1	0	4
4	Objective Oriented Programming	DSMA36B19	3	1	0	4
5	Number Theory & Cryptology	DSMA36B20	3	1	0	4
Total Contact hrs per week			**Total Credit = 20**			

Semester-VII

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Measure Theory	DSMA37B21	3	1	0	4
2	Topology	DSMA37B22	3	1	0	4
3	Abstract Algebra-II	DSMA37B23	3	1	0	4
4	Classical & Continuum Mechanics	DSMA37B24	3	1	0	4
5	Formal Language and Automata Theory	DSMA37B25	3	1	0	4
Total Contact hrs per week			**Total Credit = 20**			

Semester-VIII

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Functunal Analysis	DSMA38B26	3	1	0	4
2	Tensor Calculus & Riemanian Geometry	DSMA38B27	3	1	0	4
3	Differential Geometry	DSMA38B28	3	1	0	4
4	Soft Computing	DSMA38B29	3	1	0	4
5	Project Work / Summer Internship	DSMA38S01	0	0	0	4
6	Departmental Semeinar-I	DSMA38S02	0	0	0	2
Total Contact hrs per week			**Total Credit = 22**			

Semester-IX

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Intregral Equations & Calculas of Variation	DSMA39B30	3	1	0	4
2	Elective-I	DSMA39E01	3	1	0	4
3	Elective-II	DSMA39E02	3	1	0	4
4	Research Project-I	DSMA39S03	0	0	0	6
5	Departmental Semeinar-II	DSMA39S04	0	0	0	2
Total Contact hrs per week =			**Total Credit = 20**			

Semester-X

Sr. No.	Name of the Subject	Code	Teaching Scheme			credit
			Hours per Week			
			L	Tu.	Pr.	
1	Elective-III	DSMA310E03	3	1	0	4
2	Elective-IV	DSMA310E04	3	1	0	4
3	Research Project-II	DSMA310S05	0	0	0	8
4	Departmental Seminar-III	DSMA310S06	0	0	0	2
5	Comprehensive Viva-Voce	DSMA310S07	0	0	0	2
Total Contact hrs per week =			**Total Credit = 20**			

COURSE STRUCTURE

ELECTIVE-I

1) OPERATION REASEARCH-I
2) BIOMATHEMATICS-I
3) FLUID MECHANICS-I
4) SOLID MECHANICS-I

ELECTIVE-III

1) OPERATION REASEARCH-II
2) BIOMATHEMATICS-II
3) FLUID MECHANICS-II
4) SOLID MECHANICS-II

ELECTIVE-II & IV

1) STOCHASTICS PROCESS
2) STATISTICAL INFERENCE
3) COMPUTATIONAL FLUID DYNAMICS & MAGNATO FLUID DYNAMICS
4) COMPUTER ORGANISATION AND ARCHITECTURE
5) NUMBER THEORY & CRYPTOGRAPHY
6) FINANCIAL MATHEMATICS
7) OPERATING SYSTEMS
8) COMPUTER NETWORKING
9) ALGEBRAIC TOPOLOGY
10) WAVELETS AND APPLICATION
11) LIE ALGEBRA
12) DATA MINING AND WARE HOUSING
13) OPERATOR THEORY
14) HISTORY OF MATHEMATICS
15) ADVANCED TOPOLOGY
16)DECISION THEORY & COMPUTATIONAL STATISTICS
17)THEORY OF OPERATIONS AND BANACH ALGEBRA

SEMESTER -I

PHYSICS-I

Mathematical Preliminary:

Vector Differentiation, Scalar and Vector Fields, Directional Derivatives, Vector Differential Operator, Gradient, Divergence, Curl, Line, Surface & Volume integrals and their applications, Green's theorem.

Mechanics:

Newton's laws of motion for a system of particles, Constraints, D'Alembert's Principle, Generalized Coordinates, Generalized velocity and momentum, Lagrangian formulation, Hamiltonian formulation.

Physics of Waves:

Simple Harmonic Motion, superposition of two linear SHMs, Lissajous figures, Damped Vibration:-differential equation and solution, critical damping, logarithmic decrement, analogy with electrical circuit, Normal mode analysis (Matrix Inversion) Progressive waves, Forced Vibration, Amplitude and Velocity Resonance, sharpness of resonance and quality factor.

Time Varying Field and Maxwell's Equation:

Laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Eddy Current, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic Waves in Free Space and Conductors, Solution of propagation of Plane Electromagnetic Wave in free space and conductors, Concept of Field Energy (Poynting Vector)

Optics: Interference, Diffraction, Polarization

Interference: Coherence (temporal and spatial), Fresnel's Bi-prism, Interference of Light due to division of amplitude (Newton's Ring), colour of thin film.

Diffraction:

Types of Diffraction, Difference between Interference and Diffraction, Fraunhofer Diffraction at a Single Slit and Double slit, Plane transmission diffraction grating spectra, Comparison between Prism and Grating Spectra, Resolving Power of Microscope, Telescope and other optical instruments and limit of resolution.

Polarization:

Plane of Vibration and Plane of Polarization, Classification of Polarized Light, Preferential direction in a wave; polarized light; natural light; production of linearly polarized light; Methods of Producing Plane polarized light: Brewster's law and Malus Law, Nicol's Prism:

polarizer and analyzer; Polaroid, Anisotropic crystal; calcite crystal; Huygens' explanation of double refraction; Huygens' construction of wave fronts; experimental determination of principal refractive indices; electromagnetic theory of double refraction; phase difference between o – ray and e – ray; superposition of waves linearly polarized at right angles; types of polarized light; effect of polarizer on transmission of polarized light; retarders or wave plates; Birefringes, Babinet Compensator;.

Suggested Books

1. H. Georgi, Physics of Waves
2. Rana & Joag, Classical Mechanics, Tata McGraw-Hill Education, India.
3. Waves - Pain
4. D. J. Griffith, Introduction to Electrodynamics, PHI Pubs.
5. Hecht, Optics
6.A. Ghatak, Optics, Tata Mc Graw Hill
7. Feynman Lectures on Physics
8. Berkley Physics – Vol I & II

Chemistry-I

Atomic structure

Rutherford's model for atom, Bohr's model, Bohr's orbit, radii, energy, ionization potential, atomic spectra and atomic number. Hydrogen atom: Spectra, Balmer formula, Rydberg formula, Bohr's interpretation of atomic spectra, Bohr's correspondence principle, Moseley's experiment, fine structure of spectra and Somerfield's new energy states, Zemman effect: magnetic quantum number, vector model of atom, quantum numbers, Pauli exclusion principle, Hund's rule for atomic spectra, Aufbau principle, coupling scheme and atomic states in the vector model, qualitative description of s-, p-, and d-orbitals, electronic configuration for many electron system. Nature of bonding: covalent and ionic bonds.

Periodic Table and Properties of Elements

Long periodic Table, extended Periodic Table: classification of elements: s-, p-, d-, and f-block elements, post actinides and super actinides, important properties of elements and their periodic trends: atomic and ionic radii, ionization potential, electron affinity and electronegativity, different electronegativity scales, screening effect, effective nuclear charge, Slater's rules, inert pair effect, melting points; boiling points; diagonal relationship.

Basic organic chemistry

Different classes of organic molecules and their mechanistic classification: Ionic, radical and pericyclic reactions; heterolytic bond cleavage and heterogenic bond formation, homolytic bond cleavage and homogenic bond formation. Nomenclature IUPAC. Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions, free radicals, carbenes and arenes.

Gaseous and liquid states

Gaseous states: Gas laws, kinetic theory of gases, derivation of gas laws from kinetic theory. Maxwell theory of velocity distribution. Mean free path. viscosity of gases. Real gases, Van der waal's equation of state, Virial coefficients and equation of state.

Liquid state: Physical properties of liquids and their measurements. Surface tension and viscosity.

References

1. J. D. Lee, Concise Inorganic Chemistry, 4th Ed., ELBS, 1991.
2. G. L. Miessler, D. A. Tarr, ***Inorganic Chemistry***, 3rd Edition, Pearson, Delhi, india.
3. R. L. Dutta, Elementary Inorganic Chemistry, 5th Ed. The New Book Stall, Calcutta.
4. R. Sarkar, ***General Chemistry Part-I and Part-II***, New Central Book Agency (P) Ltd.
5. A. K. Das, ***Fundamental Concepts of Inorganic Chemistry Part-I and Part-II***, CBS Publishers & Distributors, New Delhi.
6. J. H. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, ***Inorganic Chemistry: Principle of structure and reactivity***, 4th Ed., Pearson, New Delhi.
7. Shriver & Atkins, ***Inorganic Chemistry***, 4th Ed., Oxford University Press, Delhi
8. T. W. Graham Solomon, C. B. Fryhle, *Organic Chemistry*, John-Wiley and Sons.
9. J. March, *Advanced Organic Chemistry: Reactions Mechanism and Structure* John-Wiley and Sons
10. R. T. Morrison and R. N Boyd, 'Organic Chemistry', Prentice Hall.
11. Peter Sykes, 'A guide Book to Mechanism in Organic Chemistry,' Longman.

12. D.A. McQuarrie and J.D. Simon, Physical Chemistry, Viva Books
13. Elements of Physical Chemistry by Peter Atkins & Julio De Paula, 5/E, Oxford University Press, Indian Edition
14. P.W. Atkins, Physical Chemistry, 7th ed. Oxford University press 2006

MATHEMATICS-I

Theory of Equations:

Theory of equations: Polynomials with real coefficient, synthetic division,statement of fundamental theorem of classical algebra. Surds and complex roots occur in pairs. Statement of Descartes' rule of sign and its applications. Relations between root and coefficient, symmetric functions of roots. Transformation of equations. Standard form of cubic and bi – quadratic equations. Cardan's solution of cubic equations. Descartes' and Ferrari's method of solving bi – quadratic equations.

Inequalities : Definitions and elementary properties, examples. Theorems on A. M., G.M and H.M. Their generalization theorem of weighted mean and m-th power theorem. Statement of Cauchy-Schwartz inequality, Weierstrass inequality and their applications.

Determinants:

Definition, properties, Minors, Co-factors, expansion of determinants: Laplace's method, examples. product of two determinants, adjoint and reciprocal determinants, Jacobi's theorem,symmetric and skew-symmetric determinants, their properties. Cramer's rule, consistency of equations, examples.

Matrix Theory:

Adjoint , Reciprocal,Symmetric and skew symmetric matrices, Hermitian and Skew-Hermitian matrices, minor and cofactors, orthogonal and singular matrix, adjoint and inverse of matrix up to 3×3 matrices, application of matrices to a system linear equations (both homogeneous and non-homogeneous) with not more than three unknowns, theorem on consistency of a system of linear equations.Rank of a matrix. Elementary transformations.Linear independent of row and column matrices. Row rank and column rank of two matrices. Equality of row rank , column rank and rank of a matrix. Finding rank of a matrix by considering minor or sweep out process. Rank of sum and product of two matrices. Rank (A+B)<RankA + RankB, Rank(AB)≤ Min(RankA, RankB).Trace of a matrix. Characteristics polynomial & characteristics equations, Eigen-values, eigen vectors and the characteristic equation of matrix, Caley-Hamilton theorem and its use in finding inverse of matrix, some basic theorems. Real quadratic forms, Index, Rank, Signature.Theorem of consistency of a system of linear equations, Linear equations. Consistency of a system of equations. Number of solutions of a non-homogeneous system. Homogeneous system of

equations, solution of linear equation with not more than three unknown by matrix method. Solution of matrix equation, examples.

Theory of Complex Number

Definitions, properties. Geometrical representation of a complex number: Argand diagram. Modulus and Amplitude. Properties of moduli and amplitudes of complex numbers. Examples.

DeMoivre's theorem and its applications. Examples.

Exponential, sine, cosine and logarithm of complex number. Direct and inverse circular and hyperbolic functions. Expansion of trigonometry functions, Gregory's series. Summation of series.

Vector algebra:

Revision of Vector, Scalar and vector product of two vectors. Scalar and vector triple product. Product of four vectors. Reciprocal vectors. Position vector, Simple applications to geometry. Vector equations of straight line, plane and circle. Volume of a tetrahedron. Shortest distance between skew lines. Applications to mechanics: work done, torque.

Vector Calculus:

Vector function, limit and continuity, derivative of vector, derivative of sums and product of vector functions. Tangent vector to a curve at a point, Scalar and vector point function. Gradient, Normal. Directional derivative. Examples. Divergence, Physical interpretation of Divergence. Curl, Physical interpretation of Curl, Properties of gradient, divergence and curl. Sum, difference, products, Second order differential operator. Laplacian operator.

References:

1. The theory of equations(Vol. I)- Burnside and Panton
2. Higher Algebra- Barnard and Child
3. Vector Analysis-Louis Brand
4. Vector Analysis- Barry Apain
5. S.Ponnusamy-Foundation of Complex Analysis;Narosa
6. Vector Analysis-Maity and Ghosh, New Central Book Agency.
7. Vector Analysis- Schaum's series, Tata McGrawHill

PHYSICS LAB-I

[*At least seven experiments are to be performed*]

1. Determination of MH and M/H of a bar magnet.
2. To determine the Young's Modulus of the material of a beam by bending of beam method.
3. Determination of unknown resistance of a given wire the help of Carey-Foster Bridge.
4. To determine the Dispersive power of the material of the prism, angle of prism is supplied.
5. Determination of Rigidity Modulus of a wire using dynamic method.
6. Determination of surface tension of water by capillary tube.
7. Determination of Wavelength of light by Newton's ring.
8. Study of polarization of light.
9. To determine the wavelength of Laser by diffraction grating method.
10. Verification of Stefan's law.
11. To determine the Numerical aperture & bending coupling losses of an Optical fiber by quick approximation method.

CHEMISTRY LAB-I

1. (a) Preparation of standard solution of oxalic acid and standardization of NaOH solution and $KMnO_4$ solution.
(b) Preparation and standardization of Mohr's salt solution by KMnO4 solution.
(c) Preparation of standard $K_2Cr_2O_7$ solution and standardization of Mohr's salt solution and sodium thiosulphate solution.
(d) Preparation and standardization of Na_2EDTA solution.
2. Analysis of water samples by BOD and COD.
3. Estimation of Iron in water.
4. Preparation of organic and inorganic compounds using green chemistry principle

I. Benzilic acid,
II. Dibenzalpropanone,
III. Acetanilide,
IV. Biodiesel.
V. $[Cu(NH_3)_4]SO_4.H_20$
VI. $[Mn(acac)_3]$

References

1. ***Vogel's Textbook of Quantitative Chemical Analysis***, 5th Ed., ELBS with Longman.
2. R. A. Day, A. L. Undrwood, ***Quantitative analysis 6th Ed.***, Prentice-Hall of India (P.), Ltd., New Delhi
3. W.G. Palmer,***Experimental Inorganic chemistry***, Cambridge University Press (1962

SEMESTER -II

PHYSICS-II

Introduction to Quantum Mechanics:

Particle properties of wave: Planck's hypothesis, Wave properties of particle: De Broglie wave as mater waves, Davison-Germer experiment, Heisenberg's uncertainty principle and its application, Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box, Eigen values and Eigen function.

Concepts of Solids:

Statistical distributions, M-B, B-E and F-D statistics (*No Derivations)* and their simple applications, Planck's radiation law, Degenerate Fermi Gas.

Crystalline and amorphous solids, crystal structure, Bravais Lattice, Packing Fraction, Crystallographic planes and miller indices, Inter-planer spacing (cubic system only), Bragg's diffraction, Crystal structure analysis, Lattice Vibration, Electrons in a crystalline solid.

Plasma Physics:

Definition of plasma and collective behaviour, concept of temperature, quasineutrality and Debye shielding, criteria for plasmas, plasma oscillations, Single particle motions in - uniform and non-uniform electric and magnetic fields, time varying electric and magnetic fields, Applications of Plasma.

Introduction to Laser and Optical Fiber:

Spontaneous and stimulated emission, Einstein's A-B coefficient, meta-stable state, population inversion, basic principle of laser (three and four level), optical cavity and resonator, Ruby and He-Ne laser.

Propagation of light in fiber, step and graded index fiber, numerical aperture, attenuation in optical fiber, introduction of optical window, application of laser and optical fiber.

Relativity:

Reference Frames, Lorentz Transformation, Postulates of Relativity, Relativistic Mass & Mass-Energy Equivalence.

Suggested Books

1. Plasma Physics and Controlled Fusion, Francis F. Chen, Springer Pub.
2. Lasers, Fundamentals and Applications, K. Thyagrajan, A. Ghatak, Springer Pub.
3. K. Huang, Statistical Mechanics
4. D.C. Tayal, Nuclear Physics, 4th edition, Himalaya House, Bombay
5. Kittel, Introduction solid State Physics, Willy Eastern Limited
6. A.K.Ghatak and S.Lokanathan, Quantum Mechanics, Macmillan India Limited
7. B.K. Agarwal, Elements of Statistical Mechanics
8. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg and Resnick, Wiley India Pvt. Ltd.

Chemistry-II

Chemical Bonding and Structure-I

Introduction to chemical bonding , ionic compounds: lattice energy: calculation and implications, solvation energy, Born-Haber cycle and its applications, Fajan's rules and its applications

Covalent compounds: sigma and pi-bonds, hybridization, Bent's rule of hybridization, resonance, dipole moment, Geometry: Qualitative description of VBT and MOT (diatomic homo and heteronuclear molecules), VSEPR theory, hydrogen bonding, hydrogen bridge bond, delta-bond, metal-metal bond.

Basic stereochemistry

Elements of symmetry: simple axis, plane of symmetry, center of symmetry, alternate axis of symmetry, chirality, optical activity, specific rotation, optical purity. Configuration: Types of isomerism. Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis - trans nomenclature; Concept of chirality.

Chemical Kinetics and Chemical equilibrium:

Order and molecularity of a reactions, rate laws and rate equation for first order, second order, and zeroth order reactions. Determination of order of reactions, Energy of activation .

Catalytic reactions: homogeneous and heterogeneous catalytic reaction. Enzyme catalyzed and auto catalyzed reactions, Michelis-Menten equation. General Characteristics of catalytic reactions.

The law of mass action, equilibrium constants, the reaction isotherms, the reaction isochore, Le chatelier's principle.

Coordination Chemistry-I

Addition compounds: double salts and complex salts; Werner's theory; ligands and denticity, classification of ligands, pi-acidic ligands, macrocyclic ligands, chelates, chelate effects, chelation therapy, supercomplex, geometry, coordination number; IUPAC nomenclatures; isomerism: structural and stereoisomerism: geometrical and optical, facial amd meridional isomers, chirality,

Thermodynamics - I

Definitions of systems and surroundings**:** Thermodynamic systems: Open, Close, isolated, state of a system;, state function; Variables: Intensive, Extensive properties.

Thermodynamic process: Cyclic, reversible, irreversible, isothermal, adiabatic, isochoric, isobaric. Concept of heat, work, energy, internal energy. Concept of thermal equilibrium and Zeroth law of thermodynamics, Graphical explanation of work done during expansion and compression of an ideal gas.

First law of Thermodynamics. Concept of enthalpy and as a state function: Heat change at constant volume and constant pressure, relation between C_p&$C_v$using ideal gas and van der Waals equations.

Second law of thermodynamics.Concept of entropy, Gibb's free energy, Helmholtz's free energy.Carnot's cycle.

References

1. J. D. Lee, Concise Inorganic Chemistry, 4th Ed., ELBS, 1991
2. G. L. Miessler, D. A. Tarr, ***Inorganic Chemistry***, 3rd Edition, Pearson, Delhi, india.
3. R. L. Dutta, Elementary Inorganic Chemistry, 5th Ed. The New Book Stall, Calcutta.
4. R. Sarkar, ***General Chemistry Part-I and Part-II***, New Central Book Agency (P) Ltd.
5. A. K. Das, ***Fundamental Concepts of Inorganic Chemistry Part-I and Part-II***, CBS Publishers & Distributors, New Delhi.
6. J. H. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, ***Inorganic Chemistry: Principle of structure and reactivity***, 4th Ed., Pearson, New Delhi.
7. Shriver & Atkins, ***Inorganic Chemistry***, 4th Ed., Oxford University Press, Delhi
8. T. W. Graham Solomon, C. B. Fryhle, *Organic Chemistry*, John-Wiley and Sons
9. J. March, *Advanced Organic Chemistry: Reactions Mechanism and Structure* John-Wiley and Sons.
10. Finar I. L., 'Organic Chemistry' volume 1, Longman, London.
11. E. L. Eliel, 'Stereochemistry of carbon compounds,; Tata-McGraw Hill.
12. Peter Sykes, ' A guide Book to Mechanism in Organic Chemistry,' Longman.
13. P.S.Kalsi, 'Organic Reactions, Stereochemistry and Mechanism,' New age International Ltd.
14. D. Nasipuri, Stereochemistry of Organic Compounds, New age International
15. G.M. Barrow, 'Physical Chemistry' 5th ed. Tata Mc.Grow Hill, New Delhi, 1992
16. P.W Atkins, Physical Chemistry, 7th ed. Oxford University press 2006
17. G.W Castellan, 'Physical Chemistry' 4th ed. McGrow Hill 1999

MATHEMATICS-II

Calculus

Differential Calculus:

Revision of basic Calculus, Sequence and series: Limit of sequence. Convergent and non convergent Cauchy sequence, Convergence of infinite series. Statement and use of different tests for convergence of series of non-negative terms.

Functions of several variables -1

Limits and continuity (definition and examples only).
Partial derivative. Composite function. Implicit function. Total differentials, Statement of Schwartz's and Young's theorem on commutative property of mixed derivative. Euler's theorem of homogeneous functions of two variables. Statement of Taylor's theorem for functions of two variables.

Functions of several variables-2:

Jacobian, maxima, minima, saddle points of functions of two points (examples only); Application of partial differenciation, Jacobians.

Application :

Tangent normal sub tangent and sub normal. Length of tangent and normal. Angle between radius vector and tangent. Length of arc and its derivative. Differential of are length in polar form. Curvature. Radius of curvature. Cartesian and polar curve. Newtonian method to find radius of curvature at the origin. Centre and circle of Curvature. Evolute, Envelopes. Curve tracing,Rectilinear asymptote for Cartesian and polar curve,Concavity, Convexity, Singular points. Nodes. Cusp, points of inflexion, simple problems on species of cusps of a curve (Cartesian curves only). Familiarity with the figure of the following curves: Periodic curves with suitable scaling, cycloid, catenary, lemniscape of Bernoulli, Astroid, Cardiode, Folium of Descartes, equiangular spiral. Area enclosed by a curve, determination of C.G., moments and products of inertia(Simple problems only).

Integral Calculus:

Definite integral as limit of the sum. Geometric interpretation of definite integral. Fundamental theorem of integral calculus. Properties of definite integral. Evaluation of definite integral.Definition of improper integrals, example. Definition and simple properties of beta & Gamma functions & their uses (convergence and important relations being assumed) Areas of Plane curves(Quadrature), Rectification of plane curves. Volume and surface area of solid formed by revolution of plane curves and areas about x-axis and y-axis, Working knowledge of double and triple integrals, change of order of integration,

Differentiability and integrability of an integral of a function of a parameter. Differentiability under the sign of integration, statements of necessary theorems. Centroid. Centroid of arc, plane area, volume and surface area of revolution.

References:

1. Advanced Calculus-David Widder(Prentice Hall)
2. 2. Differential and Integral Calculus(Vol-I and II)-Courant and John

Basic Environmental and Atmospheric Science

Introduction To Environmental Sciences

Introduction to the Environment. Acquisition, transformation and utilization of energy: the geochemical, biogeochemical and hydrological cycles. Concept of ecosystem.

Biodiversity. Problems and issues in biodiversity and forestry. Conservation and utilization of biodiversity. Global warming and climate change. Recent records of climate change. Impact of climate change on Indian environment. Measures to cope with climate change.

Mineral and energy resources. Impact of mining and other human activities on the environment.

Environmental impact assessment and environmental audit: an introduction. Environmental policy matters and law.

Suggested readings:

1. Anjaneyulu. Y, 2004, Introduction to Environmental Science. B. S. Publications.
2. D. Daniel Chiras, 2001, Environmental Science, 6th Ed., Jones and Bartlett Publishers.
3. De, A. K., Environmental chemistry, 5th Ed., 2005, New Age International (P) Ltd., New Delhi.
4. Subramanian. V, 2002, A text book in Environmental Science, Narosa Publishing House, New Delhi.
5. Wright. R.T, and Nebel. B. J, 2004, Environmental Science, 8th Ed. Prentice Hall India Ltd.

Environmental Pollution And Health

Air pollution: Composition of pollutants and sources. Disease associated with their Pollutants. Air quality monitoring, National and international standards for monitoring air quality. Quality of indoor air and its effect on health. Ventilation: standards, methods and health hazards. Analysis of gas effluents, SO_2, NO_x ,CO_2 etc.

Water Pollution: Sources and types of water pollutants; Ground water and surface water pollution;

Sampling and analysis and measurement of water; Water quality standards; Effects on aquatic ecosystem, Heavy metal (Arsenic, Cadmium, Lead, Mercury, fluoride, nitrate) analysis with respect to health significance. Disease related to these pollutants. Measurement of DO, BOD and COD.

Soil Pollution: Introduction, Major routes of soil pollution. Some important pollutants in soil. Diseases related to soil pollution.

Noise pollution: Sound wave ants its characteristics: Hearing of sound. Measurement of noise level, Noise levels at different sources, Effects of noise on human health.

Industrial Pollution: Introduction, characterization of industrial wastes present in Effluents, Types of industrial wastes in Effluents, Treatment and disposal of industrial Effluents.

Radiation Pollution: Introduction, Nature of radioactive Emission, Units for measurement of radioactivity and radiation. Effects of radiation on Human Health. Radioactive Fallout.

Pollution from Agriculture – Pesticides and Fertilisers: General aspects and classification. Major disasters from pesticides and herbicides, Fertilizers and environmental hazards from fertilizers.

Pollution control in India: Government obligation, mechanism and legislation in the context of public health.

Suggested readings:

1. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and allied (P) Ltd.
2. Leslie collier, Balows Albert and Sussman Max, Topley and Wilson's Microbiology and Microbial infections. Oxford University Press.
3. Murray J.F. and Nadel. J.A., 2000, Text book of respiratory medicine, 3rd Edn., W.B. Saunders & Co.
4. Park. J.E. and Park. K., 1994, Text book of preventive and social medicine, Banarsi Das & Bhanot, Jabalpur.

Green Chemistry:

Introduction, Principle and Concepts of Green Chemistry [10 L]

What is green Chemistry? Need for green chemistry; inception and evolution of green chemistry; twelve principles of green chemistry with their explanations and examples; designing a green synthesis using these principles; green chemistry in day to day life.

Suggested Books and References:

1. Green Chemistry, theory and practice. Paul T. Anastas and John C. Warner.
2. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and allied (P) Ltd.
3. Organic Synthesis in Water, Paul A. Grieco Blackie.

PHYSICS LAB-II

Experiment 1: Determination of damping constant of the Pohl's pendulum for different eddy damping current. Estimation of the natural frequency of the Pohl's pendulum.

Experiment 2: Determination of the co-efficient of viscosity of a liquid from its rate of flow through a capillary tube.

Experiment 3: To construct a one ohm coil.

Experiment 4: Determination of the frequency of a tuning fork by Melde's Apparatus.

Experiment 5: Determination of Acceleration due to Gravity (g) by a Kater's pendulum.

Experiment 6: Determination of moment of inertia of a body about an axis passing through its centre of gravity and perpendicular to its length.

Experiment 7: Measuring unknown wavelength of a laser with a diffraction grating.

CHEMISTRY LAB-II

1. To determine the viscosity of aqueous solution of ethanol/glycerol/amyl alcohol.
2. To determine the surface tension of a given solution of aqueous solutions of NaCl/acetic acid.
3. Verification of Lambert-Beer's law
4. To determine the specific reaction rate constant of the acid catalyzed hydrolysis of methyl acetate/ethyl acetate at room temperature.
5. Determination of Fe(II), Fe(III), Cu(II), Ca(II), Mg(II), Zn(II) and Cl^- in their respective compounds volumetrically through redox, precipitation and complexometric titrations.
6. Determination of hardness of water.
7. Determination of functional groups in organic conpounds.

References

1. ***Vogel's Textbook of Qualitative Inorganic Analysis***, 5th Ed., ELBS with Longman.
2. W.G. Palmer, ***Experimental Inorganic chemistry***, Cambridge University Press (1962)

SEMESTER-III

Ordinary Differential Equation

Differential equation, Significance of ordinary differential equation. Geometrical and physical consideration. ODE of first order and first degree. Statement of existence theorem.

Variable separation method. Homogeneous and exact differential equations. Condition of exactness. Integrating factor. Rules of finding integrating factor.Non-exact differential equations reducible to exact form. Exactness in second order, Linear differential equation and equations reducible to the linear form. Bernoulli's equation. First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions, Linear differential equations with constant coefficients. Homogeneous and non-homogeneous linear ordinary differential equations. Linear differential equations of higher order. Complementary function. Method of Undetermined Coefficients. Symbolic operator D.

Second order linear equations with variable co-efficients. Reduction of order when one solution of the homogeneous part is known. Complete solution, Method of variation of parameter. Reduction to normal form, Change of independent variable, Transformation of the equation by changing the dependent variables / the independent variable, Method of variation of parameters. Ordinary simultaneous differentia equations with constant coefficients, Higher order ordinary differential equations with variable coefficients reducible to known forms, Wronskian, Normal form of the equation of the second order. Simple eigen value problems, Application of ODE of first order and first degree. Orthogonal trajectories. Electric circuit. Mechanical system. Applications of higher order linear differential equations. Simple harmonic motion. Simple pendulum. Oscillation of Spring. Deflection of Beam, Ordinary and regular point. Series solution of ordinary differential equations, Series solution of differential equation

References:

1. Integral Calculus-Das and Mukherjee, U.N.Dhur and Sons
2. Integral Calculus-Maity and Ghosh, New Central Book Agency

Abstract Algebra-I

Groups, Subgroups, Centralizers, Normalizers, Stabilizers, Kernels, Cyclic groups, Subgroups generated by a subset of a group, Quotient groups, Lagrange's theorem, Homomorphisms, Isomorphism theorems, Composition series, Solvable groups, Nilpotent groups, Symmetric group, Alternating group, Group actions, Permutation representations, Automorphisms, p-groups, The Sylow theorems, Simplicity of the Alternating group, Direct products of groups, Fundamental theorem of finitely generated abelian groups, Groups of small orders, Rings, Ring homomorphisms, Ideals, Ring of fractions, The Chinese remainder theorem, Euclidean domains, Principal domains, Unique factorization domains, Matrix rings, Polynomial rings, Irreducible Criteria, Eisenstein's criterion.

Essential Reading:

1. D. S. Dummit & R. M. Footee, *Abstract Algebra*, Wiley, 2008

Supplementary Reading :

1. N. Herstien, *Topics in Algebra*, Wiley, 2008
2. J. J. Rotman, *An Introduction to the Theory of Groups*, Springer, 1999.

Probability & Statistics

Probability:

Frequency and Axiomatic definition of probability, Random Variable, Probability distribution function, discrete and continuous random variable, probability mass function, probability density function, Binomial, Poisson, Beta, Gama, Uniform and normal distribution. Poisson process. Transformation of random variables, Transformation of one

dimensional random variable(simple applications), Two dimensional probability distributions, discrete and continuous distribution in two dimensions, Uniform distribution and two dimensional normal distribution. Conditional distribution. Transformation of random variables in two dimensions, Mathematical expectation, mean, variance(simple problems), moments, central moments, measures of location, dispersion, skewness and kurtosis, median, mode, quartiles,Moment generating function, characteristic function, statement of their uniqeness, Two dimensional expectation, covariance, correlation co-eficient, joint characteristic function, multiplication rule for expectation, conditional expectation. Regression curves, least squre regression lines and parabolas,Chi-squre and t-distribution and their important properties. Tchebychev's inequality,Convergence in probability, Bernoulli's limit theorem, Law of large numbers, Poisson's approximation to binomial distribution and normal approximation to binomial distribution. Statement of central limit theorem in case of equal components.

Statistics:
Random sample, concept of sampling and various types of sampling, sample and population. Collection, tabulation and graghical representation, grouping of data, sample characteristic and their computation, sampling distribution of statistic, Estimates of population characteristic or parameter, point estimation and interval, estimation, criterion of a good point estimate, maximum likelihood estimate. Interval estimation of population proportion, interval estimation of a Normal population parameters, estimate of population parameters with large sample when distribution of
the population is unknown, Testing of Hypothesis, null hypothesis and alternative hypothesis. Type one and type two error, testing of hypothesis for a population proportion and Normal population parameters and large sample test for population with unknown distribution, Chi-square test of goodness of fit.

References:

1. Ground Work of Mathematical Probability and Statistics-Amritabha Gupta, Academic Pub.
2. Mathematical Statistics-Gupta and Kapur-Sultan Chand.
3. Statistical Methods,Vill-I and II-N.G.Das
4. Linear Programming Problem- Chakroborty and Ghosh-U.N.Dhur and Sons
5. Operations Research-Kantiswarup et. al, Sultan Chand and Sons.
6. An Introduction to Linear Programming and Game theory-S.Vajda
7.B.R.Bhat – Modern Probability Theory
8. K.L.Chug – Elementary Probability Theory & Stochastic Processes
9. Hoel , Port and Stone – Introduction to Stochastic Processes
10. J.Lamperti-Stochastic Processes
11. S.K.Srinivasan and K.M.Mehta- Stochastic Processes

Programming

PROGRAMMING IN C : review of basic concepts of C-programming, Further Data Types**,** Structures**,** Defining New Data Types**,** Unions**,** Coercion or Type-Casting**,** types, static, pointers, pointer and functions, pointers and arrays, arrays of pointers, multidimensional, arrays and pointers, Static Initialization of Pointer Arrays**,** Pointers and Structures**,** Common Pointer Pitfalls**,** exercise,The C Preprocessor **:**#define**,** #undef**,** #include**,** #if -- Conditional inclusion**,** Preprocessor Compiler Control**,** Other Preprocessor Commands**.** Input and Output

(I/O): stdio.h**,** Reporting Errors**,** perror( )**,** errno**,** exit( )**,** Streams**,** Predefined Streams**,** Redirection**,** Basic I/O**,** Formatted I/O**,** Printf**,** scanf**,** Files**,** Reading and writing files**,** sprintf and sscanf**,** Stream, status Enquiries**,** Low Level I/O**,** Exercises**.**

MATLAB 7 : Basic Features: Simple Math, The Matlab workspace about variables, complex number, floating point arithmetic, Mathematical functions. Script M files: Use, Block comments and code cells, startup and finish. Array and Array operations: Simple array, Array addressing or indexing, Array construction, Array orientation, Scalar Array Mathematics, array Manipulation, Array sorting, Sub array searching, Array size, Array and Memory utilization, Multidimensional Array construction & its manipulation. Numeric data type: Integer data type, floating point data types.

Cell Arrays and structures: Cell array creation, its manipulation, Retrieving cell array content, comma separated list, cell functions, cell array of strings, structure creation, structure manipulation, structure functions. Character string: String construction, string evaluation, string functions, cell array of strings. Relational and logical operations: Relational and logical operators, Relational and logical functions, Nans and empty, operator precedence. Control flow: For loops, while loops, if else end construction, switch case construction, Try catch blocks.

References:

1. V.Rajaraman, Computer Progmamming in C, Prentice Hall, India,1994
2. B.Kernighan and D.Ritchie: The C Programming Language Prentice Hall, India,1995

Programming Lab

Working with matrix: Generating matrix, Concatenation, Deleting rows and columns. Symmetric matrix, matrix multiplication, Test the matrix for singularity, magic matrix. Matrix analysis using function: norm, normest, rank, det, trace, null, orth ,rref, subspace, inv, expm, logm, sqrtm, funm.

Array: Addition, Subtraction, Element-by-element multiplication, Element-by-element division, Element-by-element left division, Element-by-element power. Multidimensional Arrays, Cell Arrays, Characters and Text in array,

Graph Plotting: Plotting Process, Creating a Graph, Graph Components, Figure Tools, Arranging Graphs Within a Figure, Choosing a Type of Graph to Plot, Editing Plots, Plotting Two Variables with Plotting Tools, Changing the Appearance of Lines and Markers, Adding More Data to the Graph, Changing the Type of Graph, Modifying the Graph Data Source, Annotating Graphs for Presentation, Exporting the Graph.

Using Basic Plotting Functions: Creating a Plot, Plotting Multiple Data Sets in One Graph, Specifying Line Styles and Colors, Plotting Lines and Markers, Graphing Imaginary and Complex Data, Adding Plots to an Existing Graph, Figure Windows, Displaying Multiple Plots in One Figure, Controlling the Axes , Adding Axis Labels and Titles, Saving Figures.

Programming: Conditional Control – if, else, switch, Loop Control – for, while, continue, break, Error Control – try, catch, Program Termination – return.

Scripts and Functions: Scripts, Functions, Types of Functions, Global Variables, Passing String Arguments to Functions, The eval Function, Function Handles, Function Functions, Vectorization, Preallocation.

Data Analysis: (i) Preprocessing Data : Loading the Data, Missing Data, Outliers, Smoothing and Filtering, (ii)Summarizing Data: Measures of Location, Measures of Scale, Shape of a Distribution, (iii) Visualizing Data: 2-D Scatter Plots, 3-D Scatter Plots, Scatter Plot Arrays, Exploring Data in Graphs, (iv) Modeling Data: Polynomial Regression, General Linear Regression,

Linear Algebra: Systems of Linear Equations, Inverses and Determinants, Factorizations, Powers and Exponentials, Eigenvalues, Singular Values.

Polynomials: Polynomial functions in the MATLAB® environment, Representing Polynomials, Evaluating Polynomials, Roots, Derivatives, Convolution, Partial Fraction Expansions, Polynomial Curve Fitting, Characteristic Polynomials.

Statistics Lab

Computational works are to be done on the following topics.

1. Calculation of A.M., G.M., H.M., median and mode
2. Calculation of quartiles, deciles and percentiles
3. Calculation of range, quartile deviation, mean deviation, standard deviation and root mean square deviations
4. Calculation of central moments from raw moments, calculation of skewness and kurtosis
5. Calculation of raw moments from central moments, calculation of moments about one point from moments about another point
6. Flitting of binomial distribution
7. Flitting of Poisson distribution
8. Flitting of normal distribution
9. Tasting of hypothesis based on normal distribution
10. Tests based on chi-square distribution
11. Tests based on t-distribution
12. Tests based on F-distribution

SEMESTER-IV

Real Analysis

The real number system : Elementary logic, The field axioms, the axiom of order, geometric representation of real numbers.

Metric sets and limits : Metric sets, Interior points and boundary points of a set, open sets and closed sets, limit point of a set, sequences, monotonic sequences, Cauchy sequences, limit of a function.

Continuity and Differentiability: Continuous functions, uniform continuity, mean value theorem for derivatives, the total differential, the directional derivative.

Integration : Step functions, upper and lower integral of a bounded function, integral of a bounded function, interchange of limits, the fundamental theorem of differential and integral calculus.

Essential Reading :

1. J.M. Howie, *A First Course in Real Analysis*, Springer, 2001

Linear Algebra

Vector spaces, Bases and dimensions, Change of bases and change of coordinates, Sums and direct sums, Spanning sums and independence, The dimension of a vector space, The complexification of a real vector space, Quotient spaces. Linear transformations, The kernel and image of a linear transformation, The rank and nullity theorem, Change of bases for linear transformations, Linear functionals, Representation of linear transformations by matrices, Dual spaces, Second dual, Reflexive spaces, Invariant subspaces, Direct-sum decomposition, Cyclic subspaces and Annihilators, The minimal polynomial, The rational and Jordan canonical forms, Inner product spaces, Orthonormal bases, Gram-Schmidt process. Adjoint operators, Normal, unitary, and self-adjoint operators, Spectral theorem for normal operators.

Essential Reading:

1. K. Hoffman and R. Kunze, *Linear Algebra*, PHI, 1971
2. S. Roman, *Advanced Linear Algebra*, Springer, 2007

Partial Differential Equation

Origin of first order partial differential equations, Cauchy's problem, Linear equations, Integral surfaces passing through a given curve, Surfaces orthogonal to a given system of surfaces, Nonlinear partial differential equations of the first-order, Cauchy's method of characteristics, Compatible systems of first-order equations, Charpit's method, Special types of first-order equations, Solutions satisfying given conditions, Jacobi's method, Origin of second order partial differential equations , Second and higher order equations in physics, Linear partial differential equations with constant coefficients, Equations with variable coefficients, Characteristic curves of second-order equations, Characteristics of equations in three variables, Solution of linear hyperbolic equations, Separations of variables, Integral transforms method, Nonlinear equations of second-order. Laplace's equation: The occurrence of Laplace's equation in physics, Elementary solutions of Laplace's equations, Family of equipotential surfaces, Boundary value problem, Problems with axial symmetry, Kelvin inversion theorems , theory of green's function for Laplace equation.

Essential Reading:

1. N. Sneddon: *Elements of Partial Differential Equations*, Dover, 2006

Numerical Analysis

Definition and sources of errors, Propagation of errors, Backward error analysis, Sensitivity and conditioning, Stability and accuracy, Floating-point arithmetic and rounding errors. Nonlinear equations, Bisection method, Newton's method and its variants, Fixed point iterations, Convergence analysis. Newton's method for non-linear systems. Finite differences, Polynomial interpolation, Hermite interpolation, Spline interpolation, B-splines. Numerical integration, Trapezoidal and Simpson's rules, Newton-Cotes formula, Gaussian quadrature, Richardson Extrapolation IVP: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, Multistep methods, Predictor-Corrector method Accuracy and stability, Finite Element method. Finite Difference Method

Essential Reading:

1. S. D. Conte and Carl de Boor, *Elementary Numerical Analysis - An Algorithmic Approach, 3rd Edition*, McGraw Hill, 1980.

Supplementary Reading:

1. K. E. Atkinson, *Introduction to Numerical Analysis*, 2nd Edition, John Wiley, 1989.

Data Structure & Algorithm

Data structure: Asymptotic notations- o, O, θ, Θ, ω, Ω and their properties. Arrays, stacks, queues. Linked list. Trees. Binary trees. Evaluation of expression. Addition of polynomial using linked list and other examples. *M*-way search tree. B-tree (concept only). Analysis of algorithms.

Searching: Linear and binary and their analysis.

Sorting: Quick, heap and merge sorts and their analysis.

Algorithms design techniques: Divide-and-conquer method. Greedy method. Dynamics programming technique. Branch-and-bound method. Examples.Representation of graph in a computer. Graph searching. Binary tree traversals. Spanning tree. Shortest path problem. NP-Completeness.

Numerical Methods Lab

Experiments to be handled using computer

1. Bisection Method
2. Method of false position and secant method
3. Newton-Raphson method
4. Method of successive approximation
5. Gaussian elimination method
6. Gauss-Seidel iterative method
7. Inversion of a matrix
8. Eigen values and eigen vectors
9. Lagrange's interpolation
10. Newton's forward and backward interpolation
11. Everette's formula
12. Numerical differentiation
13. Trapezoidal rule of integration
14. Simpson's one-third rule
15. Simpson's three-eighth rule
16. Euler's method
17. Improved Euler's method
18. Runge-Kutta second and fourth order methods
19. Predictor-corrector methods
20. Taylor series method
21. Finite Element Problem
22. Finite Difference Problem

SEMESTER-V
Linear Programming and Game Theory

Linear Programming :
Lines and hyperplanes, convex sets, convex hull and their properties - Formulation of a Linear Programming Problem - Theorems dealing with vertices of feasible regions and optimality - Graphical solution - Simplex method (including Big M method and two phase method); infeasible and unbounded LPP's, alternate optima - Dual problem and duality theorems - Dual simplex method and its application in post optimality analysis - Revised simplex method - Sensitivity analysis - parametric programming .

Transportation problem: Introduction - existence of solution - degeneracy - MODI method (including the theory) - Assignment problem - Hungarian method for solving assignment problems - travelling salesman problem.

Theory of Games:
Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games –graphical method.

Essential Reading :

1. H.A.Taha, *An Introduction to Operations Research* , PHI

Supplementary Reading:

1. Kambo, *Mathematical Progamming Techniques*, East-West Publi., Delhi
2. Kanti Swarup et. al., *Operations Research*, Sultan Chand and Co.,
3. S.D.Sharma , *Operations Research*, Kedarnath.
4. J.K.Sharma, *Operation Research*, MacMilan.
5. Hiller and Libermann, *Introduction to Operation Research*, TMH.
6. Wayne L.Winston, *Operation Research*, Thomson BrooCole.

Statics and Dynamics

Statics:
Reduction of a system of coplanar forces. Stability of equilibrium, energy test of stability, Principle of Virtual Work, Deduction of conditions of equilibrium of a particle under coplanar forces from the principle of virtual work, converse of the principle of virtual work, Common catenary and catenary of uniform strength. Forces in three dimension, Poinsot's central axis and its equation, wrenches.

Dynamics-I:
Simple Harmonic Motion, damped vibrations, forced vibration, damped forced oscillations, elastic string, Hook's law, Tangent and normal acceleration. Velocity and acceleration along radial and transverse directions, Central orbits, central forces, motion of a particle under central force. Differential equation in polar and pedal coordinates, velocity under central force. Apse, apsidal distance and apsidal angle.

Dynamics-II:
Kepler's laws of planetary motion, artificial satellites, Escape velocity, Geo stationary satelite Disturbed orbits, Motion in resisting medium. Motion of particle of varying mass, Motion of a particle in three dimensions. Accelerations in terms of different coordinates, Moment

Ellipsoid, equimomental system, principle axis. D'Alemberts principle, D'Alembert's equation of motion, principles of conservation of linear and angular momentum. Independence of the motion of center of inertia and the motion relative to the center of inertia. Principle of conservation of energy, Equation of motion of a rigid body about a fixed axis, expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum, interchangeability of the point of suspension and the point of oscillation, simple equivalent pendulum, Equation of motion of a rigid body moving in two dimension, expression for kinetic energy and the angular momentum about the origin of a rigid body moving in two dimension. Equation of motion under impulsive forces.

Refernces:

1. Numerical Analysis-S.A.Mollah, New Central Book Agency.
2. Dynamics of a Particle and of Rigid Bodies-S.L.Lony, Radha Publishing House.
3. Dynamics of Particle and Rigid Bodies-Chakroborty and Ghosh-U.N.Dhur and Sons.
4. A text book on statics-M.Ray-S.Chand
5. Dynamics of a Particle and of Rigid Bodies-S.L.Lony,Radha Publishing House.
6. Dynamics of Particle and Rigid Bodies-Chakroborty and Ghosh-U.N.Dhur and Sons

Integral Transforms & Applications

Fourier transforms, Fourier cosine transforms, Fourier sine transforms, Fourier transforms of derivative, Parseval's theorem for cosine and sine transforms. Multiple Fourier transforms, inversion theorem for Fourier transform, inverse Fourier sine transform, inverse, Fourier cosine transform, Inverse Fourier complex transformation, Convolution theorem, relationship between Fourier and Laplace transforms.

Applications of Fourier transforms, Complex inversion formula for Laplace transform, solution of boundary value problems by Laplace and Fourier transforms.

Mellin transforms, elementary properties, Melline transforms of derivative and integral, Melline inversion theorem, convolution theorem. Applications of Mellin transforms,summation of series

Hankel transforms, elementary properties of Hankel transforms, Hankel inversion theorem, Hankel transforms of derivatives of functions, Hankel ransformation of elementary functions, Parseval's relation for Hankel transforms, relation between Fourier and Hankel transforms. Applications of Hankel transforms , solution of partial differential equation.

References:

1. I.N.Sneddon, The Use of Integral Transforms, Tata McGrawHill
2. B.P.Parasar, Differential equation and integral equation, SBS Publications
3. Petrovsky, Integral Equation, Mir Publication
4. G.Yankovsky, Problems and exercise in Integral Equation, Mir Publication
5. R.R.Goldberg, Fourier Transform, Cambridge Univ. Press.

Fuzzy Set, Rough Sets & Application

Fuzzy sets: Characteristics function and definition of fuzzy sets, fuzzy point, α - level sets, convex fuzzy sets, basic operations on fuzzy sets. Cartesian products, algebraic products, bounded sum and difference,

t-norms and t-co norms, quasi-coincidence of two fuzzy subsets. Fuzzy numbers, triangular fuzzy numbers

Generalization and variants of fuzzy sets : L-fuzzy sets, interval-valued fuzzy sets, Type 2 fuzzy sets, intuitionistic fuzzy sets and set operation of intuitionistic fuzzy sets, The Zadeh's extension principle.

Fuzzy relations and functions: Fuzzy relations on fuzzy sets, composition of fuzzy relations, Max-Min and Min-Max compositions, basic properties of fuzzy relations, Fuzzy pre order and fuzzy order relations, fuzzy equivalence relation, fuzzy compatibility relations, fuzzy graphs, fuzzy similarity relations, examples of different fuzzy relations, fuzzy relation equations based on sup-i and inf-ω_i compositions. Fuzzy functions on fuzzy sets, image and inverse image of fuzzy sets and some basic theorem on fuzzy functions.

Fuzzy matrix: Sum, multiplication of two fuzzy matrices, Idempotent fuzzy matrix and their problems.

Introduction to soft sets, rough sets and its application.

Fuzzy Optimization :

Linear Programming Problems with Fuzzy Recourses:

(i) Vendegay's approach

(ii) Werner's approach

L.P.P. with fuzzy resources and objective :

Zimmermann's approach , L.P.P. with fuzzy parameters in the objective function . Fuzzy multi-objective Linear Programming Problem . Methodologies of solving fuzzy M.O.L.P .

Lab Work on Data Structure & Algorithm

Implementation of different abstract data structures in C, with implementations using different methods and performance comparisons among them wherever possible. Use of data structures for solving simple problems.

SEMESTER-VI

Complex Analysis

Complex numbers: The complex Plane. Functions of a complex variable. Limit. Continuity. Differentiability. The definition of an analytic function. Cauchy-Riemann differential equation. Construction of analytic function.

Complex integration: Jardan arc. Contour . Rectifiable arcs. The absoluate value of complex integral. Cauchy's theorem. Cauch's integral formula. The derivatives of an analytic function. Cauch's inequality. Morer's theorem. Liouville's theorem. Taylor's and Laurent's series. Maximum modulus principle.

Singularities: Zero of an analytic function. Different types of singularities. Poles, Isolated, Removal and Essential singularities.

Residues: Residue at pole, Residue at infinity, Cauchys residue theorem, Number of poles and zeros of an analytic function, Rouche's theorem.

Contour integration: Evaluation of integrals using contour integration.

Conformal representation: Conformal transformation, Mobius transformation or Bilinear transformation. Mapping properties of important functions.

Discrete Mathematics

Functions and matrices: Special functions, Properties of functions, pigeonhole principle, Composition of functions.
Induction and algorithms: The division algorithm, Divisibility properties, Mathematical induction, Algorithm correctness, The growth of functions, Complexities of algorithms.
Recursion: Recursively defined functions, Solving recurrence relations, Generating functions, Recursive algorithms, Correctness of recursive algorithms, Complexities of recursive algorithms.
Combinatorics and discrete probability: The fundamental counting principles,The generalized inclusion and exclusion principle, Discrete probability.
Relations: Boolian matrices, Relations and digraphs, Computer representations of relations, Properties of relations, Operation on relations, The connectivity relations, Equivalence relations, Partial and total orderings.
Graphs: Computer representation of graphs, Isomorphic graphs, Paths, cycles and circuits, Eulerian and Hamiltonian graphs, Planner graphs, graph colouring.
Trees: Spanning trees, Minimal spanning trees, Rooted trees, Binary trees, Binary search trees.
Boolean algebras and combinatorial circuits: Boolean algebras, Boolean functions, Logic gates, Combinatorial circuits, Minimization of combinatorial circuits, Recent developments.

Essential Reading:

1. T. Koshy, *Discrete Mathematics with Applications*, Academic Press (An Imprint of Elsevier) First Indian Reprint 2005.

Supplementary Reading:

1. R. Johnsonbaugh, *Discrete Mathematics*, Pearson Prentice Hall, 2008

Stochastic Processes

Stochastic Processes: Definition and examples of stochastic processes, Classifications of stochastic processes, Markov chains: Definition and examples, Transition Probability matrices, Classification of states of a Markov chain, Determination of higher order transition probabilities, Stability of a Markov chain, Graph theoretic approach, Markov chains with denumerable number of states, Reducible Markov chains, Markov Chains with continuous state spaces, Non-homogeneous Markov Chains, Markov chains in continuous time: General pure birth and death processes, Birth and death processes with absorbing states, Renewal processes: Renewal processes in continuous time, renewal equation, Renewal theorems, Residual and excess lifetime, Renewal reward processes, Regenerative renewal processes, Regenerative inventory systems, Generalization of the classical renewal theory, Stochastic processes in queuing and reliability: General concepts of queuing systems, Steady state and transient behavior, Birth and death process in queuing theory, Network of Markovian queuing systems, Reliability, Introduction to Brownian motion: Wiener processes, Differential equations for a Wiener process, Kalmogrov's equations, The first passage time distribution for a Wiener process. Recent developments.

Essential Reading :

1. J. Medhi, *Stochastic Processes*, New Age Publishers, Second Edition, Reprint 2007.

Supplementary Reading :

1. S. Karlin and H. M. Taylor, *A First Course in Stochastic Processes*, Academic Press, 1975.

Object Oriented Programming

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING:

A Look at Procedure-Oriented Programming, Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of OOP, Object Oriented Languages

TOKENS, EXPRESSIONS AND CONTROL STRUCTURES:

Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined and Derived,Data Types, Type Compatibility, Reference, Variables, Scope Resolution Operator, Type Casting, Implicit Conversion, Operator Precedence, Control Structures, Structure, Function.

CLASSES AND OBJECTS:

Class specification, class objects, accessing class members, data hiding, empty classes, pointers within a class, passing objects as arguments, returning objects from functions, friend functions and friend classes, constant parameters and member functions, structures and classes, static members, objects and memory resource, class design steps.

OBJECT INITIALIZATION AND CLEANUP:

Constructors, destructor, constructor overloading, order of construction and destruction, constructors with default arguments, nameless objects, dynamic initialization through constructors, constructors with dynamic operations, constant objects and constructor, static data members with constructors and destructors, nested classes.

OPERATOR OVERLOADING AND TYPE CONVERSION:

Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators Using Friends, Manipulation of Strings Using Operators, Rules for Overloading Operators, Type Conversions

INHERITANCE: EXTENDING CLASSES:

Deriving Derived Classes, Single, Multilevel, Multiple, Hierarchical, Hybrid Inheritance, constructors & destructors in derived classes, constructors invocation and data members , initialization, Virtual Base Classes, Abstract Classes, delegation.

POINTERS, VIRTUAL FUNCTIONS AND POLYMORPHISM:

Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions,
Implementation of run-time polymorphism, Pure Virtual Functions.

WORKING WITH FILES:

Classes for File Stream Operations, Opening and Closing a File, File Pointers and their Manipulations, Sequential Input and Output Operations, Error Handling During File Operations, Command Line Arguments

GENERIC PROGRAMMING WITH TEMPLATES:

Class Templates with multiple parameters, Function Templates, Overloading of Template Functions, Member Function Templates.

OBJECT-ORIENTED ANALYSIS AND DESIGN:

Object-Oriented analysis and design, procedure oriented development tools, prototyping , paradigm

BOOKS RECOMMENDED

1. Object Oriented Programming By- Budd, Addison Wesley.

2. Mastering C++ By K.R Venugopal , Rajkumar, TMH.
3. C++ Primer, By - Lip man and Lajole, Addison Wesley.
4. The C++ Programming language by Bjarne Stroustrup, Addition-Wesley
5. C++ programming By Robert Leffore
6. Object Oriented Programming with C++ by Balaguruswamy, TMH
7. An Introduction to Object Oriented Programming with C++ by Timthy Budd, Addition-Wesley
8. C++ and Object-Oriented Programming By - Kip R. Irvine, Prentice Hall.

Number theory & Cryptology

Basis representation: Principles of mathematical induction, The basis representation theorem, *The fundamental theorem of arithmetic*: Euclid's division lemma, Divisibility, The linear Diophantine equation, The fundamental theorem of arithmetic, Combinatorial and computational number theory: Fermat's little theorem, Wilson's theorem, Generating functions, The use of computers in number theory, *Fundamentals of congruences*: Basic properties of congruences, Residue systems, Riffling, *Solving congruences*: Linear congruences, The theorems of Fermat and Wilson revisited, The Chinese remainder theorem, Polynomial congruences, Arithmatic functions: Combinatorial study of □(n), Formulae for d(n) and □(n), Multiplicative arithmetic functions, The Mobius inversion formula, *Primitive roots*: Properties of reduced residue systems, Primitive root modulo p.

Crypotology:

Introduction : Basic objects of Cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, Cryptanalysis, attack models, Classical cryptography.

Block ciphers : Modes of operation, DES and its variants, RCS, IDEA, SAFER, FEAL, BlowFish, AES, linear and differential cryptanalysis.

Stream ciphers : Stream ciphers based on linear feedback shift registers, SEAL, unconditional security,Message digest : Properties of hash function, MD2, MD5 and SHA-1, keyed hash function, attack on hash function.

Public Key Parameters : Modular arithmetic, GCD, Primality testing, Chinese remainder theory, Modular square root, finite fields.

Intractable Problems : Integer fatorisation problem, RSA problem, Modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithm for solving the Intractable Problems. Public key encryption : RSA, Rabin and EIGamal scemes, side channel attacks,Key Exchange : Diffie-Hellman and MQV algorithms.

Essential Reading

1. G. E. Andrews, *Number Theory,* Courier Dover Publications, 1994.

SEMESTER-VII

Measure Theory

Outer measure, Measurable sets and Lebesgue measure, Nonmeasurable sets, Measurable functions, Littlewood's three principles, The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of a nonnegative function, The general Lebesgue integral, Convergence in measure, Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex

functions, The Lp spaces, The Minkowski and Holder inequalities, Convergence and completeness, Approximation in Lp, Bounded linear functionals on the Lp spaces.

Essential Reading

1. E. D. Benedetto, *Real Analysis: Foundations and Applications*, Springer, 2002
2. H. L. Royden, *Real Analysis (Third Edition)*, Macmillan Publishing Company, 1988 3. G. De. Barra, *Measure Theory and Integration*, Horwood Publishing Corporation, 2003.

Topology

Topological spaces and continuous functions: Topological spaces, Basis for a topology, Order topology, Product topology, Subspace topology, Closed sets and limit points, Continuous functions, Homeomorphism, Metric topology, Quotient topology.

Connectedness and compactness: Hausdorff spaces, Connected spaces, Connected subspaces of the real line, Compactness and local connectedness, Compact spaces, Compact subspaces of the real line, Limit point compactness, Local compactness.

Countability and separation axioms: Countability axioms, Separation axioms, Normal spaces, Regular spaces, Completely regular spaces, Urysohn lemma, Urysohn metrization theorem, Tietze extension lemma.

The Tychonoff theorem: Compactification, One-point compactification, The Stone-Cech compactification, Metrization theorems and paracompactness, Local finiteness.

Complete metric spaces and function spaces: Compactness in metric spaces, Pointwise and compact convergence, Ascoli,s theorem, Baire's spaces and dimension theory, A nowhere differentiable function, Applications of topology in engineering and sciences.

Essential Reading:

1. J. R. Munkres: *Topology*: (Pearson Prentice Hall), 2005.

Abstract Algebra-II

Groups, Subgroups, Centralizers, Normalizers, Stabilizers, Kernels, Cyclic groups, Subgroups generated by a subset of a group, Quotient groups, Lagrange's theorem, Homomorphisms, Isomorphism theorems, Composition series, Solvable groups, Nilpotent groups, Symmetric group, Alternating group, Group actions, Permutation representations, Automorphisms, p-groups, The Sylow theorems, Simplicity of the Alternating group, Direct products of groups, Fundamental theorem of finitely generated abelian groups, Groups of small orders, Rings, Ring homomorphisms, Ideals, Ring of fractions, The Chinese remainder theorem, Euclidean domains, Principal domains, Unique factorization domains, Matrix rings, Polynomial rings, Irreducible Criteria, Eisenstein's criterion.

Essential Reading:

1. D. S. Dummit & R. M. Footee, *Abstract Algebra*, Wiley, 2008

Supplementary Reading :

1. I. N. Herstien, *Topics in Algebra*, Wiley, 2008 2. J. J. Rotman, *An Introduction to the Theory of Groups*, Springer, 1999

Classical and Continuum Mechanics

Classical Mechanics

Generalized co-ordinates, holonomic and non holonomic systems, unilateral and bilateral constraints; principle of virtual work, D'Alemberts principle. Variational principle, problems of mechanics, moving problems of calculus of variations, shortest distance, minimum surface of revolution, Brachistochrone problem iso-perimetric problem, geodesic, fundamental lemma of calculus of variations.

Lagranges equation of first kind and of second kind, uniqueness of solution, Energy equation of conservative fields, generalized momentum, problem of Liouville type, cyclic coordinates. Hamilton's principle, principle of least action, Routh's equation, Hamilton-canonical equation of motion, Poisson bracket, Poisson's identity, Jacobi-Poisson theorem.

Continuum Mechanics

Stress : Body force, Surface force, Cauchy's stress principle. Stress vector, State of stress at a point, Stress tensor, The stress vector-stress tensor relationship. Force and moment equilibrium, Stress tensor symmetry, Stress quadric of Cauchy, Stress transformation laws, Principal stress, Stress invariant, Stress ellipsoid.

Strain : Deformation Gradients, Displacement Gradient, Deformation tensor, Finite strain tensors, Small deformation theory—infinitesimal strain tensor, Relative displacement,Linear rotation tensor, Interpretation of the Linear strain tensors, Strain ratio,Finite strain interpretation, principal strains, strain invariant, cubical dilatation, Compatibility equation for linear strain, Strain energy function. Hook's Law. Saint Venant's Principle, Airy's strain function.

Isotropic media, Elastic constraints, Moduli of elasticity of isotropic bodies and their relations, displacement equation of motion. Waves in isotropic elastic media.

Perfect fluid, Kinematics of fluid, Lagrangian method, Eulerian method, Acceleration, Equation of continuity, The boundary surface,Stream lines and Path lines, Irrotational motions and its physical interpretation , Velocity potential , Euler's equation of motion of an inviscous fluid, Cauchy integral , Bernouli's equation , Integration of Euler's equation.

References:

1. D.N.Berghese and A.M.Downs, Classical mechanics and Control, John Willey
2. Goldstein, Classical Mechanics, Narosa Publications
3. Rana and Jong, Classical Mechanics, Narosa Publications
4. E.T.Whittecker, Treatise on the Analytical Dynamics and Rigid Bodies
5. I.S.Sokolnikoff : Mathematical Theory of Elasticity , Tata Mc. Grawhill , 1997.
6. S.Valliappan : Continuum Mechanics , Oxford & IBH Publishing C

Formal Language and Automata Theory

INTRODUCTION:

Introduction to language theory, tokens. Alphabets, definition of grammar, Production rules, sentences, sentential forms, language definitions, derivations.

REGULAR LANGUAGES:

Definition, Pumping Lemma of regular sets, Chomsky Hierarchy of languages.

FINITE AUTOMATA:

Finite automaton, Deterministic, Non-Deterministic and their equivalence, Equivalence of regular expressions and FA. Moore and Mealy machines.

CONTEXT FREE LANGUAGE:

Relations between classes of languages, Context Free Grammar, Derivation trees, ambiguity simplification, Normal forms, applications.

PUSHDOWN AUTOMATA:

Pushdown automata, definitions, context free languages, construction of PDA for simple CFLs, Linear bounded automata.

TURING MACHINES:

Turing machines, Introduction to computability, Universal Turing Machines, Types of Turing Machines, Techniques for construction of Turing machines, Undesirability and Halting Problem

BOOKS RECOMMENDED

1. Introduction To Automata Theory, Languages, And Computation by John E. Hopcroft, Rajeev Motwani , Jeffrey D. Ullman, Publisher: Pearson
2. Z. Kohavi, Switching and Finite Automata Theory, Tata McGraw Hill, 1984.
3. E.V. Krishnamoorthy , Introductory Theory of Computer Science, Affiliated East West

SEMESTER-VIII

Functional Analysis

Normed spaces, Banach spaces, Further properties of normed spaces, Finite dimensional normed spaces and subspaces, Compactness and finite dimension, Bounded and continuous linear operators, Linear functionals, Linear operators and functionals on finite dimensional spaces, Normed spaces of operators, Dual spaces, Inner product spaces, Hilbert spaces, Further properties of inner product spaces, Representation of functionals on Hilbert spaces, Hilbert-adjoint operator, Self-adjoint, unitary and normed operators, Fundamental theorems for normed and Banach spaces: Zorn's lemma, Hahn-Banach theorem, Hahn-Banach theorem for complex vector spaces and normed spaces, Adjoint operators, Reflexive spaces, Topological vector spaces.

Essential Reading:

1. Y. Eidelman, V.D. Milman, A. Tsolomitis, Functional *Analysis: An Introduction*, AMS Bookstore, 2004
2. E. Kreyszig, *Introductory Functional Analysis with Applications*, Willey, 1978

Tensor Calculus & Riemanian Geometry

Tensor Analysis-I:

Summation Convension, Kronecker symbol. n-dimensional space, transformation of coordinates in Sn. Invariants, covariant and contravariant vectors. Covariant, contravariant and mixed tensors. Algebra of tensors. Symmetric and skew-symmetric tensors, Contraction, outer and inner product of tensors. Quotient law, reciprocal tensor. Riemann space, the line element and metric tensor, raising and lowering of indices, associate tensor, magnitude of a vector, inclination of two vectors, orthogonal vectors. Christoffel symbols and their

properties, law of transformation law of Christoffel symbols,Covariant differentiation of tensors, covariant differentiation of sum, difference and product of tensors, Gradient, divergence, curl and Laplacian.

Tensor Analysis-II:
Curvilinear coordinate system in E3 : line element, lengthy of vector, angle between two vectors in E3 in a curvilinear coordinate system. Basis in a curvilinear coordinate system, reciprocal base, covariant and contravariant components of a vector in E3, partial derivative of a vector. Sperical and cylindrical coordinate system.
Curves in E3 . Parallel vector fields along a curve in E3, parallel vector field in E3 , parallel vector space in a Riemannian space, parallel vector field in a surface of a Riemannian space. Serret-Frenet formulas.
Riemann-Christoffel curvature tensor, Ricci tensor, flate space, Bianchi identities, intrinsic differentiation, conformal curvature tensor, space of constant curvature.
Riemannian Manifold:
Riemannian metric, existence of Riemannian metric, linear connection , existence of linear connection, torsion and curvature of a linear connection, symmetric connection, symmetric connection, metric connection, Riemannian connection, existence of Riemannian connection. Riemann curvature, sectional curvature, Ricci tensor, scalar curvature, tensors in Riemannian manifold, Schur's theorem.
Parallel vector field, Geodesics: Existence of geodesic, parallel translation, length minimizing property of geodesic. complete manifold, Hopf-Rinow theorem, Hadamard theorem. Parametrised surface, Gause lemma. Totally geogesic submanifold.
Isometric immersion: Riemannian submanifold , second fundamental form of a Riemannian submanifold, Gauss equation, Ricci equation, Coddazi equation.

References:

1. A Text Book of Tensor Calculus-M.C.Chaki: Calcutta Publishers.
2. Tensor Calculus-U.C.De, A.A.Shaikh and J. Sengupta-Narosa.
3. Differentoa Geometry of Curves and Surfaces in E3(Tensor approach)-U.C.De:
Anamaya Publishers.
4. Vector Analysis-Maity and Ghosh, New Central Book Agency.
5. Vector Analysis- Schaum's series, Tata McGrawHill
S.Kumeresan, A Course in Differential Geometry and Lie Groups,Hindusthan Book Agencies,New Delhi,2002
6. U.C.De and A.A.Shaikh , Differential Geometry of Manifolds,Narosa Publishing House,2007
7. S.Boothby, An Introduction to Differentiable Manifolds and Riemannian Geometry, Accademic Press,1975
8. F.W.Warner, Foundations of Differentiable Manifolds and Lie Groups, Springer Verlag,1983

Differential Geometry

Vector Fields: height of the level set, level curves, Integral curve, smooth vector field, The tangent Space: tangent to the level set, gradient,
Surfaces: Hyperplane, Lagrange multiplier, Vector Fields on Surfaces, maximal integral curve, orientation and its consistency, Osculating plane, Serret Frenet formula, Singular points and their classification Gauss, The Gauss map spherical image, one-sheeted hyperboloid,

Geodescis: maximal geodesic, great circle, Parallel Transport, covariant derivative and acceleration, Fermi derivative, The Weingarten Map: shape operator, geodesic flow,
Curvature of plane curves: center of curvature, radius of curvature, Isometries, Intrinsic differentiation, Gauss-Kronecker curvature, translation, rotation, Funda-mental theorem on curves,
Riemannin metrics: Hyperbolic metric, Stereographic projection, Poincare metric, affine and Riemannian connection and covariance derivation, Applications of differential geometry in engineering and sciences.

Essential Reading

1. J. A. Thorpe, *Elementary Topics in Differential Geometry* (Springer), 2004.

Soft Computing

Soft Computing Techniques

Neural Networks: Overview of biological Neuro-system,Mathematical models of neurons, ANN architecture, Learning rules; Learning paradigms - Supervised, Unsupervised and Reinforcement learning; ANN training algorithms - perceptions, Training rules, Delta, Back propagation algorithm; Multilayer perceptron model; Applications of artificial neural networks; Competitive learning networks; Kohonen self organizing networks; Hebbian learning; Hopfield networks; Associative memories; Boltzman machine; Fuzzy Logic: Introduction to Fuzzy logic; Classical and Fuzzy sets: Overview of classical sets, Membership function, Fuzzy rule generation; Operations on Fuzzy sets: Compliment, Intersections, Unions, Combinations of operations, Aggregation operations; Fuzzy arithmetic: Fuzzy numbers, Linguistic variables, Arithmetic operations on intervals and numbers, Lattice of Fuzzy numbers, Fuzzy equations; Fuzzy logic: Classical logic; Genetic Algorithms; Evolution Strategies; Evolutionary Programming; Genetic Programming; Selecting, crossover, mutation, schema analysis, analysis of selection; Markov & other stochastic models; Simulated Annealing; Tabu Search; Ant Colony based optimization,Partical Swam Optimization.

Project Work / Summer Internship

Departmental Semenier-I

SEMESTER-IX

Integral Equations & Calculus of Variations

Integral Equation

Definition, different types of integral equations; kernels; eigen value and eigen function problem. Conversion of ordinary differential equations into integral equations, solution of integral equation, Green's function and its applications, Fredholm integral equation of the second kind with separable kernels. Solution of Fredholm and Voltera integral equations by successive approximation, Classical Fredholm theory: Statements of Fredholm's first, second and third fundamental theorems and their applications. Integral equations with symmetric kernels, Singular integral equations, Integral transform method of solution of integral equations.

Calculus of Variations

Calculas of Variation: Euler-Lagrange equation, degenerate Euler equation, Natural boundary, transversality conditions, simple applications of variational principle, sufficient conditions for extremum, variational formulations of boundary value problem, minimum of quadratic boundary value problem, minimum of quadratic functional approximate methods-Galerkin's method, variational methods for BVP in ordinary and partial equations.

References

2. I.N.Sneddon, The Use of Integral Transforms, Tata McGrawHill
2. B.P.Parasar, Differential equation and integral equation, SBS Publications
6. Petrovsky, Integral Equation, Mir Publication
7. G.Yankovsky, Problems and exercise in Integral Equation, Mir Publication
8. R.R.Goldberg, Fourier Transform, Cambridge Univ. Press
9.

Decision Theory & Computational Statistics

Decision Theory :

Games and statistical games , statistical decision problem , decision function , risk function , prior and posterior distribution, Baye's risk and Baye's rules , least favorable prior, minimaxity ,admissibility and complete classes , admissibility of Baye's rules , existence of minimal complete class and Baye's rules,the supporting and separating hyperplane theorems , essential completeness of the class of nonrandomized rules, minimax and complete class theorems , solving for minimax rules , essential completeness of class of rules based on sufficient statistics, continuity of risk function, invariant decision problems , admissible and minimax invariant decision rules .

Computational Statistics

Analysis of variance , one- way and two – way classification , Concept of design of experiment , Some standard design : completely randomized design , randomized block design , Latin Squares, Graeco Latin Squares and Factorial Design , Confounding and blocking in factorial design , fractional factorial design , Simple and multiple regression models . Classical techniques of time series analysis , smoothing and decomposition , Analysis of covariance model

Theory of operators & Banach Algebra

Theory of Operators

Bounded linear operators on Banach and Hilbert spaces , Self – adjoint and normal operators , compact operators , Fredholm alternatives , Eigen – value and eigen – vectors , Spectrum, spectral theory , Banach Algebra of bounded linear operators , Unbounded operators , Nonlinear operators, Monotone, Strictly monotone and strongly monotone operators .

Banach Algebra

Normed algebra, Banach Algebra , Gelfand – Mazur theorem , spectrum , spectral radius formula , commutative Banach algebra , Maximal ideal space , L_1 , L_∞, H_∞ as Banach algebras

Operation Research – I

Goal Programming : Introduction, Difference between LP & GP approach , Concept of Goal Programming , Graphical solution- method of GP , Modified simplex method of GP .
Dynamic Programming : Introduction , Nature of Dynamic Programming, Deterministic processes , Non- Sequential discrete optimization , Allocation problems , Assortment Problems , Sequential discrete optimization , Long-term planning problem , Multi-stage decision process, Application of Dynamic Programming in production scheduling and routine problems .
Inventory Control : Inventory control – Deterministic including price breaks and Multi-item with constraints . Probabilistic (with and without lead time). Fuzzy and Dynamic inventory models .
Queuing Theory : Basic Structure of queuing models. Poisson queues , M/M/I , M/M/C or finite and infinite queue length , Non-Poisson queue- M/G/I , Machine-Maintenance (steady state).
Network : PERT and CPM : Introduction , Basic difference between PERT and CPM . Steps of PERT/CPM Techniques , PERT/ CPM Network Components and precedence relationships , Critical path analysis , Probability in PERT analysis , Project Time-Cost , Trade-Off. Updating of the project , Resource allocation – resource smoothing and resource leveling .
Replacement and Maintenance Models : Introduction. Failure Mechanism of items , Replacement of items deteriorates with time , Replacement policy for equipment when value of money changes with constant rate during the period. Replacement of items that fail completely individual replacement policy and group replacement policy. Other replacement problems staffing problem . Equipment renewal problem .
Simulation : Introduction. Steps of simulation process , Advantages and disadvantages of simulation. Stochastic simulation and random numbers . Monte – Carlo simulation . Random number . Generation . Simulation of inventory problems , Simulation of Queuing problems , Role of computers in Simulation. Application of Simulations .

Biomathematics- I

Chapter : I.
Qualitative Theory of Linear and non-linear differential equations : Stability of linear system , Stability of linearized system , Stability of non- linear system , limit cycle , P-B theorem and its application
Chapter : II.
Models of biological oscillators : Goodwin's model , its stability and oscillations .
Chapter : III.
Reaction – diffusion system : Chemotaxis , Developmental pattern formulation and stability theory , Belousov – Zhabctinskii reaction , Field – Noyes (F. N.) model , Stability and oscillation in F.N. model, relaxation oscillator approximation for the Belousov – Zhabotinskii reaction and analysis for limit cycle oscillations .
Chapter : IV.
Stability of spatially distributed ecosystem :
Ecological introduction , Diffusion models of spatially distributed communities , occurrence of diffusive instability in predator-prey systems . Immigration and Emigrations .
Chapter : V.
Continuous population models for single species :

Ecological introduction , Simple models including Logistic model of uniform population – their stability analysis . Influences of random perturbations on population stability , delay models , Lag-factor and stability of population steady state .

Chapter : VI.

Continuous models for two interacting populations : Ecological introduction , Lotka – Volterra model of predator – prey system , Gausses model ,Kolmogorov model , Types of predator trophic function , analysis of predator – prey model with limit cycle periodic behavior – Parametric domains of stability .Relaxation type oscillations and ecological catastrophes . Completion models – exclusion principle , stability analysis , models of mutualism - stability analysis .

Chapter : VII.

Continuous models for three or more interacting populations : Food chain models – closed and open food chains , stability of food chains , persistence of three species food chain .

Chapter : VIII.

Discrete population models for single species :

Ecological introduction , Simple models , A graphical procedure of solutions , discrete logistic models – their stability , Periodic solutions , Bifurcations and Chaos , Discrete-Delay models .

Reference Books :

1. Mathematical Biology – J.D. Murray(Springer – Verlag , 1980)
2. Modelling Dynamic Phenomenon in molecular and Cellular Biology – Lee.A.Segal (Cambridge University Press) .

Solid Mechanics- I

Strain : Finite and infinitesimal deformations and strain tensor , Principle strains , compatibility equations , Strain components in orthogonal curvilinear co-ordinates .

Stress : State of stress in a body , Stress equations of equilibrium and motion , Surface conditions , Principal stresses , Stress equations of equilibrium motion in orthogonal curvilinear co-ordinates .

Fundamental Equations : Equations of equilibrium motion in terms of displacements , Beltrami – Michell compatibility equations , Fundamental boundary value problems of elastostatics and elastodynamics , Uniqueness of solutions , Simply and multiply connected region , Saint – Venant's Principle , Semi inverse method .

Plane Problem of Elasticity : Plane strain , Plane stress , Generalized Plane stress , Airy's Stress function , Complex representation of biharmonic function, Compatibility equations, Kolosov-Muskhelisvili formulae for displacements and stresses , First and 2^{nd} fundamental boundary value problems , Uniqueness of solutions , Solution of plane problems using conformal mapping, Applications .

Torsion and flexture problem : Torsion of a circular shaft , Torsion of a cylindrical bar of arbitrary uniform cross-section , Reduction of torsion problem to internal Dirichlet problem,Stress function , Solution of torsion problem for circular & rectangular cross – section.

Vibration : General theorem of vibration , Torsional , longitudinal , flexural vibration of a circular cylinder , Radial vibration of a hollo sphere .

Wave : Wave of dilation and waves of distortion , Motion of a surface of discontinuity, Velocity of waves in isotropic and anisotropic solid media , Plane wave , Surface wave , Rayleigh wave , Love wave .

Thermo elasticity : Stress-strain relations , Differential equation of heat conduction, Basic equation in dynamical thermo elasticity(uncoupled case),coupling of temperature and strain fields , Goodier's thermo elastic potential , Method of biharmonic representations , Thermo elastic correspondence principles, Method of Green's function , Method of complex variables , Some problems, Thermo elastic vibrations and waves , Elementary concepts of generalized thermo elasticity.

Fluid Mechanics – I

Fundamental Formulations : Viscous fluids , Viscosity strain tensor , State of cubical dilatation rate of rotation , Stress-strain relations for viscous fluids(using tensor). Navier-Stokes equation of motion and their vector form . Navier-Stokes equations of motion of a viscous liquid in circular cylindrical and spherical polar co-ordinates .

Extension of Helmholtz's equations for diffusion of vorticity to a viscous liquid . Equation of energy in a viscous fluid flow . Rate of dissipation of energy in a viscous liquid flow . Principle of similitude . Renold's numbers and Froude numbers in dynamically similar flows . Non-dimensional form of Navier-Stoke's equations of steady motion under pressure only .

One dimensional motion: Steady laminar motion of a viscous liquid through straight tubes of uniform cross section (general case), circular section(justifying no slipping at the wall), Elliptic section , Equilateral triangular section and rectangular section , Steady linear flow through the annular space between two co-axial circular cylinders and elliptic cylinders.

Viscous flow between parallel planes , Rayleigh's theory of lubrication .

Two-dimensional motion : Equation satisfied by the stream function in two-dimensional motion of a viscous liquid under conservative field of external forces and particular cases , Hamel's equation for the stream function , Exact solution of Hamel's equation such that the stream lines are logarithmic spirals , and the curves of constant vorticity and concentric circles .

Slow steady motion due to a sphere rotating uniformly about a diameter and due to a circular cylinder rotating uniformly about its axis particular cases .

Diffusion of vorticity from a line vortex , and particular cases .

Three-dimensional motion : Stokes solution for slow steady parallel flow past a sphere,Stokes formula for the resistance of the sphere, Stokes stream-function in flow past a sphere , Stokes stream-function in this flow past a sphere and flow pattern , Oseen's criticism on Stokes solution . , Oseen's solution for slow steady parallel flow past a sphere and the resistance of the sphere . Stokes stream-function in Oseen's solutions and parallel flow past a circular cylinder . Resistance of the cylinder per unit length when the Renold's number of the flow is small .

Mechanics of Viscous Fluids : Fundamental concepts of boundary layer when the Renold's number is moderately large . Prandtl's Equation of the boundary layers , Expressions of displacement thickness and momentum thickness of the boundary layer . Vorticity and stress components within the boundary layer in two dimensional motion , Separation of boundary layer from an obstacle .

Blasius equation for steady two – dimensional motion past a flat plate and its solution in the form of an infinite series . Boundary layer for two dimensional steady converging radial flow between two non-parallel walls. Boundary layer for steady two – dimensional jet . Flow symmetrical about a free stream line . Problem of steady three- dimensional jet . Karman's integral equation of the boundary layer . Alternative form of the integral equation in terms of displacement thickness and momentum thickness . Application of Karman's integral equation in the study of approximate solutions of steady two – dimensional flow past a flat plate and comparison with the corresponding exact solutions , calculations of frictional resistance on both sides of the plate and checking of errors . Application of this method by assuming linear , quadratic ,cubic and biquadratic distribution of velocity . Lamb's trigonometric solution.

Mises transformation of boundary layer equation into an equation of conduction of heat with variable coefficient of conduction .

Nonsteady boundary layers . Method of successive approximations and its application in the case of a flat plate impulsively set in motion . Unsteady motion of oscillating cylinder and deduction of oscillatory motions of a piston .

Reference Books :

1. Viscous fluid theory , Volume – 1 - S.I.Pai
2. Hydrodynamics - H. Lamb
3. New methods in laminar boundary later theory – D. Meksyn

Research Project-I

Departmental Seminar-II

Advanced Topology

Nets, Filters, ultra filters, convergence of nets and filters with special reference to zero-set filters and ultrafilters, compact sets, compact spaces, simple properties, Alexander's theory, Tychonoff's theory, Locally compact spaces, Tychonoff's spaces, Topological embedding, Embedding Lemma, Embedding theory, Compactification, one point compactification.

Alexanderoff one point compactification, Stone-Cech compactification, $\beta(X)$, Ordering of compactification, minimality of X and maximality of $\beta(X)$.

Weak topology and completely regular topology, Topology generated by a family of pseudometrics. Uniform spaces, Bases,subbases, total boundedness, Cauchy nets and filters, Completeness, Uniformly continuous maps, Uniform isomorphism, Product uniform space, Quasiuniform spaces, Proximity spaces, Induced topology, Proximal neighbourhoods, Quasiproximity spaces.

List of References:

1) General Topology : J. L. Kelley
2) General Topology : Willard
3) Topology : Dugundji
4) Topology : R. Engalking
5) Topology : K. Kuratowski
6) Proximity Spaces : S.A.Naimpally and Warrack
7) Topology : N. Bourbaki

Computational Fluid Dynamics & Magneto-Fluid dynamics

Computational Fluid Dynamics:
Governing equation of fluid dynamics, Conservation form, simple CFD techniques, Lax-Wendroff technique, Mac Cormack's techniques, Finite volume methods, Application to Euler equation, Upwind difference scheme, viscous flow solutions, staggered grid, SIMPLE algorithm , SOLA algorithm, boundary element method and application to potential flows.

Magneto-Fluid dynamics:
Some preliminaries on Electricity and Magnetism—Electrostatics, Gauss Law, Dipoles, Dielectrics, Polarisation, Electric Displacement vector, Conduction Current, Magnetic effects of currents, Electromagnetic induction.

The MHD generalization of the theorems of Bernoulli and Kelvin. The Maxwell stress tensor, The Energy Principle, The MHD physics of MHD power generation.
Fundamental equation of Electrodynamics, Maxwell's equation, The equation of Magneto-Hydrodynamics. Study of Conducting fluid in motion. The Magnetic Reynold's number. Alfven's theorem. The law of isorotation of Ferraro. Magneto Hydrostatics, Force-free magnetic fields, Steady laminar motion, Toroidal and poloidel vector fields, Chandrasekhar's equipartition of energy.

SEMESTER-X

Operations research—II

Stochastic programming : Chance constraint programming techniques,
Geometric programming : Geometric programming (both unconstrained and constrained), Fuzzy geometric programming.
Games : Preliminaries concepts of continuous Game, Bimatrix Games, Nash equilibrium, solution of Bimatrix Games through quadratic programming (relation with non-linear programming)
Multiobjective Linear & Non-linear programming,Complete optimal solution, Pareto & Weak Pareto optimal solution, Utility function method , Global criterion method, Fuzzy programming technique .
Optimal Control : Performance indices, methods of calculus of variation, Transversally conditions, simple optimal problems of Mechanics, Pontryagin's Principle (with proof assuming smooth condition), Linear regulator, application of dynamic programming in proving Pontryagin's Principle, Bang-Bang controls.
Sequencing : Problem with n jobs two machines, n jobs three machines and n jobs m machines.
Reliability : Concepts, Reliability definition, system Reliability, system failure rate, Reliability of the systems connected in series or/ and parallel.
Information Theory : Introduction, communication process-memory less channel, the channel matrix, probability relation in a channel, noiseless channel.

Measure of information—Properties of Entropy function, measure of other information quantities—marginal and joint Entropies, conditional Entropies, expected mutual information, axiom for an Entropy function, properties of Entropy function. Channel capacity, Efficiency and Redundancy.
Encoding: Objectives of encoding,Shannon-Fano Encoding Procedure,Necessary and sufficient condition for noiseless encoding.

Biomathematics—II

Elementary dynamics of exploited population, the logistic growth model constant rate of harvesting, fishing effort, generalized logistic models, depensation, Yield-effort curves, critical depensation.

The open-access fishery, Gordons static model, opportunity cost, externality, economic over fishing, overfishing catastrophes,production function, Cob-Douglas production function, discounting, the Schaefer model,optimal harvest policy,effect of discounting.

Elements of control theory,one dimensional control problem, linear variational problem-singular path,block interval,impulse control.

The maximum principle and its application in linear variational problems, transversality conditions, feedback control,economic interpretation of the maximum principle, structure of the multidimensional optimal control problem and the maximum principle.
Growth and aging, Beverton-Holt fishery model, dynamic optimization.

Multispecies models in fishery management, combined harvesting of two ecologically independent fish species following logistic growth, bionomic equilibrium, optimal harvest policy. Combined harvesting of two competing fish species following Logistic growth, Selective Harvesting. Diffusion model of inshore-offshore fisheries.

Mathematical modeling in Epidemics, Deterministic models, simple epidemics, general epidemics, Kermack-Mckendric threshold theorem, Recurrent epidemics, Seasonal variation in infection rate, Allowance for incubation period, Models with undamped waves.

Stochastic epidemic models, Yule-Furry Pure Birth Process, Expectation and variance of infectives, Calculation of expectation using moment generating functions, the Stochastic simple epidemic model.
Mathematical models for the effect of toxicant in single species and the predator-prey systems, effect of toxicants on populations- first order kinetics, effect of toxicants on populations- environmental and food chain pathways, non-autonomous logistic models of polulations in deteriorating environment.
Forestry management-the Faustmann model, Kilkki-Vaisanen model, Rorre's matrix model for the management of a hight structured forest, modeling on degradation and subsequent regeneration of a forestry resource, models on acid precipitation and catastrophes in forest ecosystems.

References

1. C. W. Clark (1976) Mathematical Bioeconomics, The Optimal Management of Renewable Resources(John Wiley and Sons, New York)
2. C. W. Clark (1985) Bioeconomic Modeling and Fisheries Management (John Wiley and Sons, New York)
3. B.S.Goh (1980): Management and Analysis of Biological Populations(Elesevier, Amsterdam)

Solid Mechanics - II

Bending of Plates: Basic equations for bending of thin plates, boundary conditions, bending of plates of various shapes under different edge conditions, Plates on elastic foundations, general theory of bending and twisting of thin space-rods, Kirchoff's kinetic analogue, stability of circular rod under normal pressure.
Variational Method: Strain energy, Principal of virtual work , displacements and forces. Reciprocal theorem of Beti and Rayleigh, Theorem of minimum potential energy,variational problem and Euler's equations, Rayleigh-Ritz method
Three dimensional problem: stress function, biharmonic function,reduction of Lame and Beltrami equation to biharmonic equations, Kelvin, Boushinesq-Papkovich solutions, concentrated forces at an infinite body.
Fracture mechanics: different types of cracks, criterion on cracks, initiation and direction,Griffith and Irwins theory ,nature of singularies near cracks tips, stress intensity factor(SIF)
Solution of simple crack problem using intregral equations and intregral transform methods-line and penny shaped crack,determination of SIF ,crack propagation, Branching and arrest phenomena.
Plasticity: stress tensor,octrahedral stress,spherical stress,deviatioic stress, stress invariants, spherical and deviatoric part of strain tensor, concept of strain energy. Yield criterion, yield

surface,strain hardening and work hardening, loading and unloading, Drukers postulates, general form of flow equations for strain hardening materials.
Non-hardening materials, Theory of Plastic flow, bending by terminal couples, Torsion of Beam of circular section, Sokolovesky's solution for oval section

Fluid Mechanics – II

Basic Thermodynamics of one compressible fluids :
Six governing equations of fluid motion , Crocco-vazsonyi equation , propagation of small disturbances in a gas , mach number , Dynamical similarity of two flows . Circulation theorem . Permance of irrotational motion , Bernoulli's integral for steady isentropic and / of irrotational motion. Polytropic gas , Critical speed . Equation satisfied velocity potential and stream functions . Prandtl-Mayer flow past a convex corner .

Steady flow through a De Laval nozzle . Normal and oblique shock waves . Shock-polar diagram one – dimensional similarity flow .

Steady linearized subsonic and supersonic flows . Prandtl- Glauert affine transformation . Flow along a wavy boundary flow past a slight corner. Janzen-Rayleigh method of approximation. Thin supersonic wings . Ackeret's formula .

Legendre and Molenbroek transformations Chaplygin's equation for steady function . Solution of Chaplygin's equations , Subsonic gas jet problem , Limiting line . Motion due to a two-dimensional source and a vortex , Kerman-Tsein approximation , Two – dimensional steady flow , Reimann invariants , Method of characteristic, Transonic flow , Law of Transonic similarity , Euler-Tricomi equation and its fundamental solution , Hyperbolic flow .

Turbulent Flows : Introduction : Raynold's equation of mean motion , Raynold's stress tensor , Closure problems of Raynold's equation., Co-efficients of turbulent exchange .

Mixing length , Pranditl's momentum transfer theory , Taylor's vorticity transfer theory , Kerman's similarity hypothesis , Velocity distribution in channel flow under constant pressure gradient , Plane Poiseuille flow through a channel boundary by two parallel plates .

Mixing zone between two parallel flows . Turbulent flow in a thin layer , Two – dimensional jet , Axisymmetric jet .

Two – dimensional turbulent wake behind (i) symmetric cylinder , (ii) a row of parallel rods , Turbulent flow through smooth circular pipes ; (1/7)th power velocity distribution law ; Turbulent boundary layer on a flat plate.

Statistical approach ; Isotropic homogeneous turbulence , correlation between velocity components , longitudinal and lateral corrections , Eulerian correlation with respect to time , Taylor's one – dimensional energy spectrum , Energy relations in Turbulent flows .
Computational models.

References:

1. Theoretical Aerodynamics – I.M.Milney Thomson, Macmillan ,1958
2. Fluid Mechanics – L.D. Landau and E.M.Linfashitz ; Pergamon , 1959

Research Project-II

Departmental Semenier-III

STATISTICAL INFERNECE (PARAMETRIC)

Parametric models, parameters, random sample and its likelihood, statistic and its sampling distributions, problems of inference. Examples from standard discrete and continuous models such as Bernoulli, Binomial, Poisson, Negative Binomial, Normal, Exponential, Gamma, Weibull, Pareto etc. Concept of sufficiency, minimal sufficiency, Neyman factorization criterion, Fisher information, exponential families. Maximum likelihood estimators, method of moment estimators, percentile estimators, least squares estimators, minimum mean squares estimators, uniformly minimum variance unbiased estimators, Rao-Blackwell theorem, Cramer-Rao lower bond, different examples. Statistical Hyptheses-simple and composite, statistical tests, critical regions, Type-I and Type-II errors, size and power of a test, Neyman Pearson lemma and its different applications. Most powerful test, uniformly most powerful test, unbiased test and niformly most unbiased test. Likelihood ratio test. Interval estimation, confidence intervals, construction of confidence intervals, shortest expected length confidence interval, most accurate one sided confidence interval and its relation to UMP test.

Essential Eeadings:

1. R. L. Berger and G. Casella, *Statistical Inference.* 2. E. L. Lehmann, *Theory of Point Estimation*

Supplementary Readings:

1. T. S. Ferguson, *Statistical Decision Theory. 2.* E. L. Lehmann, *Testing of Statistical Hypotheses. 3.* P. J. Bickel and K. A. Doksum, *Mathematical Statistics.* 4. J. O. Berger, *Statistical Decision* Theory.

Operating System

INTRODUCTION:

What is an Operating System, Function of Operating System, Operating System Structure: System Components, Operating System services, System Calls.

PROCESSES:

Process concept, Process State and State Transitions, Process Control Block, Suspend & Resume of Process, Interrupt Processing, Context Switching

PROCESS SYNCHRONIZATION AND INTERPROCESS COMMUNICATION:

The critical-section Problem, Dekker's Algorithm, Semaphores, Synchronization Hardware: Test-and-Set, Compare-and-Swap, Solution of producer-consumer problem.

DEADLOCKS:

System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance & Banker's Algorithm, Deadlock Detection, Deadlock Recovery.

THREADS:
Single & Multithreading Models, Threading issues, P threads, Solaris 2 Threads, Window 2000 Threads, Linux Threads, Java Threads.
CPU SCHEDULING:
Basic concepts, Scheduling Levels, Scheduling Criteria, Pre-emptive & Non-preemptive Scheduling, Scheduling Algorithms, Multi-processor scheduling,
MEMORY MANAGEMENT:
Memory Organization, Storage Hierarchy, Storage Management Strategies, Swapping, Contiguous & Non Contiguous Memory Allocation, Virtual memory: Paging, Segmentation, Segmentation with Paging, Notion of Locality and working sets, thrashing, page replacement algorithms
FILE-SYSTEM INTERFACE:
File Concepts, File Organization, Access Methods, Directory Structure, File-system Mounting, File Sharing, Protection.
FILE-SYSTEM IMPLEMENTATION:
File-system Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery.
DISK SCHEDULING:
Disk Structure, Disk Caching, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure, Disk Attachment, Stable-storage implementation,
PROTECTION:
Goals of Protection, Domain of Protection, Implementation of Access Matrix, Revocation of Access Rights, Capability-Based Systems, Language-based Protection.
SECURITY:
The security Problem, User Authentication, Program Threats, System Threats, Securing Systems and Facilities, Intrusion Detection, Cryptography, Computer-Security Classifications.

BOOKS RECOMMENDED:
1. Operating System Concepts By: Abraham Silberschatz, Peter Baer Galvin & Greg Gagne. John Wiley & Sons, Inc.
2. Operating System By: H M Deitel Pearson Education, LPE.
3. An Introduction to Operating System Concepts & Practice By: Pramod Chandra P Bhatt; PHI Pvt Ltd.

Computer Networking

INTRODUCTION:
Definition, goals, applications and classification of computer networks. Some well-known networks, Protocols and standards.
NETWORK MODELS:
Layered Tasks, Internet Models, Direct and indirect interconnection, need for addressing and routing. Concept of subnet-structure and topology of subnet, circuit, message and packet switching.
NETWORK ARCHITECTURE:
Layered architecture and protocol hierarchy. OSI Reference Model. Services and important functions of each layer. TCP/IP Model, Design issues of layers.
BRIEF REVIEW OF PHYSICAL AND DATA LINK LAYERS :
Guided and Unguided media, Line Discipline, Flow control, Capacity utilization, Sliding Window, Stop & wait protocols, Error detection mechanism, VRC,LRC,CRC, Automatic ,Repeat Request(ARQ)- stop-and wait , go-back-n, selective repeat.
MEDIUM ACCESS CONTROL:

ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Ethernet, Token Ring, CSMA/CA

NETWORK LAYER:

Need for Network layer, Connection–oriented and connectionless services, Addressing: Internet address, classful address, subneting, superneting, Classless Addressing, Routing techniques –Static versus Dynamic Routing, flooding, Distance vector and link-state routing, Basics of IP

TRANSPORT LAYER:

Congestion control algorithms. Basics of TCP and UDP.

APPLICATION LAYER PROTOCOLS: Basics of Telnet, FTP, SMTP, HTTP.

WIRELESS AND MOBILE NETWORKING: IEEE 802.11, IEEE 802.16, BLUETOOTH and IEE 802.15. Ad-hoc networks. Cellular networks – GSM, CDMA

ISDN, B-ISDN, FRAME RELAY AND ATM NETWORKS: Concept of ISDN and B-ISDN. Review of the digitization status of the telephone network. X.25, Frame Relay and ATM evolution, ATM layers, sub layers and their functions, ATM switch architecture.

BOOKS RECOMMENDED:

1. Data Communication and Networking, 4th Edition, McGraw-Hill, Behrouz Forouzan.
2. A. S. Tanenbaum, "Computer Networks", 4th Ed., Pearson Education Asia (LPE), 2003.
3. L.L. Peterson and B.S. Davie, "Computer Networks: A Systems Approach", 2nd Ed., Morgan Kaufman, Harcourt Asia, 2000.
4. W. Stallings, "Data and Computer Communications", 6th Ed., Pearson Education Asia(LPE), 2000.
5. F. Halsall, "Data Communications, Computer Networks and Open Systems", 4th Ed.,Pearson Education Asia (LPE), 1996.
6. L. Garcia and I. Widjaja, "Communication Networks: Fundamental Concepts and Key architectures", Tata-McGraw-Hill Ed., 2000.
7. J.F. Kurose and K.W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education Asia (LPE), 2001.
8. L. Kleinrock, "Queuing Systems, Vol. 1: Theory", John Wiley, 1975.
9. Bertsekas and R. Gallagar, "Data Networks", 2nd Ed., PHI (EEE), 1988.
10. W. Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", 4th Ed.

Homotopy Theory:

Brouwer Fixed point theorem, categories, Functors, Natural transformations, Natural equivalence, Homtopy, Convexity, Contrctibility, Mapping cylinder and cones, Paths and path connected spaces, Affine spaces, Affine maps, Homotopy as equivalence relation, Contractible Spaces, Homotopy of maps, Homotopy classes, Homotopically equivalent spaces with examples, Fundamental Groups, Induced maps and homomorphisms, Lifting property, Calculation of first homotopy groups, Function spaces, Group objects and cogroup objects, Loop space and suspension, Exact sequence of homotopy groups, Homotopy lifting propert, Homotopy extension property, Fibrations and cofibrations, CW-complexes and their examples, attaching of maps, Homotopy groups of CW-complexes, The effect on the homotopy groups of a cellular extension, Spaces with prescribed homotopy groups, Weak homotopy equivalences and CW-approximation Homotopy extension and classification theorems, Study of some cases where homotopy theory is applied in electrical engineering.

Essential Reading:

1. J. Rotman, *Algebraic Topology*, Springer-Verlag, 2004

Wavelets and Application

Fourier transform on L1 (R) and L2 (R) and basic properties and examples; Motivation and definition of Windowed Fourier Transform and examples, Time frequency localization, the reconstruction formula; Motivation and Definition of the wavelet transform and examples, Basic properties, The reconstruction formula, Frequency localization, Scaling functions and wavelets, orthogonal bases of compactly supported wavelets, orthonormal Wavelets; Definition of Multiresolution Analysis and examples, Properties of scaling functions and orthonormal wavelets bases, Construction of orthonormal wavelets.

Essential Reading:

1. L. Debnath, *Wavelet Transforms and Their Applications*, Birkhäuser, 2002.

Supplementary Reading:

1. G. Bachman, L. Narici, and E. Beckensterin, *Fourier and Wavelet Analysis*, Springer-Verlage, 2000.
2. C.K. Chui, *An Introduction to Wavelets*, Academic Press, 1992.

Lie Algebra

Definitions and example, Solvable and nilpotent Lie algebras, Simple and semi-simple Lie algebras, Levi's theorem, Idealizer and centralizer, Derivation of a Lie algebra, Structure constant, Special linear algebra, Lie groups and Lie algebras, Classical groups and their Lie algebras, Cartan-Killing form, Root-space decomposition of a Semi-simple Lie algebra, Properties of root space, Simple root system and classification of finite dimensional complex Semi-simple Lie algebra, Cartan matrix, root diagrams, Dynkin diagrams, Weyl group of a root system, Weyl reflection, Real forms of Lie algebras and their classification through Satake and Vogan diagram, Applications of Lie groups and Lie algebras to robotics, Genetic coding, Control theory, Computer vision, Particle physics.

Essential Reading:

1. K. Erdmann, M. J. Wildon, *Introduction to Lie Algebras*, Springer 2006

Data Mining and Warehousing

OVERVIEW & CONCEPTS:

Need for data warehousing, basic elements of data warehousing, Trends in data warehousing.

PLANNING &REQUIREMENTS:

Project planning and management, Collecting the requirements. Architecture & Infrastructure: Architectural components, Infrastructure and metadata.

DATA DESIGN AND DATA REPRESENTATION:

Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading, data quality. Information Access & Delivery: Matching information to classes of users, OLAP in data warehouse, Data warehousing and the web. Implementation And Maintenance: Physical design process, data warehouse.

INTRODUCTION:

Basics of data mining, related concepts, Data mining techniques.

DATA MINING ALGORITHMS:

Classification, Clustering, Association rules.

KNOWLEDGE DISCOVERY:
KDD Process
WEB MINING:
Web Content Mining, Web Structure Mining, Web Usage mining.

ADVANCED TOPICS:
Spatial mining, temporal mining.
VISUALIZATION:
Data generalization and summarization-based characterization, Analytical characterization, analysis of attribute relevance, mining class comparisons: Discriminating between differentclasses, mining descriptive statistical measures in large databases Data Mining Primitives, Languages, and System Architectures: Data mining primitives, Query language, Designing GUI based on a data mining query language, Architectures ofdata mining systems , Application and Trends in Data Mining: Applications, Systems products and research prototypes, Additional themes in data mining, Trends in data mining

BOOKS RECOMMENDED:-

1. Adriaans, P. (1996), Data mining, Addison-Wesley
2. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers
3. Paulraj Ponnian, "Data Warehousing Fundamentals", John Wiley.
4. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education
5. Margaret Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall
6. Weiss, Sholom "M. - Predictive data mining: a practical guide" / Sholom M. Weiss, Nitin Indurkhy. - San Francisco, Calif. : Morgan Kaufmann Publishers, 1998. - 1558604030
7. Advances in knowledge discovery and data mining / edited by Usama M. Fayyad. - Menlo Park, Calif. : AAAI Press; Cambridge, Mass.; London : MIT
8. Thomsen, Erik, 1959, "OLAP solutions : building multidimensional information systems" / Erik Thomse. - 2nd ed. - New York; Chichester : Wiley
9. Mitchell, Tom M., Tom Michael, 1951-. - Machine learning / Tom M. Mitchell. - New York; London : McGraw-Hill
10. Ralph Kimball, "The Data Warehouse Lifecycle toolkit", John Wiley.
11. M Berry and G. Linoff, "Mastering Data Mining", John Wiley.
12. W.H. Inmon, "Building the Data Warehouses", Wiley Dreamtech.
13. R. Kimpall, "The Data Warehouse Toolkit", John Wiley
14. Konar A., Artificial Intelligence and Soft Computing, CRC Press, 2000

Operator Theory

Banach Spaces: The Banach space of continuous functions, Abstract Banach spaces, The conjugate space of continuous linear functionals, Examples of Banach spaces: c0, l1 and l, Weak topologies on Banach spaces, The Alaoglu theorem, The Hahn-Banach theorem, The conjugate space of C([0,1]). The open mapping theorem, The Lebesgue spaces: L1 an L, The Hardy spaces: H1 and H, Banach algebras: The Banach algebra of continuous functions, Abstract of Banach algebras, Abstract index in a Banach algebra, The space of multiplicative linear functions, The Gelfand transform, The Gelfand-Mazur theorem, The Gelfand theorem for commutative Banach algebras, The spectral radius formula, The Stone-Weirstrass theorem, The generalized Stone-Weirstrass theorem, The disk algebra, The algebra of functions with absolutely convergent Fourier series, The algebra of bounded measurable functions, Geometry of Hilbert space: Inner product spaces, The Cauchy-Schwarz inequality, The Pythagorian theorem, Hilbert spaces, Examples of Hilbert Spaces: Cn, l2, L2, and H2.

The Riesz-Representation Theorem, The existence of orthogonal bases, The dimension of Hilbert spaces, Operators on Hilbert space and C*-algebras: The adjoint operators, Normal and self-adjoint operators, Projections and subspaces, Multiplication operators and maximal abelian algebras, The bilateral shift operators, C*-algebras.

Essential Reading:

1. R. G. Douglas: *Banach Algebra Techniques in Operator Theory*, Springer, 1998

Computer Organization & Architecture

COMPUTING & COMPUTERS:

Evolution of computer:-mechanical era, electronic computers, integrated circuits, processor architecture, system architecture.

DESIGN METHODOLOGY:-

System design:-system representation, design process, gate level. Register level:- register level components, programmable logic devices, register level design. The processor level processor level components, processor level design.

PROCESSOR BASIC:-

Computer Organization:- Fundamentals, additional features, Data Representation:-basic formats, fixed point numbers, floating numbers. Instruction Sets:-instruction formats, instruction types, programming considerations

CONTROL DESIGN:-

Instruction sequencing & instruction interpretation, Hardwired Control:-design methods, multiplier control unit, CPU control unit, Micro programmed control:- micro instructions & their encoding.

MEMORY:

C.P.U memory interaction, memory array organization & technology, Memory hierarchies, main memory allocation, segment, pages & files .High speed memories, Interleaved memories, caches & associative memories, Cache coherence:-sequential and weak consistency, snoopy bus protocol and directory based.

INPUT-OUTPUT ORGANIZATION:

Addressing I\O devices, Data transfer synchronization, Interrupt handling I/O channels, Computer peripherals & interfacing., Direct Memory Access, Examples of I/O Buses: PCI,SCSI, USB

BASICS OF PIPELINING:

Instruction and data pipelining, speedup, Definitions of pipeline hazards: structural, data, and control and simple techniques for handling them.

BOOKS RECOMMENDED:-

1. H.M. Mann, Computer System Architecture",P.H.I.
2. J.P Hayes, Computer Architecture & Organisation, McGraw-Hill.
3. Computer Organization 5th Ed.-Carl Hamacher Publisher: McGraw-Hill.
4. Computer Organization And Architecture - Stallings Publisher: Pearson Education
5. A.P. Malvino "Digital Computer Electronics", McGraw-Hil

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