DEPARTMENT OF MATHEMATICS

PG SYLLABUS

Effective from the Academic Year 2006-07

LOYOLA COLLEGE

Autonomous
College Conferred with Potential for Excellence by UGC
Accredited at A+ by NAAC
Chennai - 600 034

Sem	SUB	Code	TItle	Cre	Hrs
I	MC	MT 1804	LINEAR ALGEBRA	4	6
I	MC	MT 1805	REAL ANALYSIS	4	6
I	MC	MT 1806	ORDINARY DIFFERENTIAL EQUATIONS	3	5
I	MC	MT 1807	DIFFERENTIAL GEOMETRY	4	6
I	MC	MT 1808	COMPUTER ALGORITHMS	4	6
II	MC	MT 2804	ALGEBRA	4	6
II	MC	MT 2805	MEASURE THEORY AND INTEGRATION	3	5
II	MC	MT 2806	PARTIAL DIFFERENTIAL EQUATIONS	2	4
II	MC	MT 2807	COMPLEX ANALYSIS	4	7
II	SE	MT 2951	FORMAL LANGUAGES AND AUTOMATA	3	5
II	SE	MT 2952	NUMERICAL METHODS USING C++	3	5
II	SU	MT 2901	MATHEMATICAL METHODS	3	4
II	SU	MT 2902	LINEAR ALGEBRA AND MATRIX THEORY	3	4
II	SU	MT 2903	MATHEMATICAL PHYSICS	3	4
II	SU	MT 2904	MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE	3	4
III	MC	MT 3803	TOPOLOGY	3	5
III	MC	MT 3804	CLASSICAL MECHANICS	3	5
III	MC	MT 3805	ANALYTIC NUMBER THEORY	2	4
III	MC	MT 3806	ALGORITHMIC GRAPH THEORY	2	4
III	ID	MT 3875	MATHEMATICAL METHODS IN BIOLOGY (FOR II M.SC. MATHEMATICS STUDENTS)	3	4
III	ID	ZO 3875	BIO-MATHEMATICS (FOR II M.SC. ZOOLOGY STUDENTS)	3	4
III	CP	MT 3925	MATHEMATICAL SOCIAL SCIENCES	3	4
IV	MC	MT 4804	FUNCTIONAL ANALYSIS	3	5
IV	MC	MT 4805	RELATIVISTIC MECHANICS	3	5
IV	MC	MT 4806	FLUID DYNAMICS	2	4
IV	MC	MT 4807	OPERATIONS RESEARCH	3	5
IV	SE	MT 4954	THEORY OF FUZZY SUBSETS	3	5
IV	SE	MT	COMMUTATIVE ALGEBRA	3	5
IV	SE	MT 4955	PARALLEL INTERCONNECTION NETWORKS	3	5
IV	SE	MT	FINANCIAL MATHEMATICS	3	5

MT 1804 - LINEAR ALGEBRA

SEMESTER : I | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 6

Objectives: *To introduce the basic concepts and methods in the study of Linear Transformation on finite dimensional Vector spaces and their Matrix Forms.*

Unit 1: Characteristic values – Annihilating Polynomials – Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization.

Unit 2: Direct sum decompositions – Invariant Direct sums – The Primary Decomposition theorem – Cyclic subspaces and Annihilators.

Unit 3: Cyclic Decompositions and the Rational form – The Jordan form – Computation of invariant factors.

Unit 4: Forms on Inner Product Spaces – Positive Forms – More on Forms – Spectral theory.

Unit 5: Bilinear forms – Symmetric bilinear forms – Skew-symmetric bilinear forms – Group preserving bilinear forms.

TEXT BOOKS:

Kenneth Hoffman & Ray Kunze, 'Linear Algebra', Prentice-Hall of India.
[Chapter 6 : sections 6.2 to 6.8, Chapter 7 : sections 7.1 to 7.4,
Chapter 9 : sections 9.2 to 9.5, Chapter 10 : sections 10.1 to 10.4]

REFERENCES:

1. M. Artin, 'Algebra', Prentice-Hall of India.
2. Ben Noble, James W. Daniel, 'Applied Linear Algebra', Prentice-Hall of India.

MT 1805 - REAL ANALYSIS

SEMESTER : I | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 6

Objectives: *To give a systematic study of Riemann Stieltjes Integral and the calculus on R^n and a brief study of convergence of sequences and series, Power series, Fouries series and polynomials.*

Unit 1: Riemann- Steiltjes Integral: Definition and Properties of the Integral-Integration and Differentiation-Integration of vector valued functions

Unit 2: Functions of Several Variables: Differentiation-Chain Rule-Partial Derivatives -The Contraction Principle.

Unit 3: Sequences and Series of functions: Pointwise Convergence –Uniform Convergence – Weierstrass Approximation Theorem.

Unit 4: Special Functions: Power Series-Exponential and Logarithmic Functions-Trigonometric functions -Fourier Series-Gamma function.

Unit 5: Polynomials: Approximation – Motivation -Taylor Polynomial - Interpolating Polynomial - Tchebyshev Polynomial

TEXT BOOKS:

1. Walter Rudin, 'Principles of Mathematical Analysis', Third Edition, Tata McGraw – Hill International book company.
   [Pages 120 – 136, 211 – 221, 143 – 159, 184 – 196]
2. Dr. Rangan, "Real Analysis (Part II), New Century Book House (P) Ltd.
   [Chapter 12 – Pages 282 - 298]

REFERENCES:

1. Tom. M. Apostol, 'Mathematical Analysis', Second Edition, Addison Wesley Publishing House.
2. V. Ganapathy Iyer, ' Mathematical Analysis', Tata McGraw Hill Publishing House.

MT 1806 - ORDINARY DIFFERENTIAL EQUATIONS

SEMESTER : I | CREDIT : 3
CATEGORY : MC | NO. OF HOURS / WEEK : 5

Objectives: *To learn mathematical methods to solve Higher Order Differential Equations and apply to dynamical problems of practical interest.*

Unit 1: Linear Differential Equations of Higher Order – Linear dependence and Wronskian – Basic theory of linear equations – Method of variation of parameters – Two useful formula – Homogeneous Linear equations with Constant Coefficients.

Unit 2: Method of Frobenius – Bessel's functions – Legendre's equation – Legendre polynomials – Successive Approximations.

Unit 3: Rodrigue's formula – Gauss equation – Hypergeometric function.

Unit 4: Boundary Value Problem – Sturm-Liouvillie problem – Green's functions – Non-existence of solutions – Picard's theorem.

Unit 5: Stability of Quasi linear systems – autonomous systems – non-autonomous systems – a special Lyapunav function.

TEXT BOOKS:

1. S.G.Deo, Ragavendra, 'Ordinary Differential Equations and Stability Theory', Tata McGraw-Hill Publishing Company Ltd. (1980)
   [Chapter 1 : Sections 2.1 – 2.6, Chapter 5 : Sections 5.2 – 5.4,
   Chapter 7 : Sections 7.1 – 7.5, Chapter 9 : Sections 9.1 – 9.5]
2. W.W.Bell, 'Special functions for Scientists and Engineers', D.Van Nostrand Company Ltd.(1968).
   [Chapter 1 : Sections 1.1 , 1.2, Chapter 3 : Sections 3.1 – 3.3,
   Chapter 4 : Sections 4.1 , 4.2, Chapter 9 : Sections 9.1 - 9.3]

REFERENCES:

1. George F.Simmons, 'Differential Equations with Applications and Historical Notes', Tata McGraw-Hill Publishing Company Ltd. (1972).

2. Earl A.Coddington, 'An Introduction to Ordinary Differential Equations', Prentice-Hall of India, New Delhi. (1992).
3. Boyce.W.E, Diprma.R.C, 'Elementary Differential Equations and Boundary Value Problems', John Wiley and Sons, NY, (2001).

MT 1807 - DIFFERENTIAL GEOMETRY

SEMESTER : I | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 6

Objectives: *To teach some applications of abstract algebra and analysis to geometrical problems and facts.*

Unit 1: Curves – Analytical representation – Arc length, tangent – Osculating plane – Curvature – Formula of Frenet.

Unit 2: Contact – Natural equations – General solution of the natural equations – Helics – Evolutes and Involutes.

Unit 3: Elementary theory of Surfaces – Analytic representation – First Fundamental form – Normal, Tangent plane – Developable Surfaces.

Unit 4: Second Fundamental form – Meusnier Theorem – Euler's Theorem – Dupin's Indicatrix – Some surfaces – Geodesics – Some simple problems.

Unit 5: Equations of Gauss and Weingarten – Some applications of Gauss and the Coddazi equations – The Fundamental Theorem of Surface Thoery.

TEXT BOOKS:

1 Dirk J. Struik, 'Lectures on Classical Differential Geometry', Second Edition, Addison Wesley Publishing Company, London, (1961).

REFERENCES:

2. Willmore, 'An Introduction to Differential Geometry', Oxford University Press, London, (1972).
3. Thorpe, 'Elementary Topics in Differential Geometry', Second Edition, Springer Verlag, New York, (1985).

4. Mittal, Agarwal, 'Differential Geometry', Thirtieth Edition, Krishna Prakashan, Meerut, (2003).
5. Somasundaram, 'Differential Geometry', Narosa, Chennai, (2005).

MT 1808 - COMPUTER ALGORITHMS

SEMESTER : I | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 6

Objectives: *To motivate the students to Computational Mathematics, a recent trend in both educational and industrial fields.*

Unit 1: Algorithm – Definition, Time Complexity. Elementary Data Structures – Stacks, Queues, Trees, Priority Queues, Heaps, Heapsort, Graphs.

Unit 2: Divide and Conquer – General method, Binary search, Merge sort, Quick sort

Unit 3: The Greedy Method – Knapsack problem, Job sequencing with dead lines, Optimal storage on tapes, Optimal merge patterns.

Unit 4: Basic traversal – Inorder, preorder, postorder traversals, Breadth first search and traversal, Depth first search and traversal

Backtracking – Sum of subsets, *n*-Queens problem (n = 4, 8).

Unit 5: *NP* – Hard and *NP* – complete problems – Basic Concepts, Cook's Theorem(Statement only), Conjunctive Normal Form(CNF) – satisfiability reduces to Clique Decision Problem(CDP), The Clique Decision Problem(CDP) reduces to The Node Cover Decision Problem

TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 'Fundamentals of Computer Algorithms', Galgotia Publications, 1998.

REFERENCES:

2. Thomas H.Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 'Introduction to Algorithms', Second Edition, Prentice Hall of India, 2004.
3. Alfred V.Aho, John E.Hopcroft and Jeffrey D.Ullman, 'Data Structures and Algorithms', Addison-Wesley, 1983.
4. M. Gary and S. Johnson, 'Computers and Interactability: A guide to theory of *NP*-Completeness', W. H. Freeman & Company, 1979.

MT 2804 - ALGEBRA

SEMESTER : II | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 6

Objectives:

1. *To introduce to the students the general concepts in Abstract Algebra.*
2. *To give a foundation in various algebraic structures.*

Unit 1: (Groups – Symmetry)

Symmetry of plane figures – The groups of motions of the plane – finite groups of motions – Discrete groups of motions – Abstract symmetry : Group operations – The operations on cosets – The counting formula – Permutuation Representations – Finite subgroups of the rotation group.

Unit 2: (More about Groups)

The operation of a group on itself – The class equation of the Icosahedral group - Operations on subsets – The Sylow theorems – The group of order 12 - Computation in the symmetric group – The Free groups.

Unit 3: (Modules)

The definition of a Module – Matrices, Free modules and Bases – The principle of permanence of identities – Generators and Relations for modules – The structure theorem for Abelian groups.

Unit 4: (Field Extensions)

Extension fields – Roots of polynomials – More about roots – finite fields.

Unit 5: (Galois Theory)

Elements of Galois theory – Solvability by radicals – Galois Group over the rationals.

TEXT BOOKS:

1. Michael Artin, 'Algebra', Prentice Hall of India, 1994.
   [Chapter 5 – Sections 1 – 9, Chapter 6 – Sections 1 – 7, Chapter 12 – Sections 1, 2, 3, 5, 6]
2. I.N. Herstein, 'Topics in Algebra', Wiley eastern Limited, New Delhi, 1975.
   [Chapter 5 – Sections 5.1, 5.3, 5.5, 5.6, 5.7, 5.8 , Chapter 7 – Section 7.1]

REFERENCES:

3. S. Lang, 'Algebra', 2nd Edition, Addison Wesley (1965).
4. John B. Fraleigh, 'A First Course in Abstract Algebra', 2nd Edition, Addison Wesley (1975).
5. Musili, C., 'Introduction to Rings and Modules', 2nd Revised Edition, Narosa Publishing House, Chennai (1992).

MT 2805 - MEASURE THEORY AND INTEGRATION

SEMESTER : II | CREDIT : 3
CATEGORY : MC | NO. OF HOURS / WEEK : 5

Objectives:

1. *To provide a basic course in Lebesgue Measure and Integration and a study of inequalities and the L^p-spaces.*
2. *To study signed measures and decomposition theorems.*

Unit 1: Measure on the Real Line

Introduction - Lebesgue outer measure-measurable sets-Borel sets-Regular measure - Lebesgue measurable function-Borel measurable function..

Unit 2: Integration of Functions of a Real Variable

Integration of non-negative functions-Lebesgue integral-Fatou's lemma - Lebesgue monotone convergence theorem-Lebesgue Dominated convergence theorem-Riemann and Lebesgue integrals.

Unit 3: Abstract Measure Spaces

Measures and outer measures – Lebesgue Measure in Euclidean space - completion of a measure-measure spaces.

Unit 4: Inequalities and the L^p Spaces

Convex functions – Jensen's inequality –inequalities of Holder and Minkowski-L^p -convergence in measure.

Unit 5: Signed measures and their derivatives

Signed measures and Hahn decomposition –The Jordan decomposition - The Radon Nikodym theorem(statement only)-some applications of he Radon Nikodym Theorem**.**

TEXT BOOK:

1. G.de Barra: Measure Theory and Integration.

REFERENCES:

2. Munroe, M..E.- Introduction to Measure and Integration- Addison Wesley, Mass 1953.
3. I.P. Natanson- Teory ofFunctions of a Real Variable - Frederick Ungar Publishing Company, New York, 1955.
4. Royden- Real Analysis,Macmillan.
5. P.R. Halmos-Measure theory, Springer International Student Edition
6. I.k.Rana- An introduction to Measure and Integration. Narosa Publishing House

MT 2806 - PARTIAL DIFFERENTIAL EQUATIONS

SEMESTER : II | CREDIT : 2
CATEGORY : MC | NO. OF HOURS / WEEK : 4

Objective: *To give an introduction to Mathematical techniques in analysis of P.D.E.*

Unit 1: First Order P.D.E.

Formulation of P.D.E - Compatibility - Classification of Integrals - Charpit's Method- Jacobi Method - Special Types of First Order Equations - Cauchy's Method.

Unit 2: Second Order P.D.E.

Origin of Second Order P.D.E - Linear P.D.E - Solution of Reducible Equations - Solution of Irreducible Equations with Constant Coefficients - Rules for Finding C.I and P.I - Classification of Second Order P.D.E - Riemann's Method.

Unit 3: Elliptic Differential Equations

Laplace and Poisson Equation- Boundary Value Problems- Dirichlet Problem for a circle - Neumann Problem for a circle.

Unit 4: Parabolic and Hyperbolic Differential Equations

Diffusion Equation- Diffusion Equation in cylindrical and spherical coordinates- Transmission Line Problems- Uniqueness Theorem- Wave Equation- D'Alembert's Solution of One Dimensional Wave Equation.

Unit 5: Integral Transforms and Green Function Method

Laplace Transforms- Fourier Transforms and Their Applications- Green Function Method and its Applications.

TEXT BOOK:

1. J.N.Sharma and Kehar Singh, Partial Differential Equations for Engineers and Scientists – Narosa Publishing House,New Delhi, 2000

REFERENCES:

1. Greenspan Donald, Introduction to Partial Differential Equations, Tata Mcgraw Hill, New Delhi, 1961.
2. I.N.Snedden, Elements of Partial Differential Equations, Tata Mcgraw Hill, New Delhi, 1983.
3. Tyn Myint and Lokenath Debnath, Partial Differential Equations for Scientists and Engineers, North Hollan, New York, 1987.
4. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd, New Delhi, 2001
5. Robert C. McOwen, Partial Differential Equations. Pearson Education, 2004

MT 2807 - COMPLEX ANALYSIS

SEMESTER : II | CREDIT : 4
CATEGORY : MC | NO. OF HOURS / WEEK : 7

Objectives:

1.To lay the foundation for topics in Advanced Complex Analysis.
2.To develop clear thinking and analyzing capacity for research.

Unit 1: Power series representation of analytic functions – zeros of an analytic function – the index of a closed curve – Cauchy's theorem and integral calculus – the homotopic version of Cauchy's theorem – Goursat's theorem.

Unit 2: Schwarz lemma – Convex functions – Hadamard's three circles theorem – The Arzela Ascoli theorem – The Riemann mapping theorem.

Unit 3: Weierstrass factorization theorem – the factorization theorem of the sine function – the Gamma function – the Riemann Zeta function.

Unit 4: Runge's theorem – Mittag-Leffler's theorem – Jensen's formula – Hadamard's factorization theorem.

Unit 5: Simply periodic functions – Doubly periodic functions – Elliptic functions – the Weierstrass theory.

TEXT BOOK:

1. John B. Conway, Functions of one complex variable, Springer International Student Edition, 1987.
2. Ahlfors L.V., Complex Analysis, 3rd edition, McGraw-Hill, New York, 1986.

REFERENCES:

1. Copson, E.T., Theory of Functions of a complex variable, Oxford University ress, 1962.
2. Hille. E., Analytic Function Theory, 2nd edition, volumes I and II, Chelsea, New York, 1973.
3. Markushewich, A.I., Theory of Functions of a complex variable, 2nd edition, Volumes I, II and III, Chelsea, New York, 1977.

MT 2951 - FORMAL LANGUAGES AND AUTOMATA

SEMESTER : II | CREDIT : 3
CATEGORY : SE | NO. OF HOURS / WEEK : 5

Objectives:

1. *To provide an insight to theoretical computer science.*
2. *To get across to the students the notion of effective computability, using mathematical models*

Unit 1: Finite Automata and Regular Expressions

Finite state systems – Basic definitions – Non-deterministic finite automata – Finite automata with ε-moves – Regular expressions.

Unit 2: Properties of Regular Sets

The Pumping lemma for regular sets – Closure properties of regular sets – Decision algorithms for regular sets – The Myhill-Nerode theorem.

Unit 3: Context-Free Grammars

Introduction – Context-free grammars – Derivation trees – simplification of context-free grammars – Chomsky normal form.

Unit 4: Pushdown Automata

Informal description – Definitions – Pushdown automat and context-free languages.

Unit 5: Turing Machines

Introduction – The Turing machine model – Computable languages and functions – Techniques for Turing machine construction.

TEXT BOOK:

1. John E.Hopcroft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1995.
[Chapter: 2.1 – 2.5, 3.1 – 3.4, 4.1 – 4.5, 5.1 – 5.3, 7.1 – 7.4.]

MT 2952 - NUMERICAL METHODS USING C++

SEMESTER : II | CREDIT : 3
CATEGORY : SE | NO. OF HOURS / WEEK : 5

Objectives:

1. *To expose the students to various tools in solving numerical problems.*
2. *To enable the students to apply these methods in a computer environment.*

Unit 1: Introduction to C++

Variables – Input and Output – If statement – Logical operators – Nested If and Switch statements – For statement – While statement – Arrays – Pointers – Library functions – User-defined functions.

Unit 2: System of Linear Equations

Gauss-Elimination method – Pivoting – Gauss-Jordan Elimination method – Gauss-Seidal Iteration method.

Unit 3: Non-linear Equations and Interpolation

Bisection method – Newton's method – Interpolation - Newton's divided difference formula – Lagrange's interpolation – Newton's forward and backward difference formula.

Unit 4: Differentiation and Integration

Numerical differentiation – Numerical Integration – Newton Cotes method – Trapezoidal rule – Simpson's rule.

Unit 5: Ordinary Differential Equations

Initial value problem – Euler's method – Runge-Kutta method – Boundary value problem.

TEXT BOOK:

1. James M.Ortega and Andrew S.Grimshaw., An Introduction to C + + and Numerical Methods, Oxford University Press, New York, 1999.
2. Jain M K, Iyengar S R K, Jain R K., Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi.

REFERENCES:

1. Balagurusamy E., Object Oriented Programming with C + + , Tata McGraw Hill Publishing Company Ltd, New Delhi, 1996.
2. Froberg C E., Introduction to Numerical Analysis, Second Edition, Addison-Wesley Publishing Company, 1972.

MT 2901 - MATHEMATICAL METHODS

SEMESTER	: II	CREDIT	: 3
CATEGORY	: SU	NO. OF HOURS / WEEK	: 4

Objectives:

1. *To provide a mathematical background to the principles of Economics.*
2. *To help analyze and solve problems in Economics.*

Unit 1: Analytical Geometry

Straight lines – Two point form – Intercept form – Point-slope form – Slope-intercept form – Parallel, perpendicular and intersecting lines – Applications of straight lines in Business and Economics – Linear demand and supply curves – Market equilibrium – Break even analysis.

Unit 2: Integration

Definite and Indefinite integrals – Simple methods of integration – Integration by parts – Integration by partial fractions – Integration by substitutions – definite integrals – revenue, cost – National income consumption and saving – Capital formation – area as a definite integral – area between two curves – consumer's surplus – producer's surplus.

Unit 3: Differential Equations

Definition and classification of differential equations – Solutions of ordinary differential equations – separable differential equations – linear differential equations – Domar Macro model.

Unit 4: Difference Equations

Definition and classification of Difference equation – solutions of difference equations – linear first order difference equation with constant coefficients – The Harrod model.

Unit 5: Vector Differentiation

Definition of a vector – Vector differentiation of linear function - vector function – quadratic forms and bilinear forms – application of vector differentiation in maximization and minimization.

TEXT BOOK:

1. Jean E. Weber, Mathematical Analysis – Business and Economic Applications, Harper & Row, Publishers, Singapore.

REFERENCES:

1. Allan, R G D., Mathematical AnaLysis for Economists, Macmillan
2. Archibald, G C and Richard G Lipsey., An Introduction to a Mathematical Treatment of Economics, All India Traveller Book Seller, New Delhi, 1990
3. Mahta, B C and G M K Madnani., Mathematics for Economics, Sultan Chand and sons, New Delhi, 1992

MT 2902 - LINEAR ALGEBRA AND MATRIX THEORY

SEMESTER : II | CREDIT : 3
CATEGORY : SU | NO. OF HOURS / WEEK : 4

Objective: *To provide a foundation in Linear Algebra concepts, approaches and methods for the Post-Graduate Statistics students*

Unit 1: Algebra of Matrices

Linear transformations and matrices-Operations on matrices-Properties of matrix operation – Matrices with special structures

Rank and Inverse

Row space and column space- Inverse of a matrix- Properties of inverse-Rank of real and complex matrices-Change of basis

Unit 2: Linear Equations

Homogenous systems-General linear system-Generalised inverse of a matrix –Sweep out method for solving Ax = b

Unit 3: Inner product space

Inner product-Norm-Orthogonality and orthogonal basis-Orhtogonal complement

Unit 4: Eigen values

Characteristic roots – Eigen vectors and eigen spaces- Cayley-Hamilton theorem and minimum polynomial – Spectral representation of a semi simple matrix – Spectral theorems

Unit 5: Quadratic Forms

Definition of a quadratic form – Classification of quadratic forms – Rank and signature – p.d and n.n.d matrices – Hermitian forms.

TEXT BOOK:

1. A. Ramachandra Rao and Bhimasankaram, Linear Algebra, Second Edition, Hindustan Book Agency.
   Chapt 2: 2.2 to 2.4, Chapt 3:3.2 to 3.4, 3.9 and 3.10, Chapt 5: 5.1 to 5.5, Chapt 7: 7.2 to 7.5, Chapt 8: 8.2 to 8.5 and 8.7, Chapt 9: 9.1 to 9.4 and 9.8

REFERENCES:

1. Kenneth Hoffman and Ray Kunze, Linear Algebra, Second edition, Prentice Hall of India Pvt.Ltd.
2. I.N. Herstein, Topics in Algebra, Second Edition, Wiley Eastern Ltd.
3. Michael Artin, Algebra, Prentice Hall of India Pvt Ltd, 1994.

MT 2903 - MATHEMATICAL PHYSICS

SEMESTER : II | CREDIT : 3
CATEGORY : SU | NO. OF HOURS / WEEK : 4

Objective: *To expose the students to areas of mathematics having applications in physics.*

Unit 1: Complex Analysis I

Functions of a complex variable- The derivative-Cauchy Riemann differential equations- Analytic functions and sinqularities- Line integrals-Cauchy's integral theorem-Cauchy's integral formula for derivatives.

Unit 2: Complex Analysis II

Tests for convergence and divergence of series-Power series-Taylor's series-Laurent's series- Cauchy's residue theorem-Residue at infinity-Evaluation of residues- Evaluation of definite integrals-Simple problems.

Unit 3: Integral Transforms

Laplace transforms and applications-Fourier series for periodic functions- Dirichlet conditions- Half range series- Complex form of Fourier series-Fourier transforms.

Unit 4: Differential Equations

Ordinary differential equations-Series solutions and behaviour of series solutions-Singularity – Frobenius method - Hypergeometric Functions.

Unit 5: Special Functions

Bessel, Legendre, Hermite and Laguerre equations - Properties of their solutions-Recurrence relations-Orthogonal properties.

TEXT BOOK:

1. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill International Book Company, 1984
2. Erwin Krysigz, Advanced Engineering Mathematics, Seventh edition, John Wiley& Sons, New York.
3. George Arfken, Mathematical Methods For Physicists, Third edition, Academic press(1995)
4. Bell, Special Functions for Scientists and Engineers-Van Nostrand Company. London

REFERENCES:

1. Butkov, Mathematical Physics.
2. Greenberg, Advanced Engineering Mathematics, Second edition, Pearson Education Asia (2002)

MT 2904 - MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE

SEMESTER : II | CREDIT : 3
CATEGORY : SU | NO. OF HOURS / WEEK : 4

Objectives: *To provide the mathematical concepts and methods as a foundation to learn theoretical computer science.*

Unit 1: Mathematical Logic, Normal Forms, Theory of Inference, Automatic Theorem Proving, Predicate Calculus.

Unit 2: Equivalence Relation, Functions, Binary and n-ary operations, Recursive Functions, Sets and Predicates, Semi groups and Monoids.

Unit 3: Partial Order Relation - Poset – Lattices – Hasse Diagram – Boolean Algebra.

Unit 4: Basic concepts of Graph Theory – Paths – Reach ability and connectedness – Matrix representation of Graphs – Storage representation and manipulation of Graphs – Binary trees – Shortest path algorithms.

Unit 5: Finite state Automata – Deterministic and Non-deterministic, Non-deterministic Finite Automaton with–transitions – Equivalence of these without proofs – Regular expressions.

TEXT BOOK:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Companies Limited, New York, 1997.

REFERENCES:

1. Korfage R.R., Discrete Computation Structures, Academic Press.
2. Birgoft G. and Bertee T.C., Modern Appied Algebra, McGraw Hill.
3. Johnson Baugh, Discrete Maths, McGraw Hill.
4. Narasingh Deo, Graph Theory and Applications, Eastern Economy Edition.
5. Hopcroft and D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1995.

MT 3803 : TOPOLOGY

SEMESTER : III | CREDIT : 3
CATEGORY : MC | NO. OF HOURS / WEEK : 5

Objectives: *To study topological spaces, continuous functions, connectedness, compactness, countability and separation axioms.*

Unit 1: Metric Spaces

Partially ordered sets, lattices, metric spaces, definitions and examples, open sets and closed sets, convergence, completeness and Baires theorem, continuous mappings, spaces of continuous functions, Euclidean and Unitary spaces.

Unit 2: Topological Spaces

Definitions and examples, elementary concepts, open base and open subbase, weak topologies and the function algebras.

Compactness

Compact spaces, product of spaces, Tychonoff's theorem and locally compact spaces and compactness for metric spaces, Ascolis theorem.

Unit 3: Separation Axioms

T_1 spaces, Hausdorff's spaces, completely regular spaces and normal spaces, Urysohn's lemma, the Tietae extension theorem, the Urysohn's imbedding theorem, the Stone-Cech compactification.

Unit 4: Connectedness

Connected spaces, the components of a space totally disconnected spaces and locally connected spaces.

Unit 5: Approximation

The Weierstrass approximation theorem, the Stone-Weierstrass theorem, locally compact Hausdorff spaces, the extended Stone-Weierstrass theorem.

TEXT BOOK:

1. George F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Company. [Part One Chapters 1 to 7]

REFERENCES:

1. Dugundji, J., *Topology*, Prentice Hall of India, New Delhi, 1975.
2. Munkres R. James, *A first course in Topology*, Pearson Education Pve. Ltd., Delhi-2002.

MT 3804 CLASSICAL MECHANICS

SEMESTER : III | CREDIT : 3
CATEGORY : MC | NO. OF HOURS / WEEK : 5

Objectives: *To provide the student with a thorough mastery both of the fundamentals and of significant contemporary research developments.*

Unit 1: Generalised coordinates – constraints – Virtual work and D' Alembert's Principle –

Lagrange's equations – Problems using Lagrange's equation – Variational Principle and Lagrange's equations

Unit 2: Hamilton's principle -Derivation of Lagrange's equation from Hamilton's principle.-Legendre transformation and the Hamilton Canonical equation of motion.-Cyclic coordinates and Routh's procedure -Conservation theorems -Derivation from variational principle

Unit 3: The principle of least action-The types of periodicity -The discussion of the motion of the Top by Lagrange's method and by Hamilton's method.-The equations of Canonical transformation - Examples – the integral invariants of Poincare'-Lagrange and Poisson brackets and Canonical invariants

Unit 4: Equation of motion in Poisson bracket -Infinitesimal contact transformation - the angular momentum Poisson brackets relations - Lioville's theorem - The Hamilton - Jacobi equation for Hamilton's principle function.

Unit 5: The Harmonic Oscillator problem as example of Hamilton – Jacobi method Hamilton's-characheristic function – Separation

of variables in Hamilton –Jacobi equation-Action angle variables – The Kepler Problems in Action-angle variables .

TEXT BOOK:

1.Classical Mechanics – H.Goldstein-Addison Wesley. Chapters1, 2, 3, 7 ,8 & 9
2. Classical Mechanics. –D.D.E.Greenwood- Printice Hall.

REFERENCES:

1.Principle of Mechanics – J.L.Synge and B.A.Griffith – McGraw Hill.
2.Classical Mechanics – D.E.Rutherford, Olover Boyd.
3.Test book of Dynamics – P.Chorlton – Van Nostrand.

MT 3805 ANALYTIC NUMBER THEORY

SEMESTER : III | CREDIT : 2
CATEGORY : MC | NO. OF HOURS / WEEK : 4

Objectives:

1. *To introduce the concepts of arithmetic function, Dirichlet multiplication, averages of arithmetic functions, congruences and quadratic residues and teach some techniques of solving problems.*
2. *To introduce the analytical methods used in Number Theory.*

Unit 1: Arithmetical Functions and Dirichlet Multiplication

The Mobius function $m(n)$ – The Euler totient function $j(n)$– A relation connecting m and j - A product formula for $j(n)$ – The Dirichlet product of arithmetical functions – Dirichlet inverses and the Mobius inversion formula – The Mangoldt function $L(n)$ – Multiplicative functions – Inverse of a completely multiplicative function.

Unit 2: Averages of Arithmetical Function

The big oh notation – asymptotic equality of functions – Euler's summation formula – elementary asymptotic formulas – Average order of d(n), of divisor function $s_a(n)$, $j(n)$, $m(n)$ and $L(n)$.

Unit 3: Congruences

Basic properties – Residue classes and complete residue systems – linear congruences – Reduced residue systems and Euler Fermat theorem – Polynomial congruences modulo p – Lagrange's theorem – Applications – Simultaneous linear congruences – The Chinese remainder theorem – Polynomial congruences with prime power moduli.

Unit 4: Quadratic Residues & the Quadratic Reciprocity Law

Quadratic Residues – Legendre's symbol and its properties – Evaluation of $(-1 \mid p)$ and $(2 \mid p)$ – Gauss' lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol.

Unit 5: Partitions

Geometric representation of partitions – Generating functions for partitions – Euler's pentagonal- number theorem – Euler's recursion formula for p(n).

TEXT BOOK:

1. Tom M.Apostol, *Introduction to Analytic Number Theory*, Springer International Student Edition, Narosa Publishing House, New Delhi.

Sections: 2.1 to 2.11; 3.1 to 3.7; 3.9; 5.1 to 5.9; 9.1 to 9.7; 14.1 to 14.4; 14.6

REFERENCES:

1. Ivan Niven, Herbert S.Zuckermann, *An Introduction to the Theory of Numbers*, Wiley Eastern University Edition, V Edition, 1989.
2. W.J.Leveque, *Topics in Number Theory*, Addison Wesley.
3. Bressoud, D., Wagon, S., *A Course in Computational Number Theory*, Key College Publishing, 2000.

MT 3806 ALGORITHMIC GRAPH THEORY

SEMESTER : III | CREDIT : 2
CATEGORY : MC | NO. OF HOURS / WEEK : 4

Objectives:

1. *To provide the foundation of the graph theoretic notions.*
2. *To learn the algorithmic design and analysis techniques*

Unit 1: Basic definitions and notations – Intersection graphs – The complexity of Computer Algorithms – How to explore a graph.

Unit 2: Characterizing Triangulated Graphs – Recognizing Triangulated Graphs by Lexicographic Breadth-First Search – The Complexity of Recognizing Triangulated Graphs - Triangulated Graphs as Intersection Graphs.

Unit 3: Split Graphs – Characterizing Split Graphs – Degree Sequences and Split Graphs.

Unit 4: Characterizing Permutation Graphs – Permutation Labelings – Sorting a permutation using queues in parallel.

Unit 5: Interval Graphs – Some Characterizations of Interval Graphs – The Complexity of Consecutive 1's Testing – Circular Arc Graphs.

TEXT BOOK:

M. C. Golumbic, Algorithmic Graph Theory and Perfect Graphs, Second Edition Annals of Discrete Mathematics 57, 2004.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. *Introduction to Algorithms*, Second Edition. The MIT Press and McGraw-Hill, 2001.
2. Alan Gibbons, *Algorithmic Graph Theory*, Cambridge University Press, 2002.

MT 3875 MATHEMATICAL METHODS IN BIOLOGY

(For II M.Sc. Mathematics Students)

SEMESTER : III | CREDIT : 3
CATEGORY : ID | NO. OF HOURS / WEEK : 4

Objectives: *To introduce Mathematics as a tool in the study of Biology.*

Unit 1: Sequence alignments, Basic string definitions, The importance of sequence comparison in Molecular Biology, The edit distance between two strings, String alignment, Edit graphs, String similarity, Alignment graphs, Local alignment, Introduction to Gaps, CDNA matching, A concrete illustration, Choices for gap weights, Time analysis.

Unit 2: Overview of RDBMS, Advantages of DBNS, Normalization, Oracle data types, Introduction to SQL, DDL, DML, & TLC commands. Data definition Language, Data Manipulation Language, Transaction Control & data, Control language Grant & Revoke Privilege Command.

Unit 3: Multiple sequence alignments, the morphological to the molecular, Common multiple alignment methods, multiple sequence alignments, Local alignment gaps, parametric sequence alignments, suboptimal alignments, Multifunction tools for sequence analysis.

Unit 4: Phylogenetic analysis, Evolutionary Trees and Phylogeny, Ultrasonic trees, Parsimony, Ultrametric problem, Perfect phylogeny, Phylogenetic alignment, Connection between multiple alignment and tree construction, Methods in Phylogeneic Analysis, Profiles and Motifs

Unit 5: Tools in Bioinformatics, Tools for database search using search engines, Finding scientific articles, Finding public data bases, Depositing data into public data bases, Tools for Sequence Analysis, Algorithms issues in data base search, FASTA, BLAST, Amino acid substitution matrices PAM and BLOSSUM

REFERENCES:

1. George Koch and Kevin Loney; ORACLE 8-THE COMPLETE REFERENCE, Tata McGraw – Hill Edition, 1988.
2. Michael Abbey and Michael J. Correy; ORACLE 8 – A BEGINNERS GUIDE, 1997.
3. Eddy, S.R., Durbin et al; Computational Molecular Biology, 2002.
4. Cynthia Gibas & Per Jampeck, Developing Bioinformatics Computer Skills; Shroff Publishers and Distributors Private Limited, Calcutta, 2001.
5. Waterman, Michael S, Introduction to Computational Biology, Chapman and Hall, CRC Press, 2000.
6. Baxevanis, A.D., and Ouellette, Francis, B.F., Bioinformatics – A practical Guide to the Analysis of genes and Proteins, John Wiley and Sons Inc. Publishing, New York, 1998.
7. Dan Gusfield, Algorithms on Strings, trees and sequences, Cambridge University Press, USA.

ZO 3875 BIO-MATHEMATICS

(For II M.Sc. Zoology Students)

SEMESTER : III | CREDIT : 3
CATEGORY : ID | NO. OF HOURS / WEEK : 4

Objectives: *To introduce Mathematics as a tool in the study of Biology.*

Unit 1: Determinants

Properties of determinants, Minors, Cofactors, Multiplications of determinants.

Matrices

Operations on matrices, Inverse of matrices, Solution of simultaneous equations.

Unit 2: Permutation and Combination

Identities and simple problems, Binomial theorem, Exponential and Logarithmic series (statement only), Simple problems.

Basic ideas of Graph Theory

Connectivity, Trees, Various matrices connected with graphs, Construction of evolutionary trees, Phylogeny Construction.

Unit 3: Limits, Differentiation, Successive differentiation, Maxima and Minima, Simple problems.

Integration of $f(x) = x^n$, e^x, logx, Definite integrals, Simple problems.

Unit 4: Fundamentals of computers, algorithms, flowcharts. Introduction to systems and Application programs. Concept of data processing and handling of file for large volume of data. Elements of Database management in connection with Biological data bases.

Unit 5: C – programming and internet programming fundamentals. Specific features of Image Analysis in Java. Software characteristics and applications – Clustal W VI.7, Rasmol, Oligo, Molscript, Tree view, ALSCRIPT, Genetic analysis software, Phylip.

REFERENCES:

1. Narayanan,S and Manikavasagam Pillai, T.K., *Calculus*, Vol.I, S.Viswanathan Printers, 1996.
2. Manickavachagam Pillai, T.K, Natarajan,T. and Ganapathy,K.S. *Algebra*,Vol I, S.Viswanathan Printers & Publishers,1994.
3. David W.Mount, *Bioinformatics: Sequence and Genome Analysis,* Cold Spring Harbor Laboratory Press, New York.
4. Daniel C. Liebler, *Introduction to Proteomics: Tools for New Biology*, Humana Press, Totowa, NJ., 2002.
5. Pennington S., M.J.Dunn, *Proteomics: From Proteins Sequence to Function*, Springer Publications, 2001.

MT 3925 MATHEMATICAL SOCIAL SCIENCES

SEMESTER : III | CREDIT : 3
CATEGORY : CP | NO. OF HOURS / WEEK : 4

Objectives: *To equip the students with a sample of available tools/techniques in Mathematics to study and analyze the social issues and to give a first hand experience in using / experimenting with the techniques.*

Unit 1: Introduction to social sciences

Some fundamental concepts in social sciences – Research, survey, investigation and experiment. Hypothesis in social research Questionnaire, Experimental design in social research. Examples from case studies.

Unit 2: Graph theoretic tools / techniques

Conversion of issues to graphs, weighted graphs, popular models, Examples from case studies. Techniques used in Numerical Methods, Examples from case studies.

Unit 3: Statistical tools / techniques

Sampling and types of sampling. Standard measures in statistics Examples from case studies.

Unit 4: OR tools / techniques

Formulating the Linear Programming Problem-Simplex method-Transportation Problem-North West Corner Rule- Least Cost Method-Mathematical Representation of assignment Problem-Optimal Solution to Assignment Problem -Necessity for maintaining inventory-E.O.Q Problems with Deterministic and Probabilistic Demand-Networks-Graphs-Spanning Tree problem-Shortest Route Problem-Maximal Flow problem - Examples from case studies.

Unit 5: Fuzzy tools / Techniques

Fuzzy - Neural network models, Examples from case studies.

TEXT BOOK:

1. Mojumdar, P.K., *Research Methods in Social Sciences*, Viva Books pvt ltd., (2005) chapters: 2.1 – 2.3 and 3 (full), 4.5 and 8.1, 8.2, 8.8, 17.4-17.7and 8.11 General outlook from Chapters 9, 10, 11, 12 and 13
2. Bart Kosko , *Neural Networks and Fuzzy systems*, Prentice Hall of India, New Delhi (2003). Chapters: 3, 4 and 8

3. Bondy and Murthy, *Graph Theory with Applications,* Chapters 14,15
4. Kandasamy and Thilagavathi, *Numerical Methods*,
5. Kanthi Swaroop, et.al., *Operations Research,*

REFERENCES:

1. Fundamentals of Mathematical Statistics – Gupta and Kapoor.
2. Operations Research – Hamdy A Taha.
3. Research methodology – CR Kothari
4. Research methodology – Gopal Lal Jain.
5. Statistical methods- J.N.Kapoor
6. Fuzzy sets and Fuzzy Logic- George J.Klir and Bo Yuan.
7. Theory of Fuzzy subsets – A.Kauffmann
8. Fundamentals of Neural Networks – Laurene Fausett.
9. Fuzzy sets and systems – Didier Dubois and Henri Prade.

MT 4804 FUNCTIONAL ANALYSIS

SEMESTER	: IV	CREDIT	: 3
CATEGORY	: MC	NO. OF HOURS / WEEK	: 5

Objectives: *To study the details of Banach and Hilbert Spaces and to introduce Banach algebras.*

Unit 1: Vector Spaces – Subspaces – Quotient Spaces – Dimension of Vector Spaces, Hamel Basis – Algebraic Dual – Second Dual – Convex Sets – Hahn Banach Theorem – Extension form.

Unit 2: Banach Spaces – Dual Spaces – Hahn Banach Theorem in Normal Spaces – Uniform Boundedness Principle – Lemma F. Riesz- Application to Compact transformation.

Unit 3: The Natural Embedding of a Normal Space in its second dual – Reflexivity – Open Mapping and Closed Graph Theorems – Projections.

Unit 4: Hilbert Spaces – Inner Product – Basis Lemma – Projection Theorem – Dual-Riesz Representation Theorem – Orthonormal sets – Fourier Expansions – Dimensions – Riesz Fischer Theorem – Adjoint of an Operator – Self-adjoint, Normal and Unitary Operator, Projections.

Unit 5: Finite Dimensional Spectral Theory and Banach Algebra – Finite Dimensional Spectral Theory – Regular and Singular Elements – Topological Divisor of Zero – The Spectrum – Formula for the Spectral Radius – Topological Vector Spaces – Normal Spaces – Locally Convex Spaces.

TEXT BOOK:

1. Goffman, H.C., Fredrick, G., *First course in Functional Analysis*, Prentice Hall of India, New Delhi, 1987.

REFERENCES:

1. Limaye, B.V., Functional analysis,
2. G.F.Simmons , *Introduction to topology and Modern Analysis*, McGraw Hill International Book Company, New York, 1963.
3. W. Rudin *Functional Analysis,* Tata McGraw-Hill Publishing Company, New Delhi, 1973.
4. G. Bachman & L.Narici, *Functional Analysis* Academic Press, New York ,1966.
5. E. Kreyszig *Introductory Functional Analysis with Applications*, John wiley & Sons, New York.,1978.

MT 4805 RELATIVISTIC MECHANICS

SEMESTER : IV
CATEGORY : MC
CREDIT : 3
NO. OF HOURS / WEEK : 5

Objectives: *To provide the student to study the subject from a Mathemaician's point of view. Tensor Calculus gives all that is needed on the subject to understand the theory of relativity.*

Unit 1: The Galilean transformation-Michelson – Morely experiment-postulates of special theory – Lorentz transformations – consequences of Lorentz transformations – Formula for composition of velocities – phenomenon of aberration – Doppler effect.

Unit 2: Relativistic Mechanics – mass and momentum – Equivlaence of mass and energy – Relativistic transformation for mass – density – force – Minkowski's world – space loke and time – time intervals.

Unit 3: Coordinate transformation – Summation convention - contravariant and Covariant vectors – contravariant, covariant and mixed tensors - Algebra of Tensors – Quotient law – Fundamental tensors – Christoffel symbols – covariant differentiation of vectors and tensors.

Unit 4: Geodesic – Uniform vector field – Condition for flat space - Principle of covariance and principle of equivalence- effect of gravity on a light ray – Riemann Christoffel tensor – Necessary and sufficient condition for the space – time – Einstein law of gravitation for empty space.

Unit 5: Schwarzchild's solution – planetary orbits – Advance of perihelion – The deflection of light – isotropic coordinates – material energy tensor.

TEXT BOOK:

1. Special theory of Relativity – Resnik, Wieley Eastern
2. Mathematical theory of Relativity – A.S.Eddington –Cambridge, University Press
3. Riemanian geometry & tensor calculus – Weatherburn – Cambridge University Press.

MT 4806 FLUID DYNAMICS

SEMESTER : IV
CATEGORY : MC
CREDIT : 2
NO. OF HOURS / WEEK : 4

Objectives: *To introduce the students to fluids in motion, Equations of motion of a fluid, two-dimensional flows, three-dimensional flows and viscous flows.*

Unit 1: Euler's and Lagrange's descriptions of flow – material derivative continuity equation – irrotational and solenoidal velocity fields – boundary conditions for a material surface – circulation – Kelvin's theorem on circulation.

Unit 2: Euler's equation of motion – Bernoulli's theorems – Vorticity – Helmholtz vorticity theorem – two dimensional motion – stream function – complex potentials.

Unit 3: Complex potentials of sources – sinks – doublets – circle theorem – Blasius theorem – image of a source and a doublet on the circular cylinder – uniform stream past the circular cylinder.

Unit 4: Axisymmetric flow – Stoke's stream function – Butler's sphere theorem – sphere in a uniform stream – sphere in a uniform stream – Joukowski transformation – Theorem of Kutta and Joukowski – Lift of an aerofoil.

Unit 5: Navier – Stoke's equation of motion – some exact solutions of Navier-Stokes equations – flow between parallel plates – flow through a circular tube – flow between concentric cylinders – flow through a pipe of elliptical cross section – equilateral triangle cross section – flow through annulus.

TEXT BOOK:

1. Milne Thomson, *Theoretical Hydrodynamics*, Macmillan.
2. Chorlton F., *Text book of Fluid Dynamics*, CBS Publications, New Delhi.

REFERENCES:

1. Fluid Dynamics, Schaum's series.
2. Batchelor, C.K., *An Introduction to Fluid Mechanics,* Cambridge University Press.

MT 4807 OPERATIONS RESEARCH

SEMESTER : IV | CREDIT : 3
CATEGORY : MC | NO. OF HOURS / WEEK : 5

Objectives: *To provide the students mathematical techniques to model and analyse decision problems, with effective application to real life in optimization of objectives.*

Unit 1: Integer Programming

Pure and mixed integer programming problems and applications – Cutting plane algorithm – The branch and bound algorithm – Gomory's cutting plane algorithm – Zero one implicit enumeration.

Dynamic Programming

Characteristics of dynamic programming – models in dynamic programming – Capital budgeting problem – reliability problem – shortest route problem - suboptimal problem.

Unit 2: Inventory Models

The ABC inventory systems and JIT inventory systems – Deterministic models – single item static model with and without pricebreaks – multiple item static models with storage limitations – probabilistic models – A continuous review single period models – multiple period models.

Unit 3: Queuing Models

Poisson process – pure birth death process – M/M/1, M/M/C, M/Ek/1 queuing models – steady state probabilities – waiting time distribution.

Network Models

Cost considerations in network models.

Unit 4: Advanced topics in Linear Programming

Goal programming – Stochastic programming – Sensitivity analysis

Unit 5: Non Linear Programming

Lagrangian multiplier method – Necessary and Sufficient conditions due to Kuhn Tucker – Quadratic Programming by Wolfe's Method.

TEXT BOOK:

1. Hamdy A. Taha , " Operations Research ", Seventh Edition, Pearson Education Asia Editions
2. Fredrich. S. Hillier and Gerald . J. Liberman, " Operations Research " , Second Edition, CBS Publishers

3. Ravindran, Philips and Soleberg, " Operations Research – Principle and Practice" Second Edition, John Wiley and sons

REFERENCES:

1. Kantiswarup, Gupta and Man Mohan, " Operations Research ", Twelfth Edition, Sultan Chand and Sons, 2005.
2. Hadley, " Non-linear and dynamic programming", Addition Wesley.

MT 4954 THEORY OF FUZZY SUBSETS

SEMESTER : IV | CREDIT : 3
CATEGORY : SE | NO. OF HOURS / WEEK : 5

Objectives: *The theory of fuzzy subsets is a step forward a rapprochement between the precision of classical mathematics and the pervasive imprecision of the real world- a rapprochement born of the incessant human quest for a better understanding of mental processes and cognition.*

Unit 1: Introduction- Review of the notion of membership-The concept of a fuzzy subset-Dominance relations-Simple operations on fuzzy subsets-Set of fuzzy subsets for **E** and **M** finite-Properties of the set of the fuzzy subsets-Product and algebraic sum of two fuzzy subsets

Unit 2: Fuzzy graphs-Fuzzy relations-Composition of fuzzy relations -Fuzzy subsets induced by a mapping -Conditioned fuzzy subsets -Properties of fuzzy binary relation -Transitive closure of a fuzzy binary relation-Paths in a finite fuzzy graph

Unit 3: Fuzzy preorder relations -Similitude sub relations in a fuzzy preorder- Antisymmetry - Fuzzy order relations-Ant symmetric relations without loops - Ordinal relations- Ordinal functions in a fuzzy order relation-Dissimilitude relations -Resemblance relations -Various properties of similitude and resemblance-Various properties of fuzzy perfect order relations-Ordinary membership functions

Unit 4: Characteristic function of a fuzzy subset. Fuzzy variables-Polynomial forms-Analysis of a function of fuzzy various variables. Method of Marinos -Logical structure of a function of variables-Composition of intervals-Networks of fuzzy elements-fuzzy propositions and their functional representations-The theory of fuzzy subsets and the theory of probability y- The theory of fuzzy subsets and the theory of functions of structure.

Unit 5: Review of the notion of a law of composition-Laws of fuzzy internal composition. - Fuzzy groupoids-Principal properties of fuzzy groupoids -Fuzzy monoids –Fuzzy external composition - Operations on fuzzy numbers

TEXT BOOK:

1. Introduction to the Theory of Fuzzy Subsets - Volume1- A.Kaufmann.- Academic Press New York 1975.
2. Fuzzy set theory – And its Applications – Zimmermann – Kluwer Academic Publishers.

MT COMMUTATIVE ALGEBRA

SEMESTER : IV | CREDIT : 3
CATEGORY : SE | NO. OF HOURS / WEEK : 5

Objectives: *To do an advanced course in Algebra also to high light the applications of Algebra in Theoritical computer Science.*

Unit 1: Rings and ideals - Rings and ring homomorphisms.- Operations on ideals – extensions and contractions.

Unit 2: Modules – modules and module homomorphisms – Sub modules and quotient modules – Operations on sub modules – Direct sum and product. Finitely generated modules – Exact sequences.

Unit 3: Rings and modules of fractions – Properties - extended and contracted ideals in rings and fractions .

Unit 4: Primary Decomposition.

Unit 5: Integral dependence and Variations – Integral dependence – The going up theorem – The going down theorem .

TEXT BOOK:

1. M.F. Atiyah and L..G. Macdonald, *Introduction to Commutative Algebra*.

REFERENCES:

1. O.Zariski and P.Samuel, *Commutative Algebra*, Volume I and II.

MT 4955 PARALLEL INTERCONNECTION NETWORKS

SEMESTER	: IV	CREDIT	: 3
CATEGORY	: SE	NO. OF HOURS / WEEK	: 5

Objectives:

1. *To give an insight into Theoretical Computer Science.*
2. *To understand the structures of various interconnection networks.*

Unit 1: Interconnection Networks, Trees and k-ary trees, Embedding of graphs, Planar Graphs and Layout of VLSI Circuits, Diameter of Graphs.

Unit 2: Vertex transitive graphs, Edge Transitive graphs, Cayley graphs, Properties of Cayley graphs, Vertex transitive Cayley graph.

Unit 3: Hypercube networks, de Brujin networks.

Unit 4: Circulant networks, Mesh networks, Cube connected cycles, Butterfly networks, Benes networks.

Unit 5: Fault tolerance of networks, Basic Principles of network design, Routing in networks, Forwarding index of routing, Edge-Forwarding index of routing, Delay of Fault-tolerant routing.

TEXT BOOK:

1. T.F. Leighton, "*Introduction to Parallel Algorithms and Architecture: Arrays, Trees, Hypercubes*", Morgan Kaufmann Publishers, 1992, ISBN I-55860-117-1..
2. S.L.Bezrkov, "*Embedding Complete Trees into the Hypercube*", Discrete Appl. Math., Vol.110, 2001, pp.101 – 119.
3. M.R.Garey and D.S.Johnson, *Computers and Intractability, A guide to the Theory of NP-Completeness*", Freeman, San Fransisco, 1979.

MT FINANCIAL MATHEMATICS

SEMESTER	: IV	CREDIT	: 3
CATEGORY	: SE	NO. OF HOURS / WEEK	: 5

Objectives:

1. *To lay theoretical foundation with potential applications to financial problems*
2. *To provide efficient introduction to theoretical skills that are genuinely used in financial institutions*

Unit 1: Probability and Events - Conditional Probability - Random Variables and Expected Values - Covariance and Correlation - Continuous Random Variables - Normal Random Variables - Properties of Normal Random Variables - Central Limit Theorem - Geometric Brownian Motion as a limit of Simpler Models - Brownian Motion.

Unit 2: Interest Rates - Present Value Analysis - Rate of Return - Continuously Varying Interest Rates - Options pricing - pricing Via Arbitrage.

Unit 3: The Arbitrage Theorem - Multiperiod Binomial Model - Arbitrage Theorem - The Black Scholes Formula - Properties of Black Scholes Option Cost - The Delta Hedging Arbitrage Strategy.

Unit 4: Call Options on Dividend Paying Securities - Pricing American Put Options - Estimating the Volatility Parameter - Limitations of Arbitrage Pricing - Valuing Investments by

Expected utility - The Portfolio Selection Problem - Value at Risk and Conditional value at Risk - The Capital Assets Pricing Model - Mean variance Analysis of Risk, Neutral and Priced Call Options - Rates of Return.

Unit 5: Deterministic Optimization Models - Probabilistic Optimization Models - Investment Allocation Model - Barrier Options - Asian and Lookback Options - Monte Carlo Simulation - Pricing Exotic Options by Simulation.

TEXT BOOK:

1. Sheldon M.Ross, *An Introduction To Mathematical Finance*, Cambridge press – 1999.

REFERENCES:

1. Martin.Boxter and Andrew Rennie, *Financial Calculus: An Introduction To Derivative Pricing,* Cambridge University press, 1996.
2. Alison Etheridge, *A course in Financial Calculus,* Cambridge University press, 2002.
3. Hull, *Options, Futures and other Derivatives and Finance,* Prentice hall, 6th edition.
4. Roman, *Introduction to the Mathematics of Finance,* Springer verlag, 2004
5. Gerber, *Life Insurance Mathematics*, Springer, 3rd edition.
6. Booth and Philip, *Modern Actuarial Theory and Practice*, Chapman and Hall.